How can climate scientists engage in policy advocacy and preserve their scientific credibility and independence?

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Abstract

Scientists are often wary of engaging in policy advocacy as they fear it may result in the perception of bias in their science or abuse of their position. Whilst advocacy need not always result in biased science or an abuse of position, the mere suspicion that it might can be enough to deter a scientist from engaging in it. For climate scientists, this tension is well known, especially given how politically polarising action on climate change can be.

This thesis identifies how, both in theory and practice, climate scientists can engage in policy advocacy in a way that is acceptable to them and their scientific community. By providing a new way of defining advocacy and the roles that scientists can engage in when communicating, I create an advocacy spectrum that maps different communication roles for scientists. Position on this spectrum is influenced by 'contextual factors' which determine how a scientist's communication may be perceived. Depending on which contextual factors are at play, even silence may be interpreted as advocacy. The advocacy spectrum is informed by semi-structured interviews with 47 climate scientists in the UK and USA. In the interviews, I explore their concerns about advocacy and the practical methods they use for managing the tensions they experience when communicating. Analysis of this data helps to further develop arguments in the theoretical literature about science communication, the role of values in science, and the conceptions about scientists as citizens in society. As a result, I identify what constitutes acceptable and unacceptable forms of policy advocacy as perceived by scientists and the scientific community. Combining the experience of climate scientists with the understanding from the theory, I then establish eight methods scientists can use that allow scientists qua scientists to engage in policy advocacy whilst also preserving their scientific credibility and independence.

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1. Introduction

1. Climate Scientists and policy advocacy – what is the problem?

Citizen participation is often agreed to be a vital component in a healthy democracy (Bullock, 2014). Participation in the decision-making process can include voting, protesting or policy advocacy. Scientists are also citizens and are permitted to - perhaps should - participate in such decision-making processes. Whilst scientists may be comfortable with allowing scientists qua citizens the right to vote, and the right to protest some issues (such as how their pensions are invested) there seems to be disagreement when it comes to scientists qua scientists engaging in other types of political activity. Policy advocacy, for example, is defined by political values as it is 'a plea in active support of something in order that others may be persuaded to believe and act the same'.[1] As a result, it is hotly debated as to whether it is acceptable for scientists to engage in or not.

Why is this? Do scientists have a special duty to refrain from certain political activities? Is this in conflict with other duties that scientists possess? How should these conflicts be managed? As I shall explore below, the answers to these questions centre around views on the role of science in a democracy and the role of values in science.

One area of science that acutely experiences this conflict and the tensions arising is research on climate change.[2] In the last year, the conversation around action on climate change has changed significantly. The Media and Climate Change Observatory's monthly analysis of climate change in news sources showed that coverage of climate change had increased by 73% in 2019 newspapers compared to 2018, global radio coverage has increased by 74% (more than doubling in the UK and Germany), and television coverage in the USA has increased by an enormous 138%.[3] Similarly, a YouGov survey commissioned by the Centre for Climate Change and Social Transformations (CAST Centre) in August 2019 found that 62% of the UK public said that addressing climate change requires a 'high' or 'extremely high level of urgency, with 48% saying they had grown more worried about climate change

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[1] I explore definitions of advocacy in more detail in Chapter 2.

[2] In particular, natural scientists working on climate change (those whose work would fall under the remit of the Intergovernmental Panel on Climate Change's Working Group 1) provide an extreme example of how these conflicts may manifest.

[3] Available here: https://sciencepolicy.colorado.edu/icecaps/research/media_coverage/summaries/special_issue_2019.html#january (accessed on 25/03/2020)

over the past 12 months.[4] Only 8% of the British public considered the environment to be one of the top three important issues in the lead up to the 2017 general election, but when surveyed again in October 2019 climate change was second only to Brexit when the public were asked about the most important issue for the UK in the next 20 years (Steentjes *et al.,* 2020).[5] Indeed, climate change is arguably the greatest challenge humankind has ever faced. Any effective measures adopted to combat climate change will involve contributions from scientists. However, climate change is also a highly politicised subject to the extent that studies have found that climate change has the widest partisan than any other issue in the USA (Pew Research Centre, 2020). Therefore, even *practising research* in the area of climate change is interpreted as making a political statement, and indeed, climate scientists are frequently abused online and even receive death threats and white powder packages (Milman, 2017). As such, communicating as a climate scientist is no simple task.

The aim of this thesis is to understand what is meant by the term advocacy, and how engaging in advocacy may or may not be a source of tension for a scientist. I will do this by focussing on climate science, and the tensions experienced by climate scientists.[6] I will then identify practical methods that climate scientists can deploy when communicating with non-experts which will help them fulfil their role as both a scientist and a citizen, maintaining their scientific credibility and integrity.

Before explaining the structure of this thesis, it would be helpful for me to provide a brief overview of the main arguments for and against scientists engaging in advocacy, the structures that others have suggested for scientists' role in a democratic society, and the role of values in science. I will then outline why I have chosen to use climate scientists to explore the tensions of policy advocacy. By discussing these, we will be able to understand better how climate change presents a special problem.

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[4] Available here: https://cast.ac.uk/wp-content/uploads/2020/01/CAST-Briefing-paper-02-Pubic-opinion-in-a-time-of-climate-emergency-min.pdf (accessed on 25/03/2020)

[5] It is important to note that this was before the COVID-19 virus had entered the public consciousness. Research is currently being designed to understand how conceptions around climate change are changing in light of the virus, particularly in relation to the framing of emission reductions and improvements in air quality.

[6] Climate Change is a broad topic and is researched by many different disciplines. I define 'climate scientists' as those whose work and area of expertise would match those of Working Group I (WG1) scientists in the Intergovernmental Panel for Climate Change. WG1 may be broadly defined as 'natural' scientists, as opposed to 'social' scientists, as I explain more in Chapter 3.

1.1. The role of scientists and science in democratic society

It is important to clarify that the role of *science* in society is different to the role of *scientists* in society. Many of the issues I shall explore in this project arise because of this conflation. Science (or at least the science society trusts) is the product of a community, not of any one individual. As such, it is scientific knowledge that is valued as it is created by the scientific method. Scientists are valued by virtue of their ability to understand and contribute to the making of this knowledge: scientists are but keyholders to the treasure that is scientific knowledge.

For example, the scientific method requires that an experiment can be replicated by others and have them achieve the same result. For scientific research to become public knowledge, there has to be a "channel of communication through which information is transmitted" (Kitcher, 2011; p86): i.e. it has to be publicly accessible. This scientific knowledge goes through a process of investigation, submission, certification and transmission (Kitcher, 2011) to become public knowledge. These processes, especially certification, are formed by the public's collective agreement as to what constitutes reliable scientific knowledge: "Public knowledge is set up for everyone and should therefore satisfy the same condition for all" (Kitcher, 2011; p152), or what Jasanoff (2005) calls *civic epistemology*. It is the scientific method's ability to produce reliable knowledge that satisfies a broad scheme of values that gives it particular value to society, as opposed to, for example, religious knowledge which is only applicable to those who subscribe to a narrower scheme of values (Resnik, 2009).

For Kitcher, the extent to which science is an authoritative knowledge production process is directly related to how it *transparently* adheres to this broad scheme of values. In circumstances where the methods of certification are opaque to outsiders (those that are not experts in this field of 'epistemic labour'), "there can be suspicion of or resistance to the system of public knowledge…scientific authority is eroded" (Kitcher, 2011, p152). To put it more simply, making a scientific claim without backing it up with evidence and a clearly explained and justified methodology is to be opaque. Indeed, this is akin to the religious leader asking followers to believe them blindly without any evidence, or because they have access to the divine which others do not.

The scientific method, principles of replicability, scientific consensus, quantifying uncertainties (or saying where there are 'unknown unknowns'), and stipulating limitations are just some of the methods that scientists employ to ensure transparency. However, this can only be described as being transparent if the rest of the public are able to see it and understand it. As this is often not the case, the non-expert public instead have to *trust* scientists. For example, forming scientific consensus is usually done behind closed doors, or at least via publication in scientific journals - but these are only accessible if one can afford to pay to read the articles. Even if one were able to physically see the articles, the language that they use, and the knowledge that they presuppose, is only accessible to those who have been trained to understand it. To this extent then, the process is unobservable or inaccessible, which has a very similar effect as being opaque. To take the old familiar analogy of the ivory tower, a transparent window at the top of science's ivory tower may be transparent, but if the non-expert has no ladder to climb to look through the window and see for themselves that it is transparent, then it might as well be as opaque as the tower's walls. The non-expert either needs to gain the education they need to see that the process is indeed transparent (i.e. they get a ladder), or they delegate the task to another group that can gain the relevant knowledge to check the process is transparent (i.e. they rely on the window cleaners' testimony) or they just *trust* the scientists. The scientists are trusted to truthfully and accurately relay the scientific knowledge that is inaccessible to the non-expert.

Policy advocacy may therefore be perceived as presenting a threat to this trust, as when the non-expert requests scientific knowledge, they are relying upon the scientist to present the science, not the scientist's political views. As outlined already by Kitcher, asking for blind faith from the non-experts results in the erosion of scientific authority – this makes the scientist more like the religious leader with no evidence.[7] This is also why Nelson and Vucetich (2009) argue that advocacy is *only* permissible if it can be transparent and justified.[8] But if the advocacy reasoning is opaque to the non-expert (i.e. the non-expert cannot be satisfied that the advocacy is transparent and justified), or it transpires that the scientist was presenting biased science, then the direct result is that scientists' credibility is eroded. The trust has gone for the scientist to operate appropriately. Whether or not this is actually true for the non-expert public, this is the perception that scientists hold about them. Non-experts are reliant upon the scientific community to identify when another scientist is abusing their

[7] Others conceive of scientific authority being claimed in other ways too, significantly, in engaging in boundary work where efforts are made to 'other' publics by simultaneously claiming epistemic authority by some, and denying authority to others, essentially working to create a clear epistemic elite (Gieryn, 1999; Bijker *et al.*, 2009).

[8] As shall be explained later on in this chapter.

position of expertise or creating biased science – there is a limit to the transparency that the ivory tower can have. Non-experts therefore have to trust that scientists are transparent with one another, *and* trust that scientists are transparent with them. As such, a scientists' scientific credibility and independence is conferred upon them by their peers as they are the only ones who possess the expertise to make the judgement as to whether the scientific method has been followed and if the knowledge produced is scientifically robust. Therefore, the real concern for scientists engaging in policy advocacy is that they will lose credibility with their peers.[9]

It is important to note the difference between the role of science and scientists – it is the *scientist's* authority and credibility that is affected, not necessarily science's authority and credibility. Scientists are trusted to create scientific knowledge that society can rely upon. Therefore, one rogue scientist does *not* equate to society claiming that all scientific knowledge is worthless. In fact, if that scientist had contributed to the body of scientific knowledge, so long as the scientific community is satisfied that the scientific method was followed, that contribution still remains valid (but no doubt will come under intense scrutiny to double check its validity). Rather, it is the *scientist* that loses their credibility with their community. Indeed, conceptions about the role of science in society might not be that large a factor in a scientist's concern with engaging in policy advocacy. Losing credibility with the scientific community is enough to end a career. Therefore, there are other more self-concerned reasons for scientists being wary of policy advocacy and the perception of their credibility.

How exactly might policy advocacy threaten a scientist's credibility with their community? The pursuit of scientific knowledge is valuable for society for a wide range of reasons.[10] For example, it can be seen as a way to satisfy curiosity (at least in part) and, due to its appeal to broad schemes of values, scientific knowledge is useful for decision making (so long as society holds the same broad scheme of values) (Kitcher, 2011; Resnik, 2009). Some would seek to simplify this description by saying that science, by virtue of being free from the

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9 Throughout the rest of the thesis, I refer to a scientist's 'scientific credibility' to distinguish the particular type of credibility that is only given to them by the scientific community, and is also the type of credibility required to authorise their membership of the scientific community. It is this particular type of credibility that is perceived to be at risk when scientists engage in policy advocacy.

10 Different societies may value science in different ways (Collins & Evans, 2017), make different decisions about scientific knowledge and its uses (such as in technocracies [Heyward & Rayner, 2016] or in policy making [Jasanoff, 1990]) and may conceptualise the environmental problem in different ways (Godrej, 2016; Shearman, 2007). Unfortunately, exploring different society's approaches to science is too big a topic to tackle in this thesis, so I will be limiting my arguments to modern western democratic societies.

influence of values, produces objective knowledge which sound decisions can be based upon.[11] Scientific knowledge is valued because it is not *only* true when one subscribes to the same political values that the scientist(s) possesses – it remains usable across the political spectrum. Engaging in policy advocacy therefore may threaten the scientists' credibility if it is perceived that the knowledge they contribute is 'tainted' by their political values (that they are misbehaving in the ivory tower and not creating the type of scientific knowledge society values), or that they are abusing their trusted position as an expert and falsely make (political) claims about scientific knowledge (they are relaying news from the ivory tower in a way that is in line with their views on policy). I will discuss the role of values in science, the myth of the value-free ideal, and the different types of objectivity that can exist in later chapters. However, I shall provide a brief overview here to demonstrate how this simplification poses a problem to scientists considering advocacy, and also affects which roles scientists play in policy making and when speaking to non-experts.

1.2. Values in science

Many defenders of the value-free ideal in science claim that science's integrity depends on being completely separate from value judgements. 'Values' relate to "those things that individuals think are worthy of being or ought to be promoted, advanced, and realized" (Kincaid *et al.*, 2007; p10), and therefore sit in contrast to a disinterested, 'objective',[12] separate science, as advocated by supporters of the value-free ideal. Any scientific research that sees values play a direct role in determining the design or reasoning, supposedly loses its social value of being reliable knowledge (van Dijk, 2013) as scientific knowledge is seen to be purely descriptive and values are normative (Douglas, 2009).

Some even argue that natural science is more capable of being insulated from society than social science, as social science, by nature of its subject matter, cannot be investigated in a value-free way (Kuhn, 1977; Kincaid *et al.*, 2007). However, this view "obscures several distinct dimensions of science and the roles different sorts of values may or may not play in each of these dimensions" (Doppelt, 2007; p189). To describe natural science as value-free

[11] Philosophers of science will be quick to argue that this simplification is false.

[12] 'Objectivity' is a particularly interesting subject, however we will not be able to do it justice in this introduction. Many philosophers of science discuss how science can be objective despite the influence of values (Wylie & Hankinson Nelson, 2007; Douglas, 2009) or how science attains its objectivity *because* of the values that it has (Nozick, 1998).

and social science as value-laden is to misunderstand how we formulate and understand scientific investigation.

Defenders of the value-free ideal state that the autonomy of science is one of the reasons society values and creates science. Longino (1990) describes the attribution of autonomy as being, in its most extreme form, the "claim that scientific inquiry proceeds undisturbed and unaffected by the values and interests of its social and cultural context, that it is propelled instead by its own internally generated momentum" (Longino, 1990; p5). Some, including defenders of the value-free ideal, claim that autonomy gives science its *authority*. However, Longino (1990) argues that scientific practices and content are "in dynamic interaction" with social needs and values, and that "the logical and cognitive structures of scientific inquiry require such interaction" (p5). Science is clearly done because someone is interested in doing it or having the knowledge it creates. Science, therefore, cannot be autonomous as society (and scientists) need interaction in order to make sense of it (Resnik, 2009).

Therefore "simply assuming that science should be autonomous, because that is the supposed source of authority, generates many of the difficulties in understanding the relationship between science and society" (Douglas, 2009; p8). Rather than debate reasons for science's authority, I shall explain briefly in this section (and in greater depth in Chapter 5 of this thesis) how science is not autonomous from value judgements, and that there is an important role for values in science.

We can quickly conclude, as many philosophers of science argue, that science cannot be separated from values. In fact, what we determine to be 'science' is shaped by value judgements. These values can determine what science is and what good science looks like. Values are part of how science operates; they are (legitimately) involved in scientific judgements made by scientists themselves, as well as in the understanding and assessment of the role that science is to play in society. In Chapter 5, I explore in greater depth the *types* of values that exist and the different roles they play at different points in scientific research. Nevertheless, whilst the value-free ideal has been demonstrated to be impossible to achieve (and indeed, as undesirable), it still retains "rhetorical weight in that actors involved in decision making use it, sometimes convincingly, to make their case" (Keller, 2009; p28). For them, science is valuable and useful to society *because* it is value-free. For them to admit that the value-free ideal is not obtainable would also mean losing the idealised image that scientists are objective actors that can offer 'universal information' – that science is a 'view from nowhere - a view that is often beneficial for the policy maker and scientist to hold (Keller, 2009). Again, it is important to point out that the authority of scientific knowledge is *separate* from (although related to) the scientists that contribute to it. Those who subscribe to the value-free ideal either bind the two together (and therefore demand that scientists also be value-free) or pretend that scientific knowledge spontaneously appears and has no relation to the social processes that form it.

To claim that science is completely value-free is false, but it is also not right to describe science as being completely accepting of every value that exists – there are value judgements about what values should play a role in science. Scientific research contributes to public knowledge, defined by a broad scheme of values. This means that values can be widely shared or be disparate across society. For example, it is a widely shared value that cancer is not a good thing for humans, and, if at all possible, should be eradicated. Research that investigates cures for cancer reflects this widely shared societal value. However, values differ wildly in society about access to abortion clinics. Research that assumes that increased access is a good thing is likely to be rejected by those who value reduced or zero access. The shared-value status (i.e. whether the values related to the research are widely shared or disparate amongst society) influences the context that science operates within and interacts with: i.e. society has either agreed that this research is important, or is divided and therefore has a population that is hostile to the production of scientific knowledge in that subject area. This issue context, and the specific values at play, can influence scientific communication and the tensions that scientists experience when communicating.

1.3. Communication of science

The ways that scientists interact and communicate with the rest of society can also describe how their role in society is viewed. Communication type, method, style, and duration can all be descriptions of the type of relationship one party has with another, and be a strong influence on the way in which they relate and define roles. For example, there is a great deal of literature on the different types of communication models that exist between decision makers and scientists which is strongly linked to ideas about the role science should play in policy making. Weber's 'decisionist' model requires decision-makers to define the *ends* first and the scientists present which *means* are available in order to reach those ends – scientists only speak when spoken to (Hulme, 2009). In contrast, a 'Technocratic' model works the other way around, with scientists revealing 'objective facts' from which decision-makers can then derive a course of action (Hulme, 2009). Both of these examples clearly have their limitations – the decisionist model could easily result in stagnation as policy makers seem to be steering the direction research takes, and the technocratic approach seems to be built on the dangerous foundation of the value-free ideal and assuming that an 'ought' can be derived from an 'is' (Pielke, 2007).[13]

One concern for both of these models of communication relates to scientific uncertainties. Uncertain science will not be able to provide the answers these models may be seeking. Whilst a 'dialogical' model may share some of these concerns, the model design allows there to be a conversation between the scientist and decision-maker to discuss research direction, and how science can better contribute to policy-making. Kitcher suggests a dialogical model that he claims will help scientists retain authority that includes inviting a group of non-experts from across society to be educated enough to understand the science more than other members of the non-expert public. In doing so, based on a broad scheme of values and under conditions of mutual agreement, this educated group will be better informed to discuss and deliberate about the most beneficial courses of action (Kitcher, 2011).[14] Pielke (2007) also suggests four roles for scientists that differ depending on different views of democracy, and the sort of communication model society operates with: 'Pure Scientist', 'Science Arbiter', 'Issue Advocate' and 'The Honest Broker of Policy Options'.

I mention these models not so as to produce an exhaustive list, but to demonstrate how communication methods affect the role science can play in society. If the methods are designed based on flawed views about what science is (i.e. value-free) or can offer to society (i.e. complete and unwavering certainty) then science will fail to successfully fulfil the role it is expected to. In all of these models, I am yet to find one that clearly describes how scientists qua scientists can explicitly engage in policy advocacy. The literature, more broadly, has also been unable to identify a way in which scientists can engage in policy advocacy that clearly does not risk their credibility or independence as a scientist (i.e. even speaking as a citizen, there is the possibility that scientists may be risking their credibility with other scientists, depending on what it is they advocate and how). Yet advocacy, when it does come up in the

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[13] The decisionist model may also be referred to as 'applied' or 'decision-driven' policy-science, and the technocratic model known as 'basic' or 'knowledge driven' (Lemos & Morehouse, 2004).

[14] In reference to the earlier analogy, these non-experts have obtained a ladder for the ivory tower.

literature, is argued by some to be something a scientist either should never do, or if they do engage in it, they risk losing their careers and 'colouring the science' (Lackey, 2007). The aim of this thesis is to identify a way, theoretically and practically, that scientists qua scientists can engage in acceptable policy advocacy.[15] I shall now outline some generalised views on scientists engaging in advocacy and how these can cause tensions for scientists.

1.4. Science and advocacy

Nelson and Vucetich, in their 2009 paper, attempt to summarise the main arguments for and against scientists engaging in advocacy, and to tease out the rationale behind each viewpoint. The main arguments they set out as being against advocacy are as follows:

- There is a conflict between the fundamental nature of science and advocacy.
- Advocacy is detrimental to a scientist's credibility.
- Engaging in advocacy conflicts with one's ability to effectively operate as a scientist.

Arguments for engaging in advocacy are:

- Advocacy is unavoidable and therefore justified.
- Advocacy is appropriate when failure to do so would be harmful to society.
- As a citizen, scientists have a moral obligation to actively promote in society that which they are justified in thinking is right and good.

They conclude that all the arguments against advocacy fall short, as do some of the arguments for engaging in advocacy. Overall, Nelson and Vucetich (2009) propose that only one argument remains sound – that "scientists, by virtue of being citizens first and scientists second, have a responsibility to advocate to the best of their abilities and in a justified and transparent manner" (p1099). At first, it may appear that they have completed the task for me in identifying how scientists are to negotiate policy advocacy; do so as citizens. But there is no explanation as to why the identity of the scientist is to be second to being a citizen, or how one even separates and treats them as separate. However, whilst Nelson and Vucetich claim to have demonstrated that the arguments against advocacy are invalid, I argue that three key issues remain.

[15] That is to say that it is perceived to be acceptable relative to the scientific standards held by themselves (as a scientist seeking to uphold their scientific values) and their peers (the scientific community that ensures the values of science have been upheld).

Firstly, these incorrect arguments against scientists engaging in advocacy nevertheless persist, and are still held by some. At the core of these persistent arguments are views about the roles of values in science. In particular, how political values could enter into and corrupt the science, making it biased towards the policy views that the scientist holds. These persistent arguments, even if they can be proven wrong, create tensions for the scientist as they have the potential to threaten a scientist's credibility with those that maintain those arguments. Whilst it might be tempting to quickly dismiss anybody who subscribes to these incorrect arguments, one simply cannot do so, not at least as many of those who do hold these views are members of the scientific and policy making communities (Keller, 2009), including those in the scientific community whose opinions may affect the career of scientists engaging in advocacy, and the opinion that others have about those scientists. This poses a problem for the advocating scientist as scientific credibility "is a special kind of credibility and is necessarily arbitrated between a scientist and a scientific community" (Nelson and Vucetich, 2009; p1092). Therefore, persistent arguments, whether justified or flawed, affect the political situation a scientist needs to negotiate. This raises questions about credibility; how a scientist gains, maintains, and loses credibility, and why credibility is important for successfully fulfilling their role as a scientist.

Secondly, Nelson and Vucetich do not outline *how* a scientist should advocate. They state that advocacy should be done in a justified and transparent manner. A justified argument, they say, is "clearly and thoroughly presented" (Nelson and Vucetich, 2009; p1099) but what is yet to be established is *how* one can ensure that the argument is presented in this way. Similarly, they claim that "transparent advocacy occurs when advocates advance arguments they believe are sound and valid… they do not use arguments they believe may affect policy at the expense of arguments they believe to be sound and valid" (Nelson and Vucetich, 2009; p1099). Again, they provide no way of ensuring that the scientist advocate is actually being transparent and is perceived to be transparent.[16]

Thirdly, Nelson and Vucetich provide no account of how a scientist should communicate that they are engaging in advocacy *as a citizen*. There may be occasions when experts are asked to provide their professional opinion, and other times for a personal opinion, and are able to do so (i.e. speaking with the scientific consensus or speaking about their own

[16] Part of my project will seek to identify ways in which scientists can present justified and transparent arguments.

preferences and hunches). However, the way in which an audience receives that message may not make such clear distinction between expert and citizen; one may have some control over how an audience receives a message, but much less control over what an audience decides to do with that message. For example, if a scientist were speaking to an audience truly as a citizen, then the weight of their words would be the same as any other non-expert – they have exited the ivory tower and are mixing with the masses The fact of the matter is that the scientist is privileged in possessing particular pieces of knowledge not readily available to the rest of society – they still have the key to the top floor of the tower, and people recognise them as having this key. The platform that a scientist speaks from attracts a different audience in comparison to a non-expert. Indeed, scientists are often *given* platforms to speak *because* they are a scientist. To speak to an audience as a citizen, when that audience has gathered to listen to this particular citizen *because* they are a scientist, demonstrates that although the scientist may seek to be speaking as a citizen, they are being listened to as a scientist. Separating out these identities is not always possible, nor it is something the scientist has complete control over.

To be fair to Nelson and Vucetich, they are not necessarily saying that a scientist can separate or should compartmentalise or sterilise their different roles in this way. They may merely be saying that a scientist does not abandon their citizenship when they don a lab coat or open up a statistical programme. A scientist's citizenship follows them into their research, and so do the expectations of how a good citizen should behave. This means that the tensions of engaging (and not engaging) in advocacy follow the scientist in their role as being a scientist and a citizen.[17] Therefore, I am interested in exploring if there is a way of engaging in advocacy that firstly navigates invalid arguments (such as those dismissed by Nelson and Vucetich) and, secondly, also helps to reduce the tensions that come about as a result of differing views about the role of science in society. In particular, as the scientific community is the only audience that has the expertise in order to judge To put it another way, some arguments will not go away, but there may be ways in which scientists can act that is less objectionable to those that maintain these arguments. In doing so, scientists may be able to reduce (or eliminate) any proposed threat to their credibility that stems from these arguments and those that hold those views. Part three of my project will seek to provide some guidelines as to how scientists may want to consider making these sorts of decisions.

[17] In the case of the climate scientist, problematic though these tensions may be, there is an argument that the threats climate change poses may not give humanity the luxury to resolve these tensions before taking action and preventing the worst climate change impacts.

Therefore, each of these six arguments outlined by Nelson and Vucetich, both for and against engaging in advocacy, seem to hinge on two main factors: how advocacy is done and what is being advocated. These two factors reflect Nelson and Vucetich's conclusions that advocacy needs to be done justly and transparently. However, as already mentioned, the exact methods for judging and creating 'just and transparent' advocacy are, as yet, unknown.

This is of great importance for and acutely felt by the climate scientist. Climate scientists experience particular tensions when communicating, and therefore this is a rich example to explore when it comes to policy advocacy. This thesis explores how climate scientists can engage in policy advocacy, if at all, and maintain their independence and scientific credibility. As the scientific community is the most qualified community to understand the complexities of the science, they are also the most qualified in assessing how the scientific method may (or may not) have been followed. They are therefore the primary audience that advocating scientists have to satisfy. A scientist may possess some form of credibility with a lay audience but have lost all scientific credibility with the scientific community. In doing so, the scientist may find they have lost the trust of their community, and as credibility is such a key value in the formation of scientific knowledge, may no longer be considered part of that scientific community.

As outlined at the beginning of this chapter, climate change is a problem like no other that humankind has ever faced. And yet action to curb climate change and to adapt to the effects of it has been incredibly slow. Many are concerned that the global targets produced by the world's governments are nowhere near enough to prevent mass death and destruction. Despite this, climate change is a highly politicised issue. This would seem to fly in the face of those that would argue for science to not advocate for specific policies. As such, some of the arguments regarding the role of values in science and science in democracy struggle to articulate the full complexity of interactions that climate science experiences with society.

1.5. Climate Science and policy advocacy

In 1988, the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) to "provide policy-makers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation" (IPCC, 2013; p1). Hundreds of scientists across all sorts of disciplines synthesise the most

up-to-date understanding of climate science to create the reports, making sure they are "objective and produced in an open and transparent way" (IPCC, 2013, p1). Crucially, the IPCC assessments are to be "policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policy-makers what actions to take" (IPCC, 2013; p1). This is one of the ways one can aim to communicate climate change science: collectively, and avoiding being policy prescriptive. However, a vital part of the IPCC is the 'IP' – it is the 'Intergovernmental Panel'. Just as the volunteer scientists spend hundreds of hours in creating the science summaries, government representatives pour over those words, provide comments, and suggest edits.[18] The final text of each IPCC output is the combination of scientists, expert reviewers, and governments.
This approach emphasises that scientists are not the elected decision-makers charged with the task of forming policy in a democratic society. Indeed, the charge for the IPCC to remain policy-relevant but not policy-prescriptive exists in an effort to ensure that any statements remain politically independent and do not favour any particular policy. Therefore, climate scientists have to negotiate the complexities of communicating uncertain science to policy-makers when providing policy advice, while making sure that scientific explanations do not veer into policy advocacy.

Another reason climate change is a particularly difficult subject to communicate is because it is hard to engage with due to effects such as psychological distancing (Moser, 2010) (where the effects of climate change are difficult for us to mentally process) or differences in risk perception (Slovic, 2000) (particularly in how we weigh up risks that are presented to future generations, and on such a global scale). Never before has the human race encountered a problem so large and as all-encompassing as climate change, that is simultaneously so difficult for the individual to identify as presenting a real and serious risk that requires urgent action. As such, the phenomenon of the "finite pool of worry" (Linville & Fischer, 1991) means that the capacity to emotionally process the effects of climate change is not something that the human brain can affectively or analytically process (Hulme, 2009). Thus, our ability to fully understand what is at stake is poor, particularly for those who are not scientists.

Non-scientists are therefore dependent on scientists communicating findings clearly. This

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[18] See here for more information on the IPCC process:
https://www.ipcc.ch/site/assets/uploads/2018/02/FS_review_process.pdf (accessed on 25/03/2020)

means that, at some point, the scientist has to make decisions about how to best explain these concepts to others: which communication frames to use, and which complex aspects should be simplified to aid comprehension (Stephens *et al.*, 2012). These judgements create the potential for policy advocacy as in seeking to be understood the expert may be able to communicate some aspects better than others, or use language which resonates with different audiences' world views, or allow their political bias to influence their tone of voice when describing different options. They are no longer being purely 'policy descriptive', because expressions of preference may seep into their descriptions. Creating scientific narratives can include hypotheses about causation and may "contain normative elements that read policy implications into the causal argument" (Keller, 2009; p11).

For example, the term 'ozone hole' is used in framing the effects that chlorofluorocarbons have on the ozone layer. A more accurate description of the phenomenon would be 'area of ozone thinning' or 'ozone depletion'. Whilst an actual hole in the ozone layer never existed, the language proved to be quite effective in communicating the urgent need for ozone repair (yet another framed phrase) as describing a hole appears more alarming than describing a thinning. In this example, we can see how even the language used by scientists can convey a sense of urgency and agency. Saying we can 'repair' a 'hole' in the ozone conjures tactile images of a human activity, whereas 'healing' a 'thinning' of ozone distances human agency from the action since healing may be considered to be more of a passive, mystical, natural phenomenon that needs time, in comparison to the active engineering that a 'repair' would bring. Therefore, the language chosen to describe phenomena can also be interpreted as indicating a type of policy preference. However, we need to more clearly establish what is considered to be advocacy and what is just good communication. This is something I hope to do in the proceeding chapters.

These considerations present climate scientists with a big problem. Some scientists may believe that they are ethically compelled to advocate policies, however, in doing so, they may feel like they will betray what it means to be a scientist by 'colouring the science' (Lackey, 2007) and be concerned with losing scientific integrity and credibility with their colleagues and the scientific community.

By focusing on climate change science, I am able to draw some conclusions that may prove true, even for the most complex of cases. In doing this, I fill a gap in the theoretical literature, and further add to it by providing practical ways to engage in acceptable advocacy. I have interviewed climate scientists about their practical experience and opinions of their own engagement, of colleagues' engagement in policy advocacy and science communication, and of the role of scientists in democracy. I then examine political theory, philosophy of science, and science communication literature to understand what the theoretical objections, if any, may be for scientists engaging in policy advocacy, and I have identified the conditions under which advocacy is acceptable. I then combine this theoretical proposal and the learning about practice to see how closely the theory and practice map on to one another and produce some guidelines as to how a climate scientist may go about engaging in acceptable policy advocacy. As such, there are three parts to my thesis, which I explain in greater detail now.

2. Thesis structure

The first part of my thesis explores conceptual questions raised by thinking about scientists engaging in advocacy. This part will seek to answer the following questions:

- With respect to what sorts of values should science be neutral? Does policy advocacy sit in conflict with this?
- Must engaging in advocacy damage the independence and scientific credibility of scientists?

To answer these questions, I shall seek to define what policy advocacy is (and is not) and identify the different sorts of advocacy a scientist can engage in by creating an advocacy spectrum. In doing so, I will also explore additional factors that influence the perception of advocacy, and how these may also suggest a conflict between advocacy and the role of scientists in society. As I have already outlined above, different objections are raised in response to scientists engaging in policy advocacy. However, the main source of disagreement is related to the role that values play in science, and how political values may or may not enter science through advocacy. The chapter on the roles of values in science will explore the different types of values that exist and the legitimate (and illegitimate) role they can play in the scientific method. As a result, I will describe how climate scientists can legitimately engage in policy advocacy without losing their ability to retain their independence and credibility as scientists, according to their perceptions of themselves, and the perception of the scientific community.

While climate scientists may be able to retain their independence and integrity whilst also engaging in policy advocacy in theory, the *reality* of maintaining independence and integrity faces *practical* problems. The theory fails if it is not able to explain what is experienced in practice. Thus far, the theory has not been able to identify the mechanisms by which scientists can actually achieve and be seen to fulfil roles such as Pielke's (2007) 'honest broker'. If, in practice, this role is impossible to engage in or identify, then the theory is limited in how it can inform decisions about 'honest-brokering' or advocacy. Therefore, it is important to understand how scientists experience these roles in practice too, in order to build a theoretical structure that works. For this reason, I decided to conduct semi-structured interviews with climate scientists based in the UK and the USA,[19] with the aim to see if the practical and lived experience of scientists might be able to inform new theory, and provide practical insight on how this new theory on advocacy and communication roles may be performed.[20] Through these interviews, I address questions such as:

- What actions do climate scientists identify as being associated with acceptable/unacceptable forms of advocacy?
- What practices or strategies are used by scientists to help maintain credibility and trust when communicating with policy makers and the lay public?
- Under what conditions (context, audience, etc.) do scientists think they have a moral duty to 'speak up' about *what* and *how?*

In these interviews, I asked scientists about their experience of policy advocacy and the tensions they think it creates. These tensions may be real, perceived, or implied, and may exist as tensions with self, with colleagues or peers, with the wider scientific community, or with a lay audience. These tensions may be experienced by the scientists themselves in their communications or may what that they have seen others experience and try to navigate. Tensions may include being accused of creating biased science, speaking out of turn, exaggerating the science, abusing their position, or being told that they need to speak up more. I gathered information about how they think such tensions can be eased and presented my advocacy spectrum for them to critique. I then identified mechanisms by which scientists explain how tensions can be eased and sought to understand scientists' motivations for engaging (or not engaging) in policy advocacy.

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[19] The justification for these locations will be fully covered in the methodology chapter.

[20] In using the term 'climate scientists', one may actually be referring to a whole range of disciplines – from meteorology and geology, through to economics and even political scientists, depending on their subject matter. In this thesis, I focus on natural science researchers whose research relates to climate change, and so they may be from a variety of natural science disciplines. When I use the term 'climate scientist' I am talking about this particular group of scientists.

In the third and final part of the thesis I create a set of communication guidelines for climate scientists. To do this, I combine my advocacy spectrum with the examples and learning gleaned from my interviews with climate scientists. By establishing communication roles and methods, I describe the practical ways in which scientists can engage in policy advocacy without losing their independence and scientific credibility as they seek to engage in a specific type of policy advocacy. Plotting these different communications will also help to clarify when different tensions might be experienced, and therefore how to ease these tensions, or avoid them altogether. Empirical learnings on how to plot advocacy actions and combat the tensions that arise from such communication will form the basis of the guidelines crafted in this third part. I call this managing the effect of contextual factors.[21] However, as well as saying *how* to go about engaging in acceptable policy advocacy, the guidelines, by bringing together theory and practice, will also offer a structure to help climate scientists *decide* which type of communication role is best for them to engage in – whether to engage in advocacy or not. This includes considering their skillset, expertise, experience, employment circumstance, as well as their motivations for engaging in communication. Lastly, these guidelines will also outline methods for *improving* communication – that is to say, methods by which to ensure that the scientists' intended communication role is perceived to be in the same place along the spectrum by the audience (including the scientific community) that they are communicating to. In incorporating the influence of contextual factors and methods for how to manage their influence, my advocacy spectrum and methods for matching mapping describes a dialogical approach for science communication.

3. Summary

The aim of this thesis is firstly to understand the different types of advocacy that climate scientists can engage in. Fundamentally, I am *not* seeking to prescribe a course of action for scientists. I differentiate between objections to the *act* of advocacy and the content of advocacy. This thesis examines the objections to the act of advocacy by scientists and finds

[21] These guidelines will specifically address how to manage tensions arising from the scientific community. It may be that in managing the tensions associated with the scientific community that the scientist also manages tensions associated with a lay audience – indeed, given that the scientific community that discerns a scientists' scientific credibility, satisfying them should, in theory, satisfy a lay-audience as they trust the scientific community in this judgement. There may, however, remain other aspects about credibility that need to be established for an audience. As I am not interviewing non-experts, these tensions are not explored in this thesis - there is already abundant literature on how to do good science communication.

that there are ways to engage in policy advocacy that also maintain scientists' independence and scientific credibility.[22]

Understanding the tensions and objections to scientists engaging in policy advocacy is linked to conceptions about the role that science and scientists play in society, and the role of values in science. I develop a new understanding of advocacy and the roles that scientists take on when they communicate. I use this new understanding to identify the perceived tensions that scientists may experience when communicating in these roles, and the way in which these tensions emerge. Through interviewing climate scientists and exploring the theory behind the role of science and scientists, I establish which tensions are legitimate concerns: the creation of biased science and abuse of their position. Pin-pointing these concerns allows me to explore the specific objections and concerns about scientists engaging in policy advocacy, and to then identify ways in which climate scientists can engage in policy advocacy whilst being responsive to these concerns. This response is further enriched by returning to interview data to establish eight *practical* methods scientists can use to allay these concerns, allowing scientists qua scientists to engage in policy advocacy and maintain their scientific credibility and independence.

In addition, the learnings from this specific community of climate scientists may be useful to other disciplines and help to identify ways of communicating research and navigating roles as citizens and scientists. But for climate change, the need for science-informed policy and mass massive action has never been more needed. If scientists are to contribute to this global conversation as scientists and as concerned citizens, then they need to be able to communicate their science well. They need to know what is and is not acceptable in their communications, according to the perspective of their peers and community, in order to maintain the credibility and independence of science. This thesis provides that answer - both the theory and the practical methods.

22 There may still be objections to the content of what the scientist says (for example hate speech, or racist remarks) which we may still object to, but this is not explored here.

2. What is Advocacy?

1. Why we need a clear definition

Advocacy is a term that has different meanings (Scott & Rachlow, 2011; Runkle & Frankel, 2012). Some definitions are loose and encapsulate other actions such as manipulation or support. However, the literature disagrees on whether advocacy is acceptable for scientists to engage in. This is partly due to differences in opinion about the role that scientists play in society, but also due to conceptions of what advocacy is (and is not), the types of advocacy that exist, and varying interpretations of different communications as advocacy acts. By understanding the sorts of advocacy in which climate scientists can engage, we will be in a better position to identify the different tensions scientists may face when advocating, and how these tensions may or may not be eased.

In this chapter I will define advocacy and scope out its different forms. Firstly, I shall outline different definitions of advocacy used in the literature, and how they fail to accurately and fully describe different forms of advocacy in which scientists can engage. I then construct my own definition of advocacy and clarify how other terms frequently used in other authors' definitions tend to cause confusion when trying to define advocacy. Based on this, I advance an 'advocacy spectrum' which maps out the different types of advocacy and non-advocacy actions in which scientists can engage (see Figure 1). This spectrum provides a clarity that is currently missing from the literature because it describes what types of advocacy and non-advocacy exist, as well as providing a framework by which to analyse the tensions that scientists face when engaging (and not engaging) in advocacy.

As I will explain in my definition, discerning the presence (and type) of advocacy includes considering how an audience may interpret that action as a result of other contextual factors. The audience may be the intended audience for the communication, and also onlookers, such as the scientific community – both are types of audience. Scientists may therefore experience tensions relating to the mismatch between where they intend to plot themselves on the advocacy spectrum, and where the audience, via the influence of contextual factors, plot the scientist on the advocacy spectrum. I will explore what these contextual factors may be, and how they influence communication interpretation. Because of these contextual factors the intention behind a communication plays only a small part in future discussions about the acceptability of advocacy: an intention not to engage in advocacy (or intending to

Figure 1: My advocacy spectrum which is explained in section 5 of this chapter.

be as unbiased as possible) does not prevent one from being interpreted as engaging in advocacy, and therefore intention alone does not provide protection from the tensions one experiences as a result of being seen to advocate. To clarify, I am not exploring normative assessments of whether scientists *should* engage in advocacy (where intentions are likely to be more important). I am seeking to identify if there is an acceptable way for scientists to engage in advocacy – one that is acceptable according to their own views of what is acceptable (for them, and for their fellow scientists) in that it maintains their scientific credibility and independence. The normative assessment of whether or not scientists *should* engage in this acceptable advocacy is a different question not explored in this thesis.

The final part of this chapter will then use the advocacy spectrum and these contextual factors to demonstrate how silence can be defined as an advocacy action. This is something that the literature has not yet been able to do but is a crucial element to understanding how scientists may engage in advocacy.

2. Advocacy definitions and what advocacy is not

The word advocacy stems from the Latin 'advocare', meaning 'to summon a voice'. Many dictionary definitions make reference to advocacy as 'being in favour of', 'to urge by argument', and to 'give public support for a cause'. I will therefore define advocacy as 'a plea in active support of something in order that others may be persuaded to believe and act the same'. This is not too different from how Nielsen (2001) defines advocates:

> *"They have made a commitment to a particular idea, philosophy, perspective, value, person, place, and so forth. Having made such a commitment, they work to convince others to accept their viewpoint and make the same commitment." (p40)*

Other terms often fall under the definition of advocacy, or are described as being acts of advocacy. For example, lending support, manipulation, and stating opinion are often classed as forms of advocacy. Lackey's (2007) definition of advocacy is a popular choice amongst the literature (Scott *et al.*, 2007; Nelson & Vucetich, 2009; Scott & Rachlow, 2011). He defines policy advocacy as "active, covert, or inadvertent support of a particular policy or class of policies" (Lackey, 2007, p13). For Lackey, intention is not important and active or inadvertent support is classified as advocacy. I agree that an act does not need to be intentional for it to be seen as advocacy, however, I will demonstrate how understanding the mismatch between intention and audience perception is important for understanding why scientists experience particular tensions when engaging in advocacy, and other forms of communication. Similarly, I propose that advocacy requires acts of persuasion, and that 'covert advocacy' is different from persuasion. Whilst I agree that there are occasions where support can be classed as an act of advocacy, this is not always the case, and it is unhelpful to conflate support with advocacy. I shall now explain why I take a different definition of advocacy and clarify what it is I do not define as advocacy.

2.1. Support and opinion

Firstly, let us make clear the differences between an 'advocate' and a 'supporter'. The lines between these roles can be blurred, but there is a key difference between their actions. For example, I may be a supporter of Kettering Town Football Club, without seeking to plead and persuade others to support Kettering Town. When asked which team is the best, I might advocate for my team in order to persuade you to think the same. Or, alternatively, I might just simply state my opinion and not attempt to convince others to think the same. Support, or expressing an opinion, as in this example, do not amount to advocacy.

However, Mills and Clark (2001) describe the issue with advocacy as being whether scientists "should espouse a personal opinion as a scientist about what they think is a good and bad resource management solution" (2001, p193). As the football example shows, merely espousing a personal opinion is not advocacy, but the role 'as a scientist' may mean that it creates an advocacy effect due to the authoritative position scientists have – they are influential. I suggest that in this instance, the scientist is not engaging in advocacy, but by virtue of their influence, they are lending their support to something that could result in others following suit. This is a similar outcome to actually advocating and successfully persuading others to follow suit. An influencer espousing an opinion is not the same as pleading in order to persuade others to think the same, although, contextual factors may make it appear to be a form of advocacy.

I am not questioning scientists acting as supporters per se, but will explore how their authoritative role as a scientist in society may affect how their acts of support are interpreted as forms of advocacy. It is important to note that there are separate questions relating to what is and is not acceptable for scientists to support (for example, organisations or policies that would seem to be in conflict with the values of the scientific method). Obviously, there may be some advocacy positions that some may object to scientists holding (such as racist or sexist views). However, I am seeking to explore the objections and tensions relating to the act of engaging in advocacy and seeking to persuade others to have these same opinions, and therefore distinguish these questions from those relating to objections and tensions relating to the content of what is being advocated. We might object to a view that a scientist has, and therefore object to them engaging in advocacy – but this is because we do not like what they are saying, not that we object to scientists qua scientists engaging in advocacy. It is the objections and questions relating to scientists qua scientists' engagement in advocacy that this thesis is focussed on discussing. I will not be passing judgement on which political or ideological views are acceptable or not.[1]

Whilst support may be seen as a form of advocacy, it is also possible to engage in support and not engage in advocacy. Another type of engagement that is also often conflated with advocacy is manipulation.

2.2. Manipulation

Rice (2011) talks of how advocates "can manipulate decision-making processes to be biased towards any perspective" (p2009). Of course, advocates may engage in manipulation, but not all advocates do. To manipulate is to use or change information in a skilful way or for a

[1] Whilst I briefly discuss how perceptions on the acceptability of the substance of what is being discussed influences how an audience perceived if acceptable/unacceptable advocacy is present, if at all, in my presentation of the influence of contextual factors, it is outside the scope of this thesis to be explored any further.

particular purpose, to make it work towards one's advantage. Pielke (2007) describes the 'stealth advocate' as someone who deliberately and covertly narrows down the policy options presented to policy-makers: they deceitfully manipulate the options presented to policy makers. Lackey's definition of advocacy also refers to covert support. There are, however, subtle differences in the types of manipulation in which one can engage.

Usually, when discussing manipulation in the context of persuasion, manipulation may mean the underhand or covert and skilful use of information so as to produce a particular outcome. In this sense, manipulation refers to some sort of deceit. However, it is important for us to talk about how manipulation can mean something different in scientific terminology. For medics, manipulation is to control something, such as moving a joint – there is hardly anything deceitful about this. Similarly, if a scientist clearly demonstrates how they manipulated data when preparing it for graphical representation, one can hardly call this 'underhand' as the process has been transparent and facilitates better understanding. The purpose of the manipulation in this case is to better understand patterns, or to communicate theories more clearly. Indeed, the 'Climategate scandal' in 2009 at the Climatic Research Unit at the University of East Anglia is an example of this misunderstanding.[2]

Communicating scientific uncertainties to policy makers and the lay public may require (permissible) manipulation of data or communication frames. In an attempt to make things easier to comprehend, scientists may risk over-simplifying concepts which may lead to a different understanding of the science than if the full complexities had been explained. Stephens *et al.* (2012) talk of the tension between saliency, robustness and richness when trying to create visualisations of climate models. The relevance of visualisations often become harder for the non-scientist to understand as they become more robust and rich in data dimensionality (see Figure 2). As such, there is a trade off in how to present the data as an increase in robustness and richness is likely to result in a reduction of the visualisation's saliency.

We also know "the way that scientific information is presented may carry unintended

[2] The way in which the data manipulation was exposed by the hackers caused great distress amongst the public as it claimed to reveal how scientists were unhand in their manipulation of the data, performing 'tricks' to change trends (Booker, 2009). However, the scientists embroiled in the scandal were cleared of any misconduct by eight committee investigations (McKitrick, 2010). If anything, the hackers were the ones doing the manipulation and deliberate misinterpretation.

meanings, especially to non-scientists" (Rykiel, 2001, p433; Somerville & Hassol, 2011). This could lead to scientists being accused of manipulation in order to 'stealth advocate' a particular policy option, whilst this might never have been the scientist's intention. The manipulation of data to provide clarity (which can be described as a type of *framing*) may indeed be deployed in order to make a plea more persuasive, but not every case of data manipulation results in advocacy – it could just be used to communicate the science to non-experts (Chan, 2008) and therefore data manipulation and framing cannot *on its own* be described as advocacy.

2.3. Definition Summary

Understanding how advocacy differs from support, opinion and manipulation helps to clarify where issues with advocacy might arise if it is seen as being a form of one of these things. As previously mentioned, this project is interested in the different ways in which scientists engage in policy advocacy, not whether scientists are engaging in deceitful manipulation. Whilst advocacy, as I define it, is a persuasive plea, there are range of pleas that can be engaged in, from pleading in defence of scientific evidence, to some form of action to be taken that is different to the current situation, to being prescriptive about policy specifics. Others have sought to try and describe this advocacy landscape by defining and justifying certain types of advocacy, as I shall now outline.

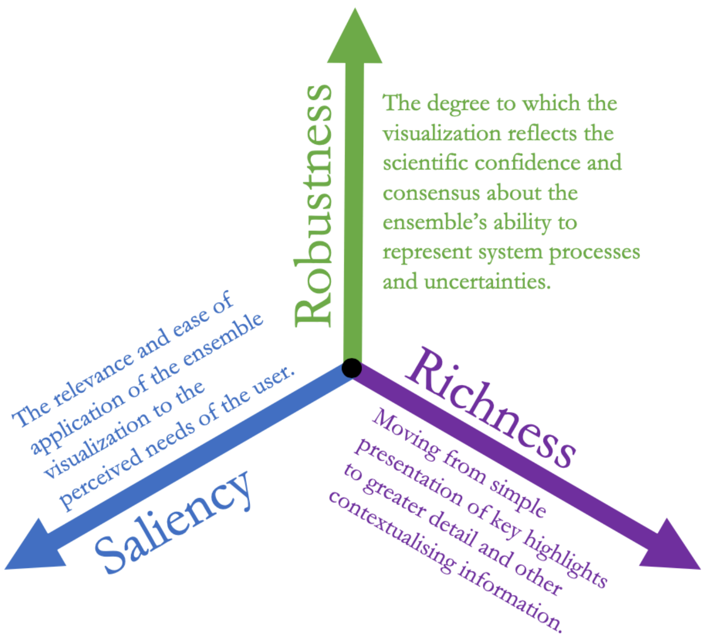

Figure 2: The Three Imperatives for Visualisation, (Stephens, et al., 2012; p410). 'Ensembles' relates to the climate models used.

3. Types of advocacy

In seeking to describe different types of advocacy, Hadley and Barnosky (2014) propose the terms *informative advocacy* and *prescriptive advocacy*. However, in practice, these fail to capture the range of advocacy actions that can be engaged in. *Informative advocacy* argues the facts, remains within the realm of positive questions and injects "the scientific realities into the many different categories of information that decision makers must take into account when formulating policy" (Hadley & Barnosky, 2014). Whereas *prescriptive advocacy* argues a particular course of action in the face of uncertainty, pursues normative questions, and narrows the choices for decision makers.

Informative advocacy sounds similar to the advocacy that argues for science to be included in the policy making process as it seeks to inform policy. However, *informative advocacy* could also encompass advocacy for action. As an illustration, let's imagine a scientist called Neil. Neil is seeking to engage in *informative advocacy*. He sees this as stating the scientific facts to policy makers. He is engaging in *informative advocacy* because no new policy has been adopted to tackle this issue yet - the decision makers have not made any changes and are keeping current policies. Neil therefore thinks there must have been a misunderstanding - the science clearly states (in his opinion) that a new policy should be implemented. He does not have any particular opinion about what specific policy should be adopted, he just thinks that the logical reaction to the science is that *something* needs to be implemented. As such, he keeps trying to communicate the science in a way that the policy makers will understand. The reality is that policy makers did understand the science, but because they have other issues to take

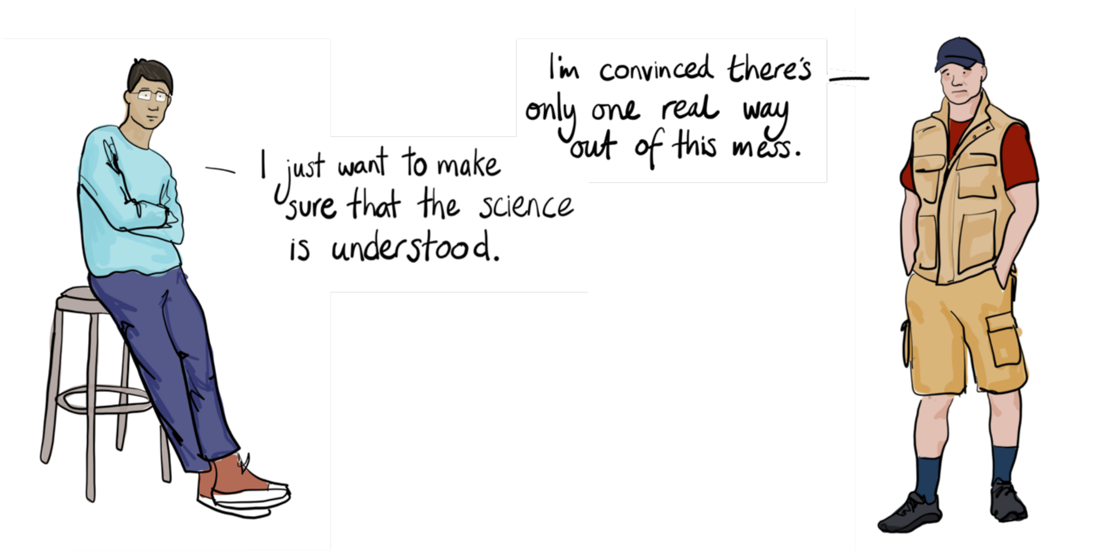

Image 1: Neil (left) and Simon (right), the scientists from the illustrative examples.

into account, and they have different values, they decided to not to implement a new policy. Therefore, by judging policy makers as 'having failed to take into account the full scientific realities affecting a decision' (a possibly normative judgement on his part), and attempting to engage in *informative advocacy,* Neil could actually be seen as engaging in another type of *advocacy*; his continued pursuit of *informative advocacy,* in this case, seems to go beyond just advocating for evidence based policy.

However, to call what Neil is doing '*prescriptive advocacy'* does not seem to fit entirely well either – but Hadley and Barnosky only differentiate between these two types of advocacy, and not any others. *Prescriptive advocacy* seeks to narrow policy choices for policy makers by being prescriptive about a course of action. Technically speaking, Neil's advocacy was not seeking to *prescribe* any particular action – he was trying to advocate for evidence-based policy. However, given the context, the policy maker might view what he was doing as narrowing policy choices as he identified that the current policy was not suitable (and had therefore eliminated one policy option from the list), thus engaging in *prescriptive advocacy*. However, Neil's advocacy, in this instance, looks very different from other types of *prescriptive advocacy.* For example, Simon is a volcanologist who advocates for a specific type of carbon taxation that focuses heavily on frequent flyers and those in extractive industries, which then funds adaptation and resilience building projects in poorer countries. It's quite clear here that Simon is arguing for a particular course of action in the face of uncertainty, is pursuing normative questions, and is narrowing the choices for decision makers.

Therefore, these terminologies miss a raft of other types of advocacy that can be engaged in, such as advocating for some course of action to be taken without being prescriptive about which course to take.[3]

Another proposal for understanding types of advocacy comes from Brussard and Tull (2007). Their work stems from the debate amongst conservation biologists and the way in which they engage in advocacy. Brussard and Tull (2007) describe four different types of advocacy in which conservation biologists can engage: *professional advocacy, advocacy for science, advocacy for ecosystem services*, and *advocacy for the natural world.* Conservation biology is founded on the value that nature should be conserved, so advocacy that argues for some form of conservation to take place is understood by many to be foundational as "the entire field rests

[3] I classify this type of advocacy in my spectrum as being *action advocacy.*

on the value assumption that biodiversity is good and ought to be conserved" (Noss, 2007; p18). Therefore, *advocacy for ecosystem services* and *advocacy for the natural world* relate to values inherent in conservation biology.[4] As such, values-based advocacy positions are not applicable to other science that do not share these values.

The two remaining types of advocacy, *professional advocacy* and *advocacy for science*, however, are useful for examining advocacy in more detail. In Brussard and Tull's opinion, *professional advocacy* "involves informing policy makers, managers, and the public about issues that arise in one's area of expertise" (Brussard & Tull, 2007, p21). If the scientist had simply published their work and left it for policy researchers to come across it and use it for policy making, the process of transferring the information to policy makers would be slow and uncertain. *Professional advocacy* accelerates this process by bringing the information to the attention of the policy makers. This differs from Hadley and Barnosky's *informative advocacy* because *professional advocacy* includes the scientist making a judgment about the relevance and implications of their research to policy and advocating this to policy makers – not just a general plea for evidence-based policy, but an argument that policy should be made based on this particular scientific evidence.

In a sense then, *professional advocacy* can veer into Hadley and Barnosky's definition of *prescriptive advocacy* as it seeks to narrow policy options, just like how Neil's advocacy may be seen as a type of *prescriptive advocacy*. But, again, this too does not quite match their description of *prescriptive advocacy* because the scientist is not advocating for a particular policy direction. Indeed, to refer to my illustration from earlier, Neil's advocacy could be described as being *professional advocacy*. However, it is not clear from Brussard and Tull's account, that this would remain the case if the science Neil was seeking to communicate was technically *outside* of his area of expertise. Neil could possibly be described as engaging in *advocacy for science*. The motivation behind *advocacy for science* is to "try to ensure that management decisions are based

[4] Here, Brussard and Tull acknowledge that "there are some who believe that nature has intrinsic value that makes it priceless, and they emphasize the primacy of ethics and aesthetics in conservation (e.g., McCauley, 2006)" but that Brussard and Tull "believe that in our largely economically centered global society, communicating the economic value of ecosystem services can add an important dimension to conservation". Whilst their account of *advocating for ecosystem services* may be largely based on economics, and therefore come under criticism for being anthropocentric, it may be possible to develop ecocentric advocacy for ecosystem services. Indeed, their description of *advocacy for the natural world* seems to be advocating for preservation of human encounters with nature and the intrinsic value of nature. All in all, both *advocacy for ecosystem services* and *advocacy for the natural world* advocate for the value of ecosystems, which I class as being the same type of advocacy (albeit with different ways of valuing nature).

on the current state of our scientific understanding and that scientific results are not ignored if they happen to be inconvenient for people in power" (Brussard & Tull, 2007, p22). This does indeed sound more like the type of advocacy that Neil was seeking to engage in. However, again we see that *advocacy for science* makes a judgement about how management decisions are made and if the science is being ignored. As such, this could again easily fall into Hadley and Barnosky's definition of *prescriptive advocacy*.

Neither *advocacy for science* nor *professional advocacy* successfully describe the advocacy that Simon, our other previous example, was seeking to engage in. Simon's advocacy goes beyond *professional advocacy*. His advocacy for carbon taxes relate to subject matters quite distant from his volcanology expertise. Similarly, Simon's advocacy cannot be described as *advocacy for science* as it goes beyond advocating for science-based decisions. And as climate change science does not have some inherent value like 'conservation' in conservation science, there cannot be a type of 'volcanology value' advocacy that Simon is engaging in – even if there was, it's not clear how that value system would result in policy preferences for taxation. Brussard and Tull offer no category for Simon's type of *prescriptive advocacy*.

Donner (2014) proposes a science-advocacy continuum based on the amount of normative judgement involved in crafting the advocacy argument (see Figure 3). Donner says that "as scientists proceed towards the advocacy side of the continuum, personal worldview tends to have a greater influence on those judgements" (Donner, 2014, p3) and thus these sorts of judgements increase with increasing scientific uncertainty, which results in increased professional risk due to the public perception of science as objective.

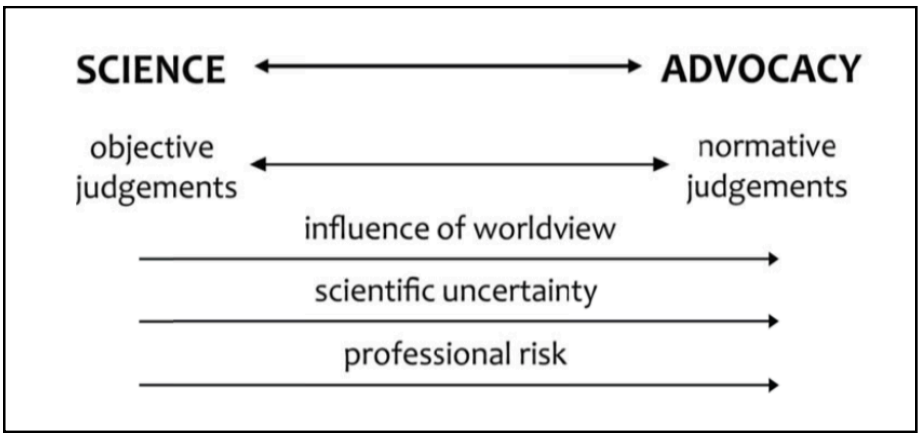

Figure 3: Donner's Science-Advocacy continuum (2014)

However, this continuum fails to always map advocacy. As another illustration, let's take Andrea, a meteorologist. Andrea is advocating for some form of policy action on climate change, the current levels of in-action, in her opinion, are not acceptable. She is basing her advocacy on established science (not uncertain science) and does not feel she is letting her worldview influence her advocacy too much - after all, she's not advocating for specific policies. However, as an early career researcher, she is facing massive professional risk. Her supervisor was asked by other senior professors in her department to tell her to quieten down as she is risking the reputation of the department and could jeopardise funding bids. And yet, when Simon the volcanologist (from the previous illustration) engaged in advocacy, there was no professional risk to him. It was obvious that his worldview was influencing his advocacy and that he was making a lot of normative judgements, and yet his university praised his 'outreach' – it actually helped his career.

Mapping Andrea's advocacy on this spectrum then looks quite different to mapping Simon. This continuum does not help explain why some forms of advocacy are deemed to be more acceptable than others, nor how to go about plotting an act along this continuum and weighing up the influence of world views and uncertain science. Neither does it outline how these considerations translate into professional risk. Donner's continuum merely states that with increased advocacy, one *tends* to see an increase of the influence of worldview, scientific uncertainty and professional risk. This fluidity between science and advocacy, whilst useful, does not help in understanding where tensions arise. This is something that my spectrum will seek to account for.

Image 2: Andrea, the meteorologist from the illustrative example.

Whilst these descriptions of advocacy are useful tools for understanding how advocacy is not a binary phenomenon, I have demonstrated that the most promising attempts nevertheless fail to fully describe the different types of advocacy that scientists can engage in. In my advocacy spectrum, I draw on these descriptions and provide further explanation and descriptions on the different advocacy and non-advocacy positions scientists can take when communicating with policy makers and the lay public: non-engagement in policy, policy advice, action advocacy, and policy specific advocacy.

The literature's descriptions of advocacy still attempt to describe advocacy based on the scientist's communication intention – that is to say, they distinguish between types of advocacy based on the decision that the scientist makes about what and how it is they communicate. These descriptions fail to recognise the influence of what I call 'contextual factors' in how the audience interpret a form of communication as advocacy or not. The influence of contextual factors is central in my advocacy spectrum and allows us to understand how examples of advocacy like Neil's and Simon's can be categorised and interpreted. I will now outline how I define these contextual factors and describe how they can influence perceptions of advocacy.

4. Contextual factors affecting audience interpretation

As mentioned above, advocacy should not be understood as solely dependent upon the intention of the scientist. Indeed, Lackey acknowledges in their definition of advocacy that it can be both inadvertent and active (2007, p13). Engaging in an active plea is dependent upon the audience perceiving there to be a plea. This perception is influenced by what I term 'contextual factors'. These are mechanisms which I propose affect the interpretation of a communication.

I have identified several types of contextual factors and summarise them as being part of three main categories: the voice, the content, and audience position. The three are interrelated and can also affect how persuasive an advocacy action is.[5] Understanding these factors and how they influence how advocacy is perceived and interpreted is really important for understanding the types of tensions scientists may experience when engaging in advocacy. In my interviews with scientists, I will seek to understand how they have

[5] This thesis does not explore the effectiveness of communications (i.e. how persuasive a particular advocacy act actually is) as much has already been written on this subject (see work by Climate Outreach, EcoAmerica, and the Yale Program on Climate Communication).

experienced the influence of these contextual factors, how it is they become aware of them and navigate them, and if there are any contextual factors I may have missed. I shall now explain how each of these contextual factors affect the perception of advocacy.

4.1. The Voice

The *voice* relates to the person engaging in a form of communication, in this case, a climate scientist. This very often will be them speaking (hence 'voice') but may also be non-verbal forms of communication too. We know from communication studies that the messenger (the person doing the communication – the voice) affects how an audience receive a message (Hammond, 2018). Characteristics of the voice can affect how communications are heard, including the voice's background, and whether the voice is engaging as an individual or as a group.

The background of a voice has a large influence on the perceived authority with which they speak to an audience. Here, background means both the history and demographic background of the voice (i.e. where they are from, what their life experiences have been, how they are identified, their demographic features, etc.) and the expertise they possess, because these shape how trusted they are as a messenger and listened to (Fessenden-Raden *et al.*, 1987; Martin & Marks, 2019; NASEM, 2017). For example, an early career researcher may not have as much authority as a tenured professor by virtue of the fact that they do not have the background of being in the field for 30 years. Similarly, demographic factors, such as age, gender, nationality and so on, are also known to affect the way in which audiences trust and interpret messages (Corner & Clarke, 2017; NASEM, 2017). The perception of scientists as trusted messengers is also related to views on the role that scientists play in a democratic society.[6] For some, this means that the scientist, by virtue of being a 'scientist', means that they speak with influence (Brown, 2009).

Another background factor which may affect the interpretation of a message is how the voice might have previously engaged in advocacy. For example, past forays into deceitful manipulation may make it difficult to trust that a scientist, now giving policy advice, is not actually engaging in deceitful manipulation again. This demonstrates the need to be aware of how certain types of engagement by a voice may interact with audience perceptions of trust (Kotcher *et al.*, 2017).

[6] As mentioned previously, this may differ in different societies.

Previous engagement may also extend to the groups and organisations that the voice is affiliated with. If a group engages in advocacy, there may be the perception that all the group's members agree with and also engage in this advocacy. Tomasso (2007) outlines how "a serious consequence of professional societies acting as advocates in public policy debates is that, by extension, all members of the professional society are considered advocates" (p213). Therefore, a scientist's individual membership of a group may affect the way in which the audience interpret their communications, particularly if the group has advocated in the past.

Speaking as a group is also a method deployed to ensure that no individual can get away with engaging in deceitful manipulation (although a coordinated approach to deceitful manipulation would be called a conspiracy). However, group diversity is an important element for controlling the potential for being heard as engaging in policy advocacy. A group that is fairly homogenous in its political values and experience may be perceived as pushing a certain agenda. For example, a frequent criticism of environmental campaign groups in the West is that they are made up of white liberal elite and are therefore often accused of pushing a leftist political agenda (Loomis, 2016; Grijalva, 2015). However, a group made of a diverse range of members may not be accused of the same sort of hidden agenda.

4.2. The Content

Audience interpretation of a message is not just influenced by what was actually said, but how it was done. However, audience perception of the message and its delivery may influence the way the message is interpreted. For example, as another illustration, Paula is a climate scientist involved in giving policy advice to policy makers. In trying to describe the realities of the risk that climate change presents, Paula frames risk as a matter of national security. For policy makers that are highly sensitive to national security threats, this may be interpreted as a form of advocacy – that urgent, decisive, precautionary action is immediately needed from the government (potentially even commandeering resources from citizens). For others, it might sound like gross exaggeration and taint their view of the voice's credibility. Paula was actually just trying to communicate the science in a way that the policy maker would understand - not necessarily advocating for any particular type of action or response. In order to better understand how the content of the communication can affect perceptions of advocacy, I shall look at three factors: the substance of the communication (what was actually said or done), the communication method, and the frame(s) used.

The substance of a communication has been the main (and sometimes even sole) factor that has been analysed when trying to determine if a communication is engaging in advocacy or not. This can be established by looking at what was actually said or done. The presence of advocacy can often manifest in the words that are used to describe an event or action. For example, Simon (from my previous example) writing to his local representative to vote a carbon taxation that focuses heavily on frequent flyers and those in extractive industries, which then funds adaptation and resilience building projects in poorer countries is quite clearly an act of advocacy. A more subtle example is the use of the word 'degraded' in the assessment of an ecosystem. Criticism has been made of scientists that use terms such as "*degradation, improvement, good,* and *poor"* in relation to describing ecosystems, as it is argued that "such value-laden words should not be used to convey scientific information because they imply a preferred ecological state, a desired condition, a benchmark, or a preferred class of policy option" (Lackey, 2007; p14). This 'preferred class of policy option' could be considered as advocacy as it seeks to narrow policy options. These normative judgements are linked to perceptions and values about what constitutes a good ecosystem. Therefore, they can also influence the perception of advocacy; policies leading to degraded ecosystems are undesirable and are advocated against.

As mentioned in the introduction, for some audiences, even the topic of climate change may seem like a certain political agenda is being pushed, if, for example, the audience perceives climate change to be a left-wing conspiracy theory. Any discussion about the reality or impacts of climate change may therefore be interpreted as advocating left wing ideologies.

Image 3: Introducing Paula, from the illustration.

Good communicators adapt the communication method that the voice uses depending upon the target audience. Indeed, using different communication methods provides access to different audiences. Tone, formatting, and the customs associated with particular types of communication method can also influence the content. For example, peer-reviewed literature has a different audience to Twitter. Peer-reviewed literature has limited circulation (often requiring the reader to have a subscription to that journal) and is written using language that is not readily understood by the lay public. It also has a particular format and style of writing, and often does not accept submissions where the author has expressed personal views, save for in explicit opinion pieces. Peer-reviewed content is often sought out for its authority on a specific subject and will be taken as an authoritative source.[7] Twitter, on the other hand, has the potential to reach a much wider audience due to its free sign-up and (relatively) easy access. It significantly limits how much an author can say, and the tone tends to be more informal and uses shorthand and hashtags. However, Twitter is reliant upon building an engaged audience by gathering followers. In contrast, peer-reviewed literature already has an engaged audience, with the audience often seeking out content related to a specific matter. This content is also often behind a paywall, therefore restricting access. This is just one example of how different communication methods can change how a communication is received – one can be stumbled upon much more easily by non-experts and the general public, whereas the other one is more likely to be sought out by a subject-related audience that are able to pay for access.

Another way in which the delivery of a message may change its interpretation is when it means something different to different audiences. For example, take two couples where one partner gives the other a box of chocolates with the message ‘I love you’. For couple A, this is a lovely, romantic gesture. For couple, B, however, this sparks a large argument and temporary separation. This is because the partner giving the chocolates in couple B forgot that their partner was highly allergic to chocolate. Their partner therefore interpreted the message as a demonstration that there were not really loved, either through neglecting to remember their allergy, or in a deliberate attempt to make them ill.

Aside from the written word, communications can also include public speaking events, interviews, debates, public performances, art works, songs, and so on. Policy briefing notes, for example, are tailored communications for policy maker audiences. Brussard and Tull’s

[7] Of course, there are more and less trusted journals and authors too.

(2007) definition of professional advocacy reflects that the scientist may advocate for different audiences to pay attention to their scientific research findings. In this sense, seeking to engage an audience of policy makers in one's research could be seen as a form of advocacy as it seeks to persuade the policy maker to spend time and attention listening to the scientist's issue. This could be advocacy for making policymaking more science-informed, or possibly appear to be advocacy for a specific type of policy.

Some scientists, in an attempt to avoid advocacy, only communicate using particular methods and are very selective in their language. Peer-reviewed publications use technical language and caveats are not explained in layman's terms, as it is expected that the audience either already understands the terminology or has the responsibility to find it out for themselves. As outlined above, Stephens *et al.* (2012) demonstrate how writing for a non-scientific audience involves a trade-off between saliency, robustness and richness (particularly when curating visualisations). By restricting communications to only fellow experts, the scientist does not need to make these judgements about simplification or explanation as much, and therefore seeks to avoid being perceived as an advocate.

The frames used in communication may also influence how advocacy is perceived. Nisbet describes framing communications as being "interpretive storylines that set a specific train of thought in motion, communicating why an issue might be a problem, who or what might be responsible for it, and what should be done about it" (2009a; p15). Framing is therefore a tool used by advocates as it "is the strategies of promoting a particular logic" (Hoffman, 2011; p8) and is strongly influenced by values. In the case of communicating scientific uncertainties, framing becomes incredibly important as it has such potential to influence the understanding of a non-expert audience. For example, "a 10% chance of dying is often interpreted more negatively by an audience than a 90% chance of surviving" (Manstrandrea et al, 2010; p2).

Communication frames interact with both a scientist's world view in their formation, and the audience's world views in interpretation (for example, ideological, political, cultural, or religious beliefs), and their past experiences and emotions. Lakoff (2010) describes how even a single word has the potential to evoke not only its defining frame, but also much of the system that the frame sits within. Lakoff also explains how this interconnectivity of 'frame-circuits' in the brain has direct connections to emotions. Emotions are therefore "an inescapable part of normal thought" (2010; p72) and powerfully affect our decision-making (Pidgeon & Fischoff, 2011; Roeser & Pesch, 2016). Framing can therefore facilitate advocacy by pleading to the audience by describing an issue in a certain way so as to engage their interest. This not only makes the issue relevant to them and their worldviews, but also appeals to their emotions.

Climate change, including the phrase itself,[8] has been framed in various ways, for example:

- Issue concerning Public Health (Maibach *et al.*, 2010)
- Conspiracy theory (Gavin & Marshall, 2011)
- Western Society's failure (Speth, 2009; Callenbach, 1975)
- Economic issue (problem or opportunity) (Stern, 2006; Stern, 2015; Speth, 2009; Fletcher, 2009)
- Caring for Mother Nature (Wapner, 2010; Russil & Nyssa, 2009; Princen, 2010)
- National Security threat (UN Security Council, 2011; Fletcher, 2009)
- As a question of justice (Vanderheiden, 2008; McKinnon 2012; Gardiner, 2011; Shue, 1996).

Different frames can be important in engaging different policy-makers and defining a policy problem. The words, imagery, symbols, and non-verbal cues such as gestures, music or tone of voice, as well as other features of the *voice* can be used to develop frames. For example, framing climate change as a security threat enables one to make a climate change an 'enemy'. Former US Central Intelligence Agency Director, James Woolsey, said that climate change was a threat bigger than terrorism, picturing side by side the terror attacks of September 11, 2001, and the damage caused by Hurricane Katrina (Fletcher, 2009). This framed climate change as a violent issue and a threat to national security (Moser, 2010). This framing may have been employed because national security is widely valued and is considered to be partly a function of state legitimacy – therefore anything that threatens to undermine security is something that should be urgently addressed (Barnett, 2003). However, using this frame may also lead people to think that climate change is something only the state can control, much like the military. Therefore, frames that engage one audience may not engage, or even actively distance, another audience (Schwartz, *et al.*, 2010). By framing climate change as a national security issue, the emotional and political responses usually associated with terrorism may be transposed onto reactions about climate change, and thus it may sound like advocacy for action on climate change.

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[8] The phrase 'climate change' is preferred by scientists as 'global warming' tends to only describe one change. (Whitmarsh, 2009).

As the communication frame affects so much of how a message is received by an audience, this is where we are likely to see the greatest variance in interpretation as frames interact differently with different audiences. Framing is a powerful tool for advocates. Not only can it provide new perspectives from which to interpret a problem, but it can "deeply influence how persuasive we find the information being communicated" (Moser, 2010; p39). But framing in and of itself is not a form of advocacy. Seeking to make something more salient to an audience by explaining it in terms that they would understand is not pleading.

4.3. The Audience

The audience is the main focus of a communication – indeed, a communication cannot exist without an audience, as to communicate means to share or exchange information. As such, the audience plays a central role in the interpretation of a communication.[9] I shall now outline the key features of audiences that can influence how a communication is interpreted.

As previously discussed, different messengers and frames will interact differently with different worldviews. Donner (2017) states:

> *"Regardless of how carefully you consider your position on the science-advocacy continuum, or how carefully you choose and articulate your public statements and actions, how you are perceived will depend on the worldview of the audience" (p432).*

Worldviews are "a set of assumptions about physical and social reality" and can be related to "personality traits, motivation, affect, cognition, behaviour, and culture" (Koltko-Rivera, 2004, p3). If the audience holds a worldview (for whatever reason) that states climate change is not real, then the very existence of a climate change scientist risks being seen as an advocacy act. This is because climate change itself is seen by the audience as purely (bad) political fiction. The audience may then declare that the scientist is engaging in unacceptable advocacy, and should therefore not be listened to, regardless of whether the scientist is actually engaging in advocacy or not. Similarly, if a scientist advocates an argument that is in harmony with the worldview of the audience, the audience may not immediately identify that the scientist is engaging in advocacy. Thus, conflicts in worldviews may more readily identify

[9] I use the term 'audience' as a way of talking about individuals and groups of people on the receiving end of a communication. Of course, within a group there may exist many different worldviews and values, and thus they may differ in their perception of the scientists' communication due to the influence of different contextual factors.

advocacy, just as a uniting of worldviews may simply sound like a factual description of a full range of policy options.

The context in which the audience receives the message can influence how they interpret it (Fessenden-Raden *et al.*, 1987). The audience's existing political, social and personal environments can affect how partisan they interpret a message to be, and thus if the speaker is seen as engaging in advocacy or not. For example, many scientific governmental organisations have a period of purdah, where there is a "period of time immediately before elections or referendums when specific restrictions on communications activity are in place" (Local Government Association, 2019). This is to prevent the governmental organisation from being seen as trying to influence the outcome of the election.

Context also influences the way in which communication frames are received, and the interpretation of the background and authority the voice speaks with (i.e. in comparison to others). For example, a female scientist speaking at a conference in the UK today might be interpreted differently by the same type of audience than if she were speaking in the 1800s, as females in science were practically unheard of at that time.

4.4. Summary

These contextual factors can influence the way in which an audience interprets a communication, which may result in them perceiving the scientist to be engaging in advocacy, or conversely, not identifying the scientist as engaging in advocacy. These contextual factors mean that advocacy (or lack thereof) may be perceived by the audience regardless of the scientist's intention. Thus, as advocacy is determined by audience perception, the scientist would be seen as advocating even if they did not intend to advocate. This can be a source of tension for the scientist – when the audience interpret them to be communicating something different to what they intended. Therefore, the tensions scientists experience are related to this distancing between intended communication role and actual role, as determined by audience perception. Building an awareness of how contextual factors can create a mismatch between intention and interpretation may help to identify ways in which they can be aligned, and the tensions reduced, as I will explore in chapter six of this thesis.[10]

[10] Tensions may remain, but at least the scientist will be aware of what they may be.

As I outline in the next section, contextual factors also help us to understand the different types of communication roles the scientist can communicate in, and why the scientist may experience particular tensions when attempting to operate in those roles. In my advocacy spectrum I will propose that, due to these contextual factors, it is more helpful to conceptualise communication roles as a spectrum with blurred boundaries, than as discrete roles.

5. Advocacy Spectrum

There is a need for a clear way to think about the different ways scientists engage in communication with policy makers and the lay public – one that can factor in the influence of contextual factors. The current literature does not provide a method nor a way of thinking about advocacy that can accommodate the influence of contextual factors. However, my advocacy spectrum (Figure 4) does this and outlines four communication roles that scientists can engage in when communicating with policy makers and the lay-public: *non-engagement in policy, policy advice, action advocacy,* and *specific policy advocacy*. These are displayed as different shaped areas in a circle – like a target board. The shape of each segment is designed so that every role has a boundary with each of the other three roles. The boundary lines between each of these communication roles across the spectrum are blurred. This is due to the influence of contextual factors and how an audience may be uncertain as to which role the scientist is engaging in. Non-engagement in policy and policy advice are not forms of advocacy. However, as always, scientists engaging in these roles need to be aware that the influence of contextual factors may result in the audience interpreting their communications as acts of advocacy. Action advocacy and policy advocacy, are, as the name would suggest, types of advocacy that can be engaged in. As demonstrated in Figure 4, and explained below, some of these boundaries are more defined than others. I shall now explain each category before describing what sort of boundary exists between each one.

The role of *Non-engagement in policy* is for actions that do not seek to engage in policy matters. The scientist wishes to only communicate research findings – they will leave it up to the policy makers and the public to interpret the results and work out implications for policy, if any exist. This category would be home to Pielke's (2007) *pure scientist,* and those seeking to engage in science communication but without any relation to policy (for example, those studying the distant universe). As such, this category is largely defined by its silence on policy. However, as we will explore below, silence does not guarantee that the audience will not interpret scientists as engaging in advocacy.

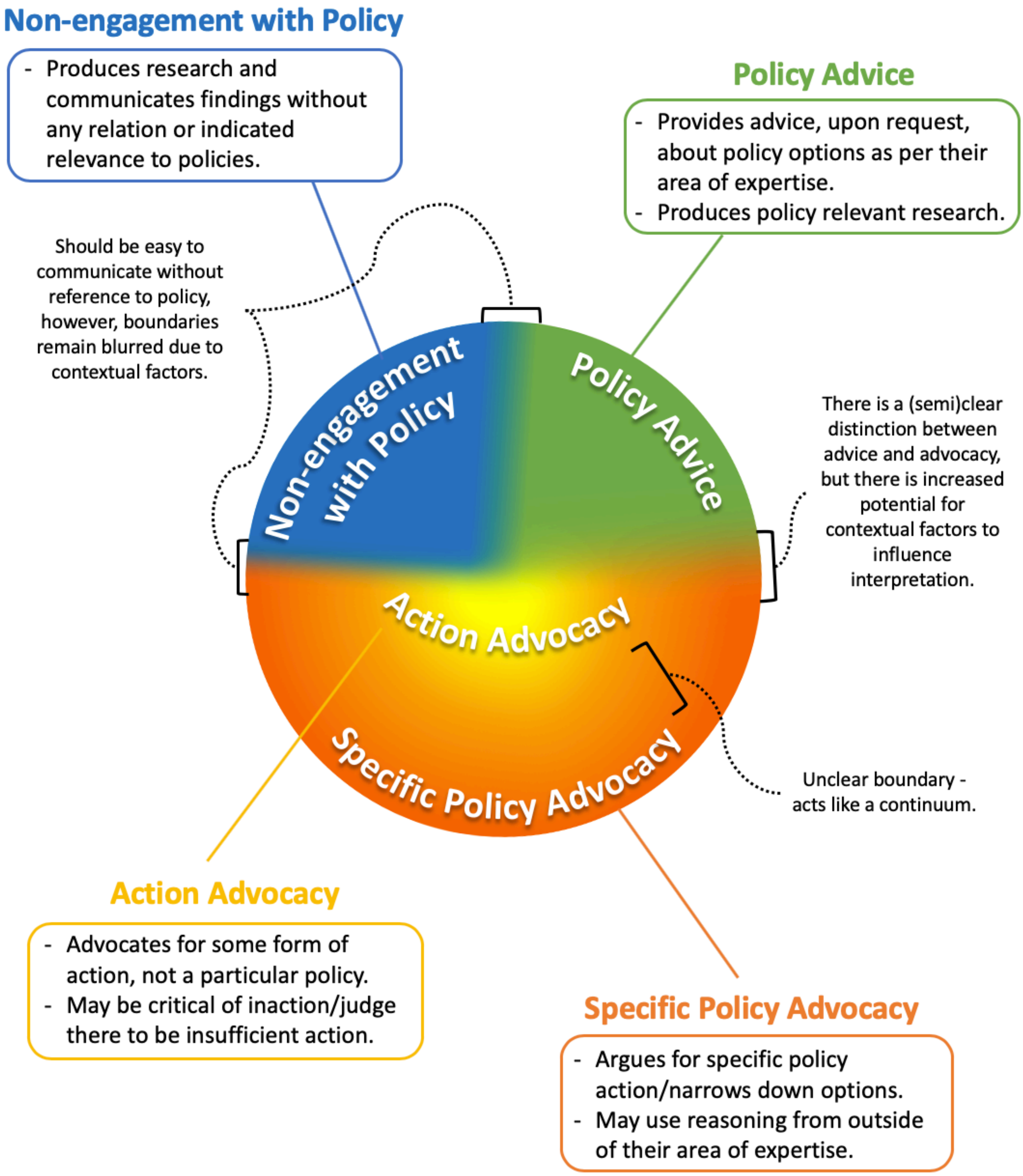

Figure 4: Advocacy Spectrum mapping the different forms of advocacy and engagement that scientists may engage in when communicating with policy makers and the lay public about policy options.

The *policy advice role* seeks to communicate science in a way that is appropriate for policy discussions. This role therefore engages in a dialogue with policy makers and is very similar to Pielke's (2007) *science arbiter* and *honest broker* roles.[11] The science arbiter is employed in research that seeks to answer policy questions and will present objective scientific answers to additional questions policy makers have. Key to defining the science arbiter role is the limited dialogue – questions are posed by policy makers and scientists answer them through scientific inquiry. As such, Pielke (2007) describes this role as remaining "removed from explicit considerations of policy and politics" (p16). However, part of policy advice may entail creating policy impact assessments or assessing the effectiveness of policy. This is the realm of the honest broker, presenting policy options to the policy maker. I couple the science arbiter and honest broker roles together in my spectrum as both endeavour to discuss science in relation to policy. They are not completely avoiding reference to policy, unlike the *non-engagement in policy* role, nor are they advocating for a particular policy action, or action within a range of policy choices.

We then have the two advocacy roles. In designing this advocacy spectrum, I went through several iterations in response to different literatures, and feedback from presentations and pilot interviews. The distinction between these roles has much to do with the main criticisms that scientists engaging in advocacy are presented with. *Action advocacy* strays away from being purely policy *descriptive* but does not go as far as being completely policy *prescriptive*. Instead it straddles a middle ground where the scientist is advocating that *something* be done, but without being specific about what that something should be. This advocacy might, for example, be criticism of inaction or a particular action, or a plea to do 'anything but that'. Policy options are narrowed only to the extent that one policy or course of action is advocated against – e.g. inaction. *Specific policy advocacy,* however, involves a plea persuading the adoption of a *specific* policy. Here, the scientist is not only explicitly advocating for action, but is going further in being more specific about which type of action they think should be taken. The reasoning behind choosing a specific policy may involve an evaluation process that relies on factors external to the scientific method - i.e. based on the scientist's values of what is morally compelling or on political views. Both of these advocacy roles are 'acceptable' advocacy roles. Unacceptable advocacy, (similar to Pielke's 'stealth advocate') is not mapped on this spectrum as this spectrum only marks out roles that are acceptable for scientists to

[11] However, contextual factors mean that a scientist trying to operate in the role of *science arbiter* or *honest broker* may be seen as engaging in another role on my spectrum.

engage in. Differentiating between acceptable and unacceptable advocacy is the focus of this thesis.

5.1. Plotting on the spectrum and predicting tensions

Plotting a communication on the spectrum is influenced by contextual factors. Predicting whether or not the scientist will experience tensions as a result is a combination of mapping the role the scientist intends to engage in and how much this may change in the view of the audience according to the influence of contextual factors. To describe how the advocacy spectrum and contextual factors are related, I will use the analogy of an archer aiming at a target (Image 4). The archer is the scientist, and they intend to fire an arrow at the target. The arrow is their communication act. Upon firing the arrow (delivering the communication), it travels through the air towards the target. During its journey through the air, the arrow's trajectory may be affected by the wind – this is the influence of the contextual factors: the voice, the content, and the audience. Finally, the arrow hits the target, which is the advocacy spectrum. That is, unless the communication fails to be heard by anyone, in which case, it has the same effect as if the scientist had said nothing at all.

The result, where the arrow has landed, is the score the archer is given; where the point has landed on the spectrum is the role that the scientist will be perceived as playing. This also means that they will experience the tensions also associated with this role. So, whilst they may have been aiming for *policy advice*, they have been heard as acting as a *specific policy advocate*, and thus experience the tensions related to being a *specific policy advocate*. This is why the

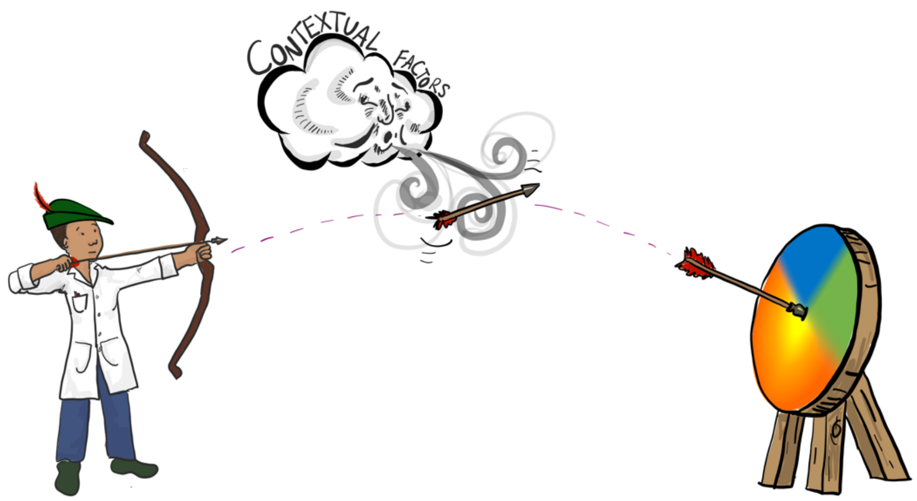

Image 4: *The Robin Hood Analogy* - Mapping on to the Advocacy Spectrum is affected by contextual factors, not just the intention of the scientist.

previous illustrations of Neil, Simon and Andrea, experienced those particular tensions – these scientists were unaware of how contextual factors may influence the audience's interpretation of their communication. They now experience the responses and tensions associated with the role the audience have interpreted them as communicating in. A talented archer, like the fabled Robin Hood, would be skilled at reading the conditions around him (the contextual factors), and thus fire an arrow in a way that would ensure that it landed exactly where he wanted it, despite the conditions the arrow travelled through.[12] Crucially, part of Robin Hood's skill was to know when a shot would be impossible due to the conditions. As such, he would manoeuvre himself into an alternative position, or wait for the conditions to change, before taking a shot in which the conditions could be managed. Therefore, a scientist that is aware of how their communication may be affected and received by an audience may be able to tailor their communications for that audience, thereby ensuring that they are interpreted in the way that they intended. The 'Methods for Matching Mapping' that follow later in chapter six of this thesis seeks to provide 'Robin Hood Training' for scientists – practical methods to help scientist be interpreted as they intended and helping them to manage the tensions they may experience as they communicate.

5.2. The need for blurred boundaries

This spectrum has therefore been designed to be able to map the interpretation of a single communication by a range of audiences as well as for a single audience. For example, one communication may be heard by audience A as being *policy advice* (option 1 in Figure 5), whereas audience B may hear it as *non-engagement in policy* (option 2 in Figure 5). As such, we would map this communication as sitting on the blurred boundary between the two (option 3 in Figure 5). If a third audience heard this same communication as being *action advocacy*, then it would be mapped as the intersection of these three (the middle – option 4 in Figure 5). Indeed, if a fourth audience saw it as engaging in *specific policy advocacy*, then we would need to map the action as covering the whole spectrum (option 5 in Figure 5). And if another audience saw the scientist as engaging in unacceptable advocacy (not hitting the target at all) then the target would cover the whole spectrum, and off of it too. The aim of the scientist is to land somewhere on this spectrum of acceptable communication roles. Landing off the spectrum by engaging in unacceptable advocacy is to be avoided. If we were only mapping a specific communication with one audience, one may suppose that there is no need for this

[12] This is maybe an ideal type and might not be possible in practice for a scientist to *always* land exactly where they intended for *all* audiences.

spectrum as the audience would decide where the communication mapped, meaning that there was no need to illustrate blurred boundaries, and each role could be separated into its own clearly defined box. This would also only work if the audience was classified as an individual person, at a specific moment in time. Fundamentally, this also presupposes that an audience can be decisive – they may be uncertain as to which role they think the scientist is engaging in. This is particularly true of the boundary between action advocacy and specific policy advocacy, where the blurred boundary is also a result of there being a continuum between the two.[13] Thus, the blurring of boundaries not only helps illustrate differences of opinion between audiences, but also undecided opinions within the same audience and the continuum between *action advocacy* and *specific policy advocacy*.

Some boundaries between the communication roles are also more distinct than others. The boundary between *non-engagement with policy* and *policy advice* is fairly distinct on the spectrum as science communication can often describe scientific concepts without any relation to policy. However, contextual factors can still influence whether this can be interpreted as

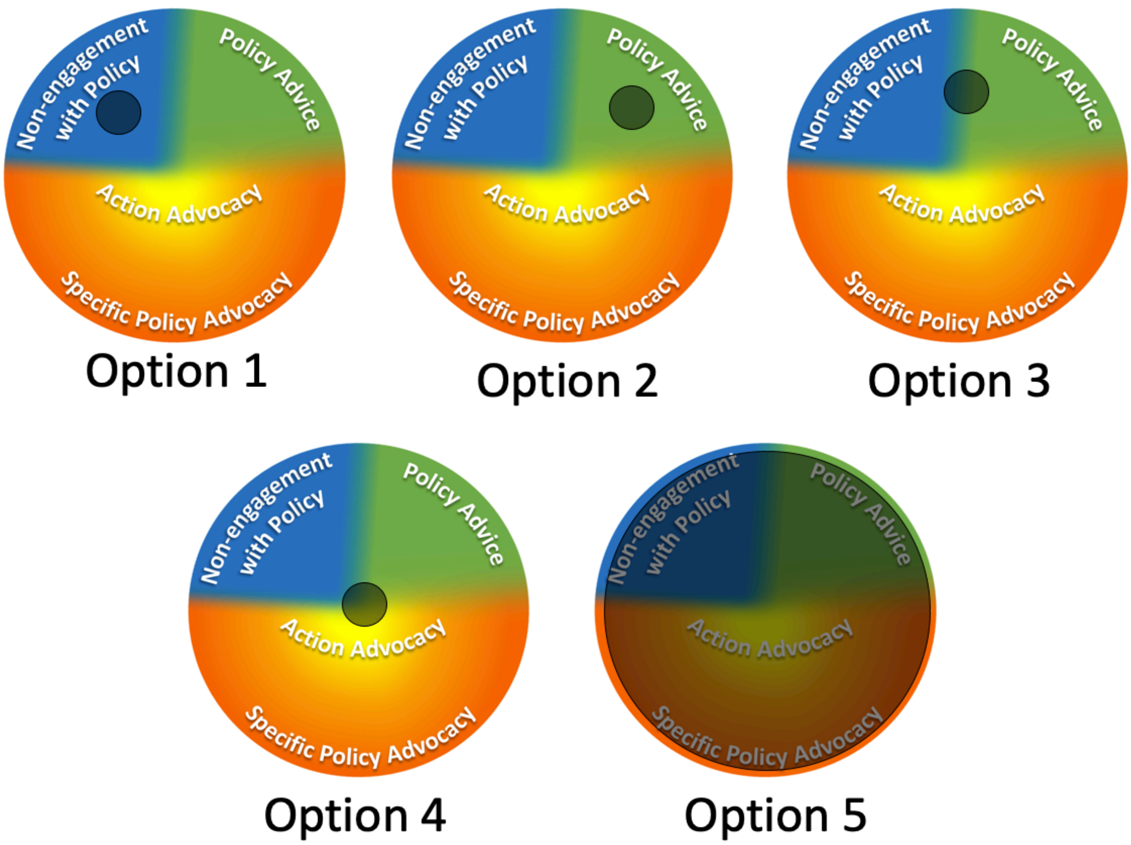

Figure 5: Mapping a communication for different audiences.

[13] This is explained in more detail below.

policy advocacy or not. Simply clarifying a point of science would not be enough to constitute *policy advice*, however, the policy maker may perceive the answer as useful advice for the policies they themselves are considering. As such, a scientist just trying to operate within the *non-engagement with policy* role may be seen as engaging in *policy advice*.

An example of how this boundary may be blurred is in the perception of the role of the Intergovernmental Panel on Climate Change (IPCC). The IPCC was founded in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to "provide policy-makers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation" (IPCC, 2013; p1). Scientists across all disciplines summarise the current understanding of climate science and author reports that are "objective and produced in an open and transparent way" (IPCC, 2013; p1). This would seem to sit squarely within the *non-engagement in policy* as it is providing a summary of the state of the science. However, IPCC assessments are to be:

> *"policy-relevant but not policy-prescriptive: they may present projections of future climate change based on different scenarios and the risks that climate change poses and discuss the implications of response options, but they do not tell policy-makers what actions to take"* (IPCC, 2013, p1).

This means that they do have some interaction with policy and will answer policy questions using scientific knowledge.

Efforts have been made, such as by the IPCC, to try and establish a clear boundary between *policy advice* and advocacy. However, contextual factors mean that no clear line can exist. As mentioned above, when communicating uncertain and complex science, scientists have to make a decision about how best to present this to a non-expert audience (Manstrandrea *et al.*, 2010; Stephens *et al.*, 2012). This can mean that in explaining the different policy options available, the scientist may actually be interpreted as engaging in advocacy by the way in which they frame policy options to policy makers. Even with clear, objective quantifications of measuring effectiveness, Nelson and Vucetich argue that the assessment of policy is a form of advocacy "because policy assessment routinely entails important yet obfuscated promotion or refutation of a policy, even when the assessor is unaware of such affects" (Nelson & Vucetich, 2009, p1091). Therefore, *policy advisors* need to be aware of the potential that certain framings (manipulations) of policy options may be interpreted as advocacy.

An example of this blurred boundary at work is in the policy advice given by conservation biologists, as previously mentioned, when referring to the suitability of policies for particular habitats. Another example is in the description of the ozone hole. As mentioned in the introduction to this thesis, the term ‘ozone hole’ is a frame for describing the effects that chlorofluorocarbons have on the ozone layer. Some might say that a more accurate description of the phenomenon would be ‘area of ozone thinning’ or ‘ozone depletion’. Whilst there technically was never an actual hole in the ozone layer, this simplified and illustrative language proved to be quite effective in communicating the urgent need for ozone repair (yet another framed phrase), since describing a hole is something we worry about in other items (like a piece of clothing, or a container), which may be a more alarming image to an audience than describing a thinning. As such, this language could therefore be interpreted as expressing that urgent action was needed.

The boundary between *action advocacy* and *policy advocacy* is the most blurred of all the boundaries, but it is possible to distinguish between the two ends of either category. Trying to establish a clear boundary between the two is not possible for two reasons: 1) the influence of contextual factors will mean that communications may be interpreted differently by audiences (and they may be uncertain); and 2) there is a continuum between these two points. At one end of the continuum, there is *action advocacy*; where no specific policy is being advocated for, rather, the advocacy is for anything other than the current position. The only policy that action advocacy is ruling out is the current policy position. *Specific policy advocacy*, on the other hand, rules out all other policy positions save for one. The continuum between the two then is anything that rules out more than one policy option, and advocates for more than one policy option. There are actions and ways of engaging in dialogue that will plot an action along this continuum – moving from being non-specific about policy action through to the gradual reduction of policy actions to just one type of action. However, plotting actions will always be influenced by the audience’s interpretation and views on what the policy options are.

For example, advocating for science to be included in decision making and for greater science funding might sound like forms of *action advocacy*. This advocacy is not necessarily saying that there should be a specific policy around funding for science or for science in decision making. However, other contextual factors may lead to a situation where advocating for science funding is seen as taking a more specific position, and therefore becoming less like action advocacy and more like *specific policy advocacy*. For example, arguing for scientific research funding to be prioritised over other funded projects. Similarly, if a scientist engages in repeated *action advocacy* – that the current policy position needs to change – and it has indeed changed several times, the scientist may sound like they are engaging in *specific policy advocacy* as each change has still not been to their satisfaction.

So far, advocacy actions have been discussed in terms of a voice engaging in a plea in order to persuade others to act. However, silence can be influential, depending on contextual factors. Indeed, just as there are actions a scientist may take to make it clear which type of advocacy (if any) they are intending to engage in, non-actions can also be interpreted by an audience as advocacy to not take action. Whilst this might sound counter intuitive, the act to stay in one's seat even when urged to leave it is an action – one still remains in the action of being seated. Therefore, one's inaction can be considered an action. For example, many scientists remain completely silent on policy issues in the hope that this will help them preserve their independence and avoid engaging in advocacy. However, in a dialogue, if the audience interprets the scientist as answering a question with silence, then, depending on the question, there is a chance the silence could be interpreted as taking a position on policy.

Similarly, if a journalist contacts a scientist asking for a comment on how effective they think the government's policy on reducing greenhouse gas emissions is, and the scientist gives an answer of 'no comment', technically the scientist has remained silent (albeit, they did actually utter the words 'no comment'). However, this (lack of) answer from the scientist may be interpreted by the journalist as the scientist disagreeing with the policy or thinking that it has failed. This in and of itself may not be enough to be defined as advocacy, if the silence is not considered to be an *active* plea. But silence can be active – it can be actively engaged in as a deliberate communication, rather than just a lack of communication. However, coupled with the contextual factors mentioned above, particularly the influence of being an expert, some audiences may be persuaded that an act of silence was a communication (and therefore active), and may take action in a certain way because of their perception of the meaning of the scientist's silence or 'no comment'. Or, to put it in even more explicit (if unlikely) terms: 'Stay silent if you advocate that this policy should be adopted' achieves much the same. In this sense then, silence can be mapped as a communication along the advocacy spectrum, depending upon the contextual factors at play, as the action can still be persuasive (if not an active plea) by virtue of the scientist's expert influence.

6. Summary

There are differences of opinion in the literature on what constitutes advocacy. I have proposed that advocacy is a plea in active support of something in order that others may be persuaded to act. This distinction acknowledges that whilst types of support and manipulation may be advocacy actions, not *all* types of support and manipulation are advocacy. However, the way in which support and manipulation count as advocacy actions changes depending on contextual factors that affect the audience's interpretation of whether a plea is present or not. This in turn affects where a scientist's message is placed on the advocacy spectrum. My advocacy spectrum provides a new way to conceptualise the roles that scientists can take when engaging in advocacy. Not only is this a new way of defining communication roles, differentiating between types of advocacy and non-advocacy, but my spectrum also describes the tensions between how a scientist intends to communicate and how it is they are actually interpreted. My list of contextual factors describes the way in which different elements influence communications and identifies the mechanisms by which the communicator's intentions may not match up with how the audience interpret their communication. Therefore, advocacy is not just whether one decides to engage in it or not, as the current literature suggests. Instead, I have demonstrated that advocacy is determined by audience perception, not the communicator's intentions, that a range of advocacy positions exist, and that contextual factors can influence how a communication is interpreted by the audience. As such, I have also been able to explain how silence can be a communication and thus interpreted as a form of advocacy.

The next part of this thesis reports on how climate scientists see each role on the advocacy spectrum, the tensions they experience when communicating, and their opinions on what types of communications are acceptable or not. Part of my consultation with climate scientists will help to ascertain if I have correctly identified advocacy – what it is and is not - and the different types of advocacy that can exist, as described on my advocacy spectrum. I also want to understand how scientists conceptualise and decide between the different spectrum communication roles. The theory also states that contextual factors will be influential in the interpretation of communication roles, therefore I will also try to ascertain how aware interviewees are of the effect of contextual factors and identify any other contextual factors that I may have missed.

In interviewing scientists, I also want to understand how they perceive advocacy and if they see it as being a threat to scientific integrity and credibility. If they do see advocacy as a threat (and likewise if they do not see it as being a threat), I want to have an account of how and why they see it as being a threat. As mentioned previously, the literature does not talk about how different audiences may find different types of advocacy more or less acceptable. I will also explore if scientists have varying views on the acceptability of different types of advocacy, as well as what contextual conditions they may perceive as making advocacy more or less acceptable.

As I outline in my next chapter on interview methodology, it is important that I speak to a diverse range of climate scientists in order to understand how different people may experience and perceive the tensions of engaging in advocacy. Whilst I do not claim that my interviews will highlight all of the tensions experienced by climate scientists, or provide all the answers on how to reduce tensions, the interviews will provide a much richer appreciation and understanding of the tensions of advocacy than what currently exists in the literature.[14] By speaking to scientists about their experience communicating, I hope to identify and gather methods and techniques they use for identifying and managing the influence of contextual factors. These can then feed into a set of best practice principles for ensuring scientists' intended communication matches audience's perception of the communication – the 'Robin Hood Training' or otherwise known as 'Methods for Matching Mapping' in chapter six of this thesis.

[14] At the time of writing, I have not been able to find any publications that involve interviewing climate scientists about their opinions on advocacy.

3. Data Collection and Analysis Methods

1. Introduction

This chapter outlines my chosen methodology for canvassing the climate science community about their thoughts on engaging in advocacy. Most of the literature on science and advocacy is purely theoretical, with only a few looking at how climate scientists perceive advocacy (Luers, 2013; Boykoff & Oonk, 2018). Even then, these are surveys with little opportunity for in-depth qualitative analysis. As such, I wanted to hear from the climate science community and listen to their experiences and opinions of advocacy and communicating with different audiences.

I conducted eight pilot interviews with individuals, followed by 47 interviews with individual climate scientists working in institutions in the UK and USA between April and August 2018.[1] I secured interviews by emailing suggested climate scientists, and through snowballing. I stopped gathering data when I identified that the data had reached a saturation point with interviewees raising no new points. These semi-structured interviews averaged one hour and ten minutes and 11 of them were over the phone with the 36 conducted face-to-face. They were transcribed full-verbatim[2] and analysed using a coding structure I had designed in NVivo software.[3]

In this chapter, I begin by discussing why my chosen methods are the most suitable for the information needed to fully examine the questions raised from the theoretical research. I also discuss in greater detail the data analysis techniques I deployed and evidence how my chosen data collection method facilitated the emergence of a larger, more detailed analysis structure and tested for gaps in the literature.

Qualitative data collection methods are most appropriate when investigating questions of perception, intention, and language. Therefore, I began by exploring different qualitative methods. To ensure that I would be able to establish a clear mechanism for demonstrating the validity of my claims, I used a purposive sampling technique and conducted semi-

[1] 27 based in the USA, and 20 in the UK; 32 male, 15 female.
[2] Transcriptions include every stutter, hesitation, and repetition.
[3] Included in the appendix.

structured interviews. This meant taking careful consideration over sample selection, question structure, and constantly reviewing my data gathering methods and technique.

2. Data collection methodologies

Two common types of qualitative research are case studies and interviews/surveys. The depth of detail and viewpoints achieved by each differ. I want to be able to have a deep understanding of how climate scientists describe policy advocacy and any tensions or stances they take when engaging (or not engaging) in it. As such, conducting semi-structured interviews is the best way to gather the type of data needed to establish this understanding.

To collect information via a survey would mean restricting the data to set definitions and responses, and would have little scope for asking clarificatory questions or exploring new avenues of interest – surveys cannot "gather rich detail about key elites' thoughts and attitudes on central issues" (Tansey, 2007; p766), unlike interviews. Similarly, a focus on case studies means a narrow view of a particular event from one (or a few more) person's perspective. Whilst this could be useful for understanding the tensions and judgements made about one particular act of policy advocacy, or lack of advocacy, as mentioned in previous chapters, the acceptability and interpretation of an act is dependent upon so many other factors – mainly the audience perception. A case study description would merely describe the perspectives of that one particular event, and not the rationale deployed on a daily basis. Therefore, at an early stage I quickly made the decision that interviews would be the best way to curate this understanding.

Interviews seek "to understand the meaning of central themes of the subjects' lived world" (Brinkmann & Kvale, 2015; p32). Interviews can provide wonderfully rich data and, depending on the interview method, can freely explore new ideas. My approach needed to be open to exploring new ideas that may not have come up in the literature review and theoretical work, and be open to using the language, definitions, and understandings that interviewees used themselves, rather than have me impose those on them. On this point, all interview methods should bear in mind the following: interviews require "a critical awareness of the interviewer's own presuppositions" (Brinkmann & Kvale, 2015; p34) in order to not simply reproduce the thoughts of the interviewer. Similarly, as "power is inherent in human conversations and relationships … interviewers ought to reflect on the role of power in the production of interview knowledge" (Brinkmann & Kvale, 2015; p38). It is therefore important to structure an interview that is open to other points of view and disagreement, as well as addressing any negative consequences of a power imbalance as far as possible. Some researchers dismiss interviewing as a valid form of information gathering as it is deemed too subjective and it is based on interpersonal interactions. Whilst there is a danger that interviews may be strongly influenced by the interviewer and their line of enquiry, there are different methods and techniques that can be deployed to lessen their influence and make such influence visible and easily analysed. I now discuss my recruitment methods, before exploring interview methods which limit the influence of the interviewer and address power dynamics.

3. Sampling methods

In order to gather a suitable sample that will work with my chosen methodology and provide me with the information I am seeking, I first needed to determine the population I wish to focus on. Ritchie and Lewis (2003) state that there are three key questions that need to be answered when defining a sample population:

- Which group is of central interest to the study?
- Are there subsets of this group that should be excluded?
- Are there additional groups or subpopulations that should be included because their views will add to the project?

As the tensions of advocacy relate to the difference between perception and intention, I decided that speaking to climate change researchers would allow me to best explore these tensions, as they are better placed than any other groups to describe their intentions. Climate change researchers are quite a large and varied group. The theory indicated that natural scientists are more likely to experience tension around the role of values in science, in comparison to those engaged in social science.[4] I also had informal conversations with those involved in policy making in the UK and in the study of environmental politics. Whilst their insights were interesting and helped to understand the political conditions of recent years, they did little to provide depth to understanding the tensions scientists experience with policy advocacy or the practical methods scientists engage in to manage those tensions. As

[4] As will be described in more detail in chapter five on the role of values in science, this tension is felt in a different way for social scientists, who are much more familiar discussing interactions with their own values (reflexive methods) and providing statements based on an understanding of a set of values and ideologies.

such, whilst speaking to non-scientists may be useful for context, they ultimately would not be a rich source of information on scientists' lived experience.

These requirements for the sample quickly ruled out methodologies associated with more statistical research. Probability sampling, for example, would be wholly inappropriate for this project as I was not setting out "to estimate the incidence of phenomena in the wider population", where neither "statistical representation nor scale are key considerations" (Ritchie and Lewis, 2003; p81-82). Random sampling of the population also does not help me achieve representation of salient characteristics. Instead, a more purposeful selection, like the theoretical sampling method or interactive sampling, would allow a greater flexibility in developing a sample (Robinson, 2013; Mason, 2018). My chosen theoretical sampling method employs an iterative element in selections, allowing the researcher to appraise the data they have gathered thus far, and what gaps emerge in the sample. These gaps are judged "according to the richness of data and the quality of concepts and theories generated" (Ritchie & Lewis, 2003; p80). Thus, the key criteria for case selection are their theoretical purpose and relevance – "sampling continues until 'theoretical saturation' is reached and no new analytical insights are forthcoming" which means that "the researcher does not look just for confirmatory evidence but also searches for 'negative cases'" (Ritchie & Lewis, 2003; p80-81). This method allows the researcher to continually asses the range of opinions present without a pre-interview survey (which may not be accurate anyway) and remain open to a range that differs from what the theory may suggest to be present (Robinson, 2013). It also provides a way to assess when the range has most likely been fully explored by reaching a saturation point.

Purposeful selection would also support exploring different contexts that scientists found themselves in. As already discussed, there are multiple factors that affect how a message is interpreted, including the context. Therefore, it would be important for the sample to reflect various contextual conditions that scientists may find themselves in. The main contexts that are more easily identifiable are the political context and employment context. For example, one element of sampling may examine whether or not the scientist was employed as a governmental researcher, or an academic researcher in higher education.[5] Another division

[5] It is important to note that employment boundaries are often blurred, in part due to some institutional structures, but also because some scientists may be employed in both settings. Similarly, employment in business may be an option, however, the likelihood of being able to find climate scientists employed by the employ of private business is likely to be difficult. The dynamic between business and policy

may be to look at the national government's position on climate change action. At the time my interviews were conducted, the Trump administration had been in power for 17 months in the USA, where opinions about climate change are phenomenally polarised (Langer Research Associates/ABC; 2018). Indeed, in the months leading up to my interviews, the Trump administration had engaged in actions including removing the mention of climate change from government websites, and had threatened massive financial cuts to scientific research, and there was also another congressional hearing on climate change which spiralled into a debate about whether climate change even existed (EDGI, 2018). In the UK, however, whilst opinion polls still tracked a difference between political party affiliation and views on climate change, the broad national narrative on climate change has been that it is happening but that there are other things, mainly Brexit, migration, and social care, that capture political attention (Fisher *et al.*, 2018). Therefore, interviewing scientists in these different political conditions would help to ensure that I did not just gain information from scientists in one particular setting.

It was also apparent to me, from my background as an environmental scientist,[6] and from the conversations I had with climate scientists, that different scientists have different views on the acceptability of policy advocacy. My background was a valuable resource from a sampling perspective, as in order to fully understand the tensions experienced by scientists, I would need to have a wide range of opinions on advocacy present in my interviews. This is almost impossible to establish pre-interview without background knowledge, unless you ask respondents to complete a detailed survey beforehand (Tansey, 2007). To do this would risk all of the negatives of a survey approach with very little of the positives. However, it is important to assess how crucial this element would be to the validity of the statements I was making. The type of data I wished to collect did not need to be a proportional representation of the scientific community; my intention is to describe the range of opinions that exist, not to assign a significance to the number of scientists that hold that opinion. I therefore needed a sampling method that would allow me to explore the full range of these opinions (which may themselves differ depending on the context) without requiring a pre-interview survey. The method would also need to develop a way of assessing when the full range of opinions in the population had been explored.

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advocacy is also another topic, and not one that this project seeks to explore.

[6] I graduated with a BSc in Environmental Science from the University of East Anglia, and was there as an undergraduate during 'Climategate'.

A fundamental requirement in order to make sure that my data is valid and explores the full range of opinion is so make sure I have a diverse sample. Making sure the sample is diverse "optimises the chances of identifying the full range of factors or features that are associated with a phenomenon" (Ritchie & Lewis, 2003; p83). It can also allow for some limited investigation between any relationship between certain features and stand points. However, it is important to emphasise that sample diversity is determined by the defined population. Speaking to a climate change denier (someone who denounces the scientific consensus on climate change) within the population I had identified would prove difficult to do, as not many climate scientists would self-identify as being climate change deniers.[7] Similarly, natural science in higher education in the West is well documented as having poor representation from communities of colour and from women (Pearson & Schuldt, 2014). Populating my sample with a diverse range of interviewees may be difficult but is important in order to gather a wide range of experiences and opinions about advocacy and the practices deployed to lessen tensions when communicating.

The methodology of theoretical sampling therefore required some additional factors to ensure that the sample would be successful in providing valid data. Snowballing can be a very useful method for speaking to a diverse range of respondents, and also for obtaining information on and access to 'hidden populations' (Noy, 2008). In snowballing, the researcher asks the interviewee if there is anybody else they could put them in touch with (Noy, 2008; Drever, 1995). This request might also be accompanied by a request to suggest people of a certain diversity and capitalises on the social networks the respondent already has, using the social capital of the respondent (and their superior knowledge of the target sample) to secure future interviews.

Purely using the snowballing approach may however result in only sampling a small section of the community that may still be quite similar in their thoughts and opinions, particularly if it is dependent upon convenience (or 'availability') sampling. (Tansey, 2007). By coupling the snowballing approach with purposive sampling, I will be able to fill in any gaps created by incomplete knowledge in the theory informing the purposive sampling. In addition to these methods, I was also able to draw on my knowledge of some scientists' positions as a

[7] That being said, I did interview some scientists who may share some of the same views as climate denialists, and whom, whilst they may not identify with this label, other climate scientists would label as being denialists.

result of my previous scientific training and research for this project. This was further enhanced by the input of my supervisor, Professor Ed Hawkins, who provided me with suggestions of scientists that would be interesting to speak to. Using both of our knowledge in this way really helped to have a broad targeted sample, and network through academic networks.

I contacted 60 people for interview via email. My response rate was over 90%, with all those who responded agreeing to interview. I managed to arrange and conduct interviews with 47 people. Whilst this response rate was very encouraging, there remained a very real concern that people might cancel last minute, or that I might not get the diversity and range that I was hoping for in the additional respondents gained from snowballing. Similarly, I was dependent upon these snowballed participants fitting the sample population I was aiming for as I was not always able to glean much information about the interviewee in advance.[8]

4. Interview methods

When choosing an interview method the main decisions I had to make were:

- Whether to interview individuals one-to-one, or as part of a group
- How to structure the interview conversation
- Who I wanted to speak to
- How I would sample that population
- How I would process data and draw understanding from it
- How I would ensure validity and rigour
- What the ethical implications of the interviews are.

I shall now provide a short discussion on the options I explored, their suitability to this project, and the decisions I made.

[8] Most of these interviewees were with natural scientists working on climate change, however, six of these interviewees, whilst working on climate change, would not describe themselves as natural scientists. These six all work very closely with natural climate scientists and help communicate the science to different audiences. Some of these interviewees were as a result of snowballing, and thus, it was not until I interviewed them that I realised that they did not necessarily do the scientific research themselves (although many had a science background). However, their thoughts on policy advocacy were still very useful, and if anything, due to their job roles, meant that they were able to comment on different scientists' approaches more easily.

I decided that individual interviews would be the best way to ensure I achieved a detailed understanding of scientists' thoughts and opinions on policy advocacy, as well as their ideas about how to navigate advocacy-related tensions. I would be able to explore in depth and create opportunities for scientists to share thoughts and reflections that they might not be as comfortable sharing in a group. Scientists, particularly in academia, often find themselves in a hierarchical system, where skilled politicking takes place in managing working relationships. As such, group interviews may actually hinder my ability to hear scientists share their thoughts freely. The range of formality in discussion is also much larger in individual interviews as the interpersonal dynamic is only influenced by two people, as opposed to a whole group. The interviewer (to a varying degree, depending on the method) can act predominantly as the questioner listening to the thoughts and opinions of one person. This provides:

> "*an opportunity for detailed investigation of people's personal perspectives, for in-depth understanding of the personal context within which the research phenomena are located, and for very detailed subject coverage. They are also particularly well suited to research that requires an understanding of deeply rooted or delicate phenomena or responses to complex systems, processes or experiences because of the depth of focus and the opportunity they offer for clarification and detailed understanding*" (Ritchie & Lewis, 2003; p36).

4.1. Interview structure

Semi-structured interviews became my chosen method as it would allow me to address the main points raised by the theory, whilst not confining conversation to those points only, allowing interviewees to be free to raise new topics the theory did not cover (Berry, 2002). It would also mean that the respondents could use their own terminology to describe the tensions of policy advocacy, and describe those tensions as they experienced them, rather than imposing my own view. Whilst this may increase the burden on the researcher to code responses, it allows the researcher to have a flexible and iterative research design and explore avenues of enquiry that might not otherwise have been identified.

As mentioned previously, the quantitative style surveys were not going to give me the rich data I needed to explore fully the perceptions and beliefs about advocacy. Using a survey with multiple choice selections, Likert scales and so on, would constrain the respondent's answers too much. The same can be said for structured interviews as they can also impose language upon respondents and hinder the ability to fully explore the respondent's self-made thought structures (Holloway & Jefferson, 2000). Aberbach and Rockman (2002) have also found that "elites especially – but other highly educated people as well – do not like being put in the straitjacket of close-ended questions"(p674). Being able to use the respondent's own framing, language and ability to redefine the problem on their own terms would be important for fully understanding how the tensions of advocacy are understood and negotiated. Unstructured interviews, on the other hand, consist almost wholly as free roaming conversation (often conducting several interviews over a period of time). Whilst this approach can help reveal deeper elements of the respondent's internal narrative, they have no strict question or topic order to follow, which can make it very difficult to explore set topics (Holloway & Jefferson, 2000).

Unlike unstructured interviews, semi-structured interviews produce data that can explore key topics of interest, sometimes even using standardised questions, but have inbuilt flexibility in where the interview travels, reacting to the respondent. Aspects of this research project could also be interpreted as being fairly personal and relating to personal convictions, therefore I also felt that it was appropriate and respectful to allow respondents to have more freedom in their description of their thoughts and opinions than set questions would allow for (Berry, 2002). To facilitate this, I created a topic guide, rather than a strict set of questions, as they facilitate "active interviewing, becoming responsive to the situation and most crucially to the terms, concepts and language used by the participants themselves" (Ritchie & Lewis, 2003; p123).

Similarly, the data I wished to collect was not a detailed description of how respondents express themselves – I wanted an explicit description of *what* they had experienced and what they thought about that. As such, a purely narrative approach to data collection and analysis would be no use to establishing this knowledge. A good topic guide should not be leading questions, but be clearly worded, single faceted, and open-ended (Kallio *et al.*, 2016). I created a series of six bullet points which were a brief summary of the six main points arising from the theory, with a series of key words and single word questions under each bullet point. These sub-points were useful in developing follow-up questions and acting as a verbal probe. Non-verbal probing techniques, such as remaining silent, are also useful (Kallio et al, 2016). Open-ended questioning in this manner has been described as being "the riskiest but potentially most valuable type of elite interviewing" as it "requires interviewers to know when to probe and how to formulate follow-up questions on the fly" (Berry, 2002; p679).

Semi-structured interviews are particularly successful in enabling this (Kallio *et al.*, 2016; Rubin & Rubin, 2005). I shall now describe my data analysis methods, and why they were the most suitable for this data set and research project.

5. Data analysis methods

In order to have an idea about how structured I needed my semi-structured interviews to be, I needed to consider how I was going to analyse the data afterwards. Qualitative data analysis, with a coding structure, would allow for a targeted set of topics to be addressed, without losing the flexibility of a semi-structured interview, and be open enough to respond to important factors like respondents' framing and language choice.

5.1. QDA with a coding structure

The most common way to tackle a mass of qualitative data is to use a code and retrieve method (Holloway & Jefferson, 2000). I created a set of coding structures that would organise thoughts around the main points raised by theory, whilst also providing flexibility to record new phenomena. Much like my sampling method, the coding structure that I developed required constant review as new topics came up. This also meant that I would sometimes ask new or different questions in order to explore these new themes. I was able to explore how some topics were closely linked, and use the iterative nature of the methodologies to further explore these linkages and relationships. The data analysis can be described as being inductive and data-driven, rather than concept-driven, forcing data to fit within predetermined concepts.

In coding data to a structure however, there remains the possibility that I will lose some of the meaning of the data as my coding structure will select what meanings to record. However, as Schreier (2012) outlines "qualitative data are very rich anyway - so rich that it is impossible for all practical purposes to really capture their full meaning" (p4). I am interested in understanding the lived experience, thoughts and opinions that scientists hold in regard to policy advocacy, and the strategies they deploy to manage any tensions arising from those experiences and opinions. In this sense, my approach is more akin to phenomenologists who "are typically interested in charting how human subjects *experience* life world phenomena" as opposed to hermeneutical scholars who "address the *interpretation* of meaning, and discourse analysts who focus on how language and discursive practices *construct* the social worlds in which human beings live" (Brinkmann & Kvale, 2015; p18). Therefore, my coding structure does try to pick up on particular language (key words) and meanings (as explained by the interviewee and from understanding their particular point in the context of the rest of the interview) (see Appendix for coding structure).

One obvious downside to this type of analysis is that it is completely dependent upon the researcher's ability to record and be alert to subtlety and intuition about meaning in a respondent's reply – computerising this would just be impossible, and would risk losing too much of the rich meaning in the data (Holloway & Jefferson, 2000; Schreier, 2012). This means that analysis is also vulnerable to the researcher's subjective interpretation. However, good coding structures can help with developing consistency, especially as you tailor and redesign coding structures to match the specifics of your data, but ultimately, there will always be differences between people when it comes to interpreting meaning. I discussed my coding with my supervisors and regularly took stock of my mood and energy levels whilst coding, developing an awareness for when I was having an emotional reaction to something I had read. In these moments, as I did in the interviews, I deployed an emotional detachment technique that facilitates the acknowledgement of the emotion, and, internally, sets it aside in order to assess and stay attuned to the respondent and what the data was showing, without receiving a sharp emotional reaction from me.

5.2. Handling data

I audio recorded all of my interviews (everyone gave their consent) in order to "facilitate use of a conversational styles and to minimize information loss" (Aberbach and Rockman, 2003; p675). I had full, strict verbatim transcripts made of the majority of the interviews, carried out by transcription agencies and myself. For interviews with poor recording quality, I listened through the recordings and made notes of the time stamp when the interviewee said something of particular interest, and a brief summary of the point they had made. Transcripts were then uploaded into the data handling software NVivo, and coded.[9]

6. Reliable data

Due to the nature of the information I was gathering and the way in which it was to be analysed, I established two main ways to ensure that my data was reliable. The first was to test how strongly held or thoroughly thought through scientists' thoughts and opinions were. I found that, in the first couple of interviews, and in some of my pilot interviews, that respondents sometimes found it difficult to articulate their thoughts and opinions. Asking

[9] A copy of my coding structure is included in the Appendix.

clarificatory questions did little to improve the description or to flush out inconsistencies. Therefore, after some self-reflection upon the training I had as a scientist, and how I had witnessed scientists talking, I found that scientists often like to gently spar with one another and play devil's advocate, finding the gaps in hypotheses. I found that, whilst coupled with good humour, gently challenging scientists every now and then (completely dependent upon the rapport and setting) with questions like "Is that always the case?", "Do you think there might be an alternative explanation?" and so on, rather than shutting down conversation, actually opened it up. I noticed how some scientists seemed to relax at this point, and really became engaged in the subject as this reflected the style of conversation that they are used to having with colleagues. For some, where their arguments seemed to be inconsistent, when gently questioned about this, very quickly and honestly admitted that their thoughts conflicted with previous statements. Without prompting, they would then set about trying to understand why this might be, and sometimes changed their minds, or clarified in greater detail their original meaning, demonstrating how the thoughts were not as inconsistent as they thought after all.

The second test was to be aware when interviews were no longer throwing up any new thoughts or opinions, reaching a point of saturation (Ritchie and Lewis, 2003; Guest *et al.*, 2006; Bleich and Pekkanen, 2013). I noticed this around interview number 43 and continued until interview number 47 before I stopped. I was able to identify this as the iterative process of creating my coding structure and reviewing my topics meant that I had to frequently review what the data was describing. After the 43rd interview, I found that I had not added anything new to my topics or coding structure, and that the amount of change had been slowing down for the past couple of interviews. As such, I carried out a few more interviews to check that I really had reached a saturation point, rather than just a plateau, and after four more interviews with no additional topics or codes, I concluded that I had reached saturation point. It would be inappropriate to apply any other tests to this data, such as repetition, as they would not provide information on the reliability of the data due to the type of data collected and the context it is collected in (Schreier, 2012).

7. Ethics of interview data collection

As my research included human subjects, the proposed interview method had to be approved by the department as meeting the ethical requirements. This included handling the correspondence with interviewees and their data in a confidential way. Any information in the transcripts that could identify the respondent was redacted, and any quotes in the following chapters of this thesis are given anonymously. I made the decision to anonymise all the comments so as to allow respondents to speak freely, knowing that their comments would be anonymous (Lilleker, 2003). I provided an information sheet in advance of the interview for respondents to review, giving information about the project, why they had been contacted to participate, and whom they should contact if they have any concerns or questions.

In some cases, we touched on fairly sensitive areas, such as when respondents' jobs, and mental health have been at risk, or when talking about subjects that have deeply affected them. In these cases, I made sure that they knew they did not have to speak about those subjects unless they wanted to.

8. Pilot Interviews

I conducted eight pilot interviews which were crucial for clarifying and tailoring my chosen methodologies, and a thorough review of these methodologies was carried out after five pilot interviews.

The key learnings from the pilot interviews were around how interviewees react to me and the subject, and practical elements such as how to organise my time and research materials. For example, it was important to let interviewees know right at the very beginning of the interview that I had a background in environmental science. Dropping this in half-way through an interview was odd and could seem like I had hidden a large part of my identity from scientists. I could visibly see them relax, and many joked about me really being "one of us", rather than a stranger from a purely political background. It also meant that they were able to, and felt comfortable, using scientific terminology and describing experiences relating to policy advocacy that were made easier by the fact that I already had knowledge of the science. During my introductions, I was also able to set the tone of the interview – by being warm and relaxed, friendly, and light-hearted whilst also expressing a confidence and professionality. This was really important to do as the power dynamic in interviews is one that constantly needs to be managed. I noticed that during the pilot interviews, I needed to assert myself a little more in order to guide conversation, and found that this was easier to do once I had to spent more time explaining my background and research purpose, and in altering how I presented myself (Dearnley, 2005). In order to guide conversation to move on to questions that might have "a higher payoff" (Berry, 2002; p680), I created a series of "bridges" in my topic guide that could be used to transfer between topics, or to revisit a subject area to glean more information (Berry, 2002).

The other key learning from the pilot interviews, and one of the reasons for carrying out pilots (Kallio *et al.*, 2016) is that it helped me to establish how long I would need, on average, in order to ensure that I got some useful data from interviews. Anything shorter than 30 minutes meant it was very hard to get any in-depth conversation going. In most cases, save for when I had another interview appointment, I was very willing to talk for as long as the respondent wanted to. As a result, my interviews ranged from 34 minutes, to three hours seven minutes, with the average time being one hour and ten minutes.

Marking these time boundaries and demonstrating an awareness and respect for their anonymity resulted in the respondents relaxing, and often interviews would go well past the hour mark. Most talked as if the recording device was not there – I was only asked to turn it off a handful of times for the scientist to say something that would not be transcribed. It was also important that I factored in time at the end to offer respondents the opportunity to ask me questions. This helped bring a natural close to the interview, and often also stimulated further input from the respondent. This approach attempted to make the interview to "be more reflexive and interactive, aiming to take a non-hierarchical approach which avoids objectifying the participant" (Ritchie & Lewis, 2003; p140).

In some interviews, I produced a copy of my proposed advocacy spectrum for interviewees to give their feedback on. I never started with the spectrum, and only produced it if I felt the scientist had already covered much of the content, so as to not lead them in anyway, but used it as an enabling or projective technique (Ritchie & Lewis, 2003). I also actively encouraged criticism. The feedback was often that it was a very useful tool to help think about different positions that are taken, and the tensions that are felt as a result. As a result of their feedback, I changed some of the terminology used in the descriptors to make the concepts clearer (from "non-engagement" to "non-engagement with policy" and from "policy specific advocacy" to "specific policy advocacy").

9. Summary

In this chapter, I have outlined the various methodologies on offer for gathering data to answer my research questions and described my rationale for choosing my methodologies. I have acknowledged the various positives and negatives of a range of methodologies and described how I have attempted to limit the negative aspects of my chosen methods in my data gathering. I also discussed the ways in which I approached data collection so as to ensure the data I collected was reliable and ethical, and outlined the key learnings that I gleaned from my pilot interviews that helped me mould my interview methodology.

In the next chapter, I shall describe the knowledge I was able to develop from the interviews.

4. What Scientists Think About Advocacy

1. Introduction

In these preceding chapters I examined understandings and definitions of advocacy, the relationship between science, scientists and society, and the main arguments for and against scientists engaging in policy advocacy. The recurring theme is a tension between perception and intention. In defining advocacy, I argued that engaging in advocacy is closely linked to the perceptions of others, because advocacy is not defined by intention alone, but by how others perceive advocacy. Contextual factors have the ability to change the way in which communications are perceived and interpreted, regardless of the intentions of the communicator. However, the theory cannot describe which tensions are more likely to occur, how intensely they may be felt, the effect of those tensions, or the practical ways in which methods can be deployed to successfully lessen those tensions. In order to understand more clearly the tensions related to perceptions and intentions of engaging in advocacy, this part of my thesis synthesises the views and experiences of climate scientists. Below, I explore the key themes that emerged out of my theoretical work and outline how consulting climate scientists will provide a greater understanding, and fill the gaps in the literature.

Whilst I proposed a definition for advocacy, there was the potential that it may still have failed to capture the fullness of the problem of advocacy as experienced by scientists. Part of my consultation with climate scientists helped to ascertain whether I had correctly identified advocacy – what it is and is not - and the different types of advocacy that can exist, as described on my advocacy spectrum. I also wanted to understand how scientists conceptualise and delineate between the different spectrum communication roles, and if they would have similar blurred boundaries as the spectrum. In doing so, I was also able to ascertain how aware interviewees were of the effect of contextual factors, and tried to identify any other contextual factors that I may have missed.

In interviewing scientists, I also wanted to understand how they perceive advocacy and whether they see it as a threat to scientific integrity and credibility. If they did see advocacy as a threat (and likewise if they did not), I wanted to understand how and why they see it as being a threat, and how they think different audiences see advocacy as a threat. I also explored how scientists may have varying views on the acceptability of different types of advocacy, as well as what contextual conditions they may perceive as making different communication roles, as outlined on my spectrum, more or less acceptable. These considerations may result in a climate scientist changing their views on what counts as acceptable advocacy. I wanted to understand what these situations may look like, and what the motivations are for this advocacy or non-advocacy.

As many of the tensions and arguments about advocacy are linked to perceptions of advocacy, I also asked scientists how they try to practically manage and interact with these perceptions, as this is currently lacking in the literature. The analysis of acceptable advocacy will follow in chapter five, and I return to the data again in chapter six to provide a summary of scientists' practical methods for managing the influence of contextual factors when communicating – the first iteration of the 'Robin Hood Training' known as 'Methods for Matching Mapping'.

2. Defining advocacy

Definitions of advocacy, on the whole, fairly closely reflected my definition – advocacy is a plea in active support of something - 'promoting a certain strategy or idea'[1] - in order that others may be persuaded to believe and act the same – 'telling people what decisions to choose'[2]. Some added that advocacy statements are based on 'shoulds' and 'oughts'[3] which are value judgements, rather than descriptions of what is, or predictions of what will happen.

The difficulties came when trying to furnish the definition with an example. Interviewees found that examples of non-advocacy could, upon further inspection and consideration from different viewpoints, be seen as advocacy actions.[4] This demonstrated that advocacy is perceived and understood in a context, not in isolation. For some, advocacy was also defined by the context within which one provides an opinion. If one were asked for an opinion and provided it, that wouldn't be classed as advocacy, but declaring one's views unprompted was seen as advocacy.[5]

In exploring definitions of advocacy, many initially expressed a negative feeling towards advocacy, saying that that advocacy was thought of as 'a bad word' and 'something to shy

[1] Interview 29.
[2] Interview 40.
[3] Interview 10.
[4] Interview 1.
[5] Interview 38.

away from'.[6] As we pressed on to teasing out the specific objections to advocacy, this initial negative reaction lessened somewhat as it became clear that negative reactions to advocacy were actually about actions that, whilst often associated with advocacy, are not fundamental components of advocacy. It was useful to ask about situations where a scientist might be seen as engaging in advocacy, but which might also be argued as not engaging in advocacy. These included certain contexts, such as speaking in the defence of science and applied science.[7]

In discussing what advocacy is not, four main themes emerged: support, advice, biased science, and science communication. There was a strong sense that support, whilst it may be seen as advocacy by some, is not necessarily an advocacy act, as you can lend your support to something without trying to persuade others that they should also lend their support.[8] This persuasion of others is key in defining advocacy actions.

Advice was a lot harder to differentiate between advocacy, mainly because when an audience seeks advice, they are welcoming comment on what it is others think they should do.[9] This appears to be similar to the element of advocacy that seeks to persuade others to believe or do the same. However, the same point about being invited to provide advice was made again – providing unsolicited advice could be seen as fulfilling the 'active plea' part of advocacy. Therefore, unsolicited advice, depending on the circumstances, may appear to be a form of advocacy.[10]

Biased science, stealth advocacy, and manipulation all carry similar definitions and objections – all, for interviewees, refer to the false presentation of the scientific knowledge. This 'bad science',[11] or pseudoscience, is abhorrent to interviewees as it undermines their work by shunning the scientific method. Many also referred to the perception that any engagement in advocacy meant that biased science was present, more than likely fuelled by the scientist's self-interest.[12] Related to this behaviour is stealth advocacy: that a scientist would try and hide the fact that they have produced biased science in support of their own self-interest.

[6] Interview 23.
[7] Interviews 7 and 38.
[8] Interviews 21 and 34.
[9] Interviews 4 and 40.
[10] Interviews 7 and 36.
[11] Interview 10.
[12] Interviews 7, 10 and 47.

This was also seen to be 'as harmful as sitting on important information and not making it public'. [13]

Science communication is not advocacy, although, due to the way in which audiences can receive messages, it may be perceived as being advocacy. At the core of science communication is the view that science is important. This view may not be shared by the whole public, and as such, may sound like advocacy to a public that do not care for science. Similarly, particular areas of science may be seen as being part of a political agenda. For example, attribution studies are often associated with blame, and as such, scientists felt that there was the perception that they were 'pushing for a certain solution' or had 'a vested interest or agenda'.[14] However communicating science is not the same as policy advocacy as it does not seek to persuade an audience to take a particular action.[15] Engaging in science communication was also seen to be less controversial (or tension-presenting) than engaging in advocacy.[16] Indeed, whilst interviewees expressed varying views on their personal duty to engage in science communication (explored further in section four of this chapter), they stated that it was essential work to be done.[17]

Some scientists claimed that their communication was not advocacy, but science communication; disseminating research results, and explaining policy implications:[18]

> *"If, on the other hand, I present a compelling picture of the implications of the science and the implications make it clear that voting for the Democrat is a smarter thing than voting for the Republican, […] that doesn't necessarily have to come across as advocacy, that can come across as the implications of the science and that's a question of the framing and the context in which I as an individual am […] operating."*[19]

However, 'best' or 'smarter' can be subjective. In this case, the scientists were talking about choosing the best governmental policy – in this case, 'best' can only exist within a framework of values outside of science, e.g. social, political, economic etc. Therefore, what they were doing was advocacy, and if they were not explicit in the framework of social, political and economic values that they applied in order to ascertain these 'best steps', or judge what was

[13] Interview 14.
[14] Interview 29.
[15] Interviews 20, 21, 22, 23, 30, 31 and 34.
[16] Interviews 7 and 29.
[17] Interviews 3, 7, 24, 30 and 34.
[18] Interview 21.
[19] Interview 22.

'smarter', then they were also engaging in stealth advocacy. Not being clear about the values one has used in judging 'best' is a problem.[20]

Another tension related to making a judgement in science communication is when scientists assess how successful they have been at communicating. In particular, tension arises when scientists use the audience's reactions and actions as a measure of how well they comprehended the scientific communication: 'surely, if only they understood, they would act in a different way'. This assumes that the audience has the same values as the scientist, or has the capacity to act, or has no cognitive dissonance – all are irrelevant factors to comprehension. The success of science communication therefore needs to measure comprehension, not resulting actions. This also applies when deciding how to simplify complex science for a lay audience to understand – one needs to make sure that when assessing how successful the simplification has been, the assessment does not itself lead to (stealth) advocacy:[21]

> *"So, I think trying to push people towards a certain response as opposed to 'I need to learn more about it and then it's up to my own politics and morality and the rest of it what I do', that is, I think, not something that a natural scientist should do, trying to push people in a certain direction. Even though it's possible we do that subconsciously, I think especially doing it consciously is problematic […] in natural sciences. And I don't think you should do that because if you're trying to consciously push people in a certain way, that is probably coming from your own politics in your own subjective way as opposed to what you know as a climate scientist."*[22]

This tension sometimes occurs in the simplification of science as it often makes use of framing methods. Framing, as discussed in the theory, is the way in which communications are crafted in order that they may be more readily understood by an audience. As such, the choice of frame can be seen as being advocacy, depending on what sort of values and beliefs the frame is engaging with, and how it leaves the audience feeling.[23] Some of the scientists I interviewed talked of how they deployed different frames for science communication, and described how framing is not just about the words that you use, but what you choose to

[20] The next chapter offers some advice on how to clearly communicate which values have been part of the decision-making.
[21] Interview 22.
[22] Interview 31.
[23] Interview 31.

write about, how much space and time you give it, and your tone (both written and in spoken word).[24] Whilst framing is part of good communication and advocacy it does not necessarily mean that the communication is also engaging in advocacy.[25]

When discussing how to understand and define advocacy, interviewees also sought to differentiate between different types of policy advocacy. For example, advocating that scientific research findings should be an important factor in decision making could be described as a policy position. There were also points made about how the content and focus of the science and its explicit application to policy, such as in applied science, could be interpreted as policy advocacy.[26] This proved a challenge to the initial conception of advocacy that many interviewees held. When interviewees sought to define advocacy, they did so from the starting point that advocacy is a phenomenon that can be clearly defined and is solely defined by the communicator. However, when we explored different dialogue contexts, it became clear that advocacy was something different. At this point in the interview, having listened to how scientists were describing a range of advocacy actions and exploring how they articulated differences, I would introduce my advocacy spectrum as a conversational aid, and ask interviewees to provide feedback on whether or not they thought it worked, or could be improved. As a result of our discussions, I was able to understand better the different types of communication positions scientists can take, and tested if the spectrum worked in practice for scientists.

2.1. Advocacy spectrum

The advocacy spectrum was well received, with many expressing that it seemed to describe their personal experiences.[27] It also helped stimulate conversation and provide a framework and language to discuss in greater detail the nuances and tensions of advocacy. Very often I did not manage to complete my explanation of the spectrum or the mapping factors when conversation moved into trying to map actors, audiences, with some scientists trying to draw their own chart to express this.[28] However, none were quite able to express what was needed in order to map contextual factors (as soon as we mapped one, we would discover another dimension was needed to map another factor). Upon explaining my 'mapping factors' it

[24] Interviews 26 and 31.
[25] Indeed, one could argue that all communications are framed.
[26] Interviews 10, 12, 23 and 26.
[27] Interviews 1, 4, 5, 6, 14, 16, 20, 23, 29, 36 and 41.
[28] Interviews 2, 10, 31, 41 all leaped to drawing more graphical depictions.

became clear that these were what interviewees were seeking to graphically express, but that charting them was not possible.

The conversations with interviewees demonstrated that I needed to clarify how just communicating scientific findings maps onto the spectrum.[29] There is a large part of science communication (often referred to as 'SciComm' by the scientific community) that seeks to land in the *non-engaged* section of the spectrum, where nothing about the communication engages in policy advocacy or advice – it just conveys the scientific facts. However, attempts at SciComm can still be influenced by contextual factors, and thus land on the spectrum in different places. As a result of the feedback from interviews, the four areas of the spectrum have remained unchanged, and we explored the characteristics and tensions associated with each category.

Policy advice was seen as a role undertaken when talking with policy makers, and not the general public. This may be because to talk to the public about policy would oftentimes be seen as engaging in advocacy. Indeed, policy advice was seen as something that one would be invited to provide to policy makers, or as part of a job role, particularly for those who worked for government agencies.[30] For interviewees, very often one of the key features for differentiating between policy advocacy and action advocacy was whether or not the scientist was solicited for their policy advice or opinion. Many referred to moments when a policy maker might ask them to provide an opinion, such as on what they thought would be the most important issue to address. These moments could potentially be seen as types of action advocacy as the scientist might be making judgements based on values that are not part of the scientific method.[31]

The difference between action advocacy and policy specific advocacy was something that scientists were familiar with trying to distinguish:

> *"I think it's humanity, not advocacy. I'm not advocating on behalf of a particular political party, or a particular policy, or, a particular solution. I'm saying "I'm a climate scientist and here's what I do, and here's the climate fingerprinting work that we've done, and here's what we've learned in the process of doing that. And here's stuff I care about and this stuff is profoundly impacted now, today, by climate change, and if our understanding is even in the*

[29] Interviews 7 and 19.
[30] Interview 30.
[31] Interview 31.

ballpark, it will be even more profoundly effected over this century, so we've got to decide what to do about it. And there are consequences for things we love and care about of those decisions – to me that is not advocacy, that is simply declaring – here's evidence, and here are my values, and let's have a respectful discussion about what to do about this. I'm not telling you what to do."[32]

"So, I can advocate for a reduction of emissions, but be ambivalent about […] what the best way to do that is. And that's important."[33]

Making this distinction between action advocacy and policy specific advocacy was very important for scientists to do as they strongly felt that engaging in policy specific advocacy was something that caused a lot of tensions and was open to criticism.[34] However, the criticism about scientists engaging in specific policy advocacy was not uniform and was highly dependent upon other factors, which is explored in the next section on acceptable advocacy.

There was a need to clarify what the non-engagement in policy role looked like. This section was sometimes interpreted as meaning non-communication or silence, rather than non-engagement in policy.[35] As such, some felt that refusing to communicate the science was wrong:

"So, I, I think that non... Non-engagement is irresponsible and it's selfish."[36]

However, as I have explained in previous chapters, silence can be seen as a form of advocacy. This role does not necessarily mean silence or the choice to just communicate science in journals – this refers to all communications that seek to be unengaged in policy and refrain from making a political statement, as is often the aim of many SciComm actions. For example, communicating "the sun is a star" is an example of a non-engagement in policy statement.[37] As such, non-engagement in policy may be seen as keeping science 'clean' from politics.[38]

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[32] Interview 24.
[33] Interview 25.
[34] Interviews 19 and 24.
[35] Interviews 7 and 10.
[36] Interview 7.
[37] That being said, a 'sun denier group' may interpret this as a political attack. But for most groups, this would remain a statement not engaged in making a political statement.
[38] Interviews 7 and 10.

Just as silence may not result in non-engagement in policy, silence may not also be considered to be an active plea. Yet curating silence and being careful about what it is they do not say are methods that some scientists deploy in an effort to ensure clear communication. However, many interviewees expressed that silence is not a reliable way for being seen as being objective or *non-engaged,* and that it can sometimes (but not always) be seen as advocacy:[39]

> *"…by my absence of advocacy, by my silence on these topics, I've been accused of being an advocate for the other side, implicitly, […] which is insane."*[40]

These differing interpretations emphasised the importance of one of the central aspects in the design of my advocacy spectrum; the blurred boundaries between roles. This was to reflect that different audiences may interpret a communication in different ways, resulting in the scientist experiencing multiple tensions associated with different positions at any one time. Some interviewees stated that they tried to draw 'a very bright line'[41] between some roles, particularly between action advocacy and policy specific advocacy, particularly when they perceived specific policy advocacy as being unacceptable.[42] Describing these blurred distinctions proved to be a good description of the types of communication positions scientists found themselves in and the tensions they experienced.

As mentioned in the theory chapters, contextual factors contribute to the blurring of boundaries and influence how a communication is interpreted by the audience. Contextual factors are split into three areas relating to voice, content, and audience. Interviewees also identified these areas as having an influence on how communications are received, and may been seen as forms of advocacy:[43]

> *"I think the […] reporting on me and who I am, and on my past behaviour is something that I'm sure colours the opinions of many who have never met me. […] Nothing I could ever do or say was going to redeem me – it would always be some fraction of the population who thought that I was dishonest and had behaved dishonestly..."*[44]

[39] Interviews 3, 10 and 11.
[40] Interview 27.
[41] Interview 24.
[42] Interviews 6, 15 and 24.
[43] Interviews 16, 24, 29 and 31.
[44] Interview 24.

"If a scientist talks about policy or policy options in any kind of a public way, say they're asked a question at a seminar or they write something on the topic on a blog, […] even if it's not particularly pushing for one policy or another, they're assumed to be an advocate, just because they talk about policy and that is not consistent."[45]

"So, I would never ever talk in a universal general way about any of these things because we know that when you talk about trust or credibility, these kinds of questions are always gonna be dependent on the particular setting and the relations that form within any particular setting."[46]

Political context was seen as a key factor in determining perceptions of advocacy. Whilst not an explicit focus of my research, contextual factors relating to the different political contexts of the UK and USA were identified by interviewees. They described different situations where scientists may engage in different types of advocacy, such as in defence of science being using in decision making:[47]

"… one of the reasons why this is so critical now is that we have a government [in the USA] that is intensely ideologically anti-science for ideological reasons. […] And that's another reason why you're seeing more […] science marches and pushback and more and more people speaking up."[48]

It was clear in these interviews that scientists are aware that contextual factors exist, and that the effect of contextual factors is seen to be enough for some scientists to try and steer well clear of engaging in advocacy, lest they be accused of biased science. They were also aware of how these contextual factors change for different audiences. Identifying methods of how to manage the effect of these contextual factors is outlined in section four of chapter six.

Like the literature, climate scientists also struggled to define what advocacy was. This is mainly because when searching for examples, perceptions of advocacy are heavily reliant upon contextual factors. Contextual factors mean that the same example will not always work for every person in demonstrating advocacy. The advocacy spectrum was well received by scientists and sufficiently described the different sorts of roles they can take when communicating with policy-makers and the lay public. By combining the advocacy spectrum

[45] Interview 27.
[46] Interview 39.
[47] Interviews 26 and 46.
[48] Interview 25.

with the understanding of affecting contextual factors, we were able to plot different communications and better understand how they may (or may not) be perceived as engaging in policy advocacy. Armed with this understanding, scientists will now be able to identify why they may experience different tensions and reactions to the ones they were expecting. Later on, chapter six provides practical advice on how to be aware of, understand, and, to a certain extent, control these affecting contextual factors, so as to more reliably be seen as communicating in the spectrum area that the scientist was aiming for. For now, though, after ascertaining an understanding of what advocacy is (and is not) I sought to understand how and when advocacy becomes objectionable.

3. Acceptable advocacy

The acceptability of advocacy for interviewees hinged upon whether or not the scientist was seen as abusing their expert position, or if the science they created or used was biased:[49]

> *"I think the real risk is just the accusation that we have an axe to grind and that you're not being objective."*[50]

This relates to the role of science and scientists in society. Understanding how advocacy can be a source of tension for scientists is important to help them navigate how to fulfil their role in a democratic society. When discussing acceptability of advocacy with interviewees, many referred to views about how science is value-free (or not). This next section will explore interviewee's conceptions of values in science, before moving on to examine how they perceived the role of science and scientists in society and how different types of advocacy may or may not be acceptable in those roles.

3.1. Views on values in science

As I will explain in more detail in the following chapter, biased science is as a result of the influence of unacceptable (often political or ideological) values in the scientific process. Therefore, one way to prove that biased science is not present is to strive to produce value-free science. In the interviews, scientists varied in their views on how value-free science can be, but most were very aware of the places in the scientific method where political or other values might creep in:

[49] Interviews 3, 4, 7, 10, 11, 12, 15 and 24.
[50] Interview 47.

"… you're really trying to get rid of any biases so that you can see the scientific process about reducing the amount of bias so that you can get to the truth but I think also part of the scientific process or part of the scientific journey is understanding that even if you do that, there's going to be some […] bias you need to recognise, even if it's the fact that […] the type of science that you do is going to bias your outcomes."[51]

Some interviewees were of the view that one should refrain from being in positions where their ability to produce unbiased research may be questioned, such as when engaging in advocacy.[52] This demonstrates that there is a perception that engaging in advocacy is a threat to science, but others stated that advocacy need not be a threat.[53] Therefore, even though a scientist may think that advocacy is not affecting their ability to produce unbiased research, others might perceive it to have done so. As such, this is a serious concern for the scientist and a threat to their career; that their peers would not find their science acceptable as a result of engaging in advocacy.[54] If scientists are expected to provide value-free science, then they will face a tension as this is not possible. All that can be asked from scientists is that they provide the most unbiased scientific knowledge they can. How they communicate this knowledge raises questions about the role they are to play in society.

3.2. Role of science and scientists in a democratic society

When discussing the role of science and scientists in democratic society, many interviewees were quick to respond that their primary role was to produce unbiased information, followed by communicating that knowledge to others:[55]

> *"It's not to say that we shouldn't individually be doing lots of things but I think as scientists we have a sort of professional responsibility to provide information in a way that's sort of as objective as possible."*[56]

Whilst acknowledging that there is value in having scientific fields that are completely unrelated to informing actions,[57] interviewees said that they thought the usefulness of science for society was very important.[58] In this sense, interviewees saw themselves as being trusted

[51] Interview 44.
[52] Interviews 16 and 34.
[53] Interviews 14 and 20.
[54] Interview 29.
[55] Interviews 6, 7, 16, 24, 27, 30 and 44.
[56] Interview 16.
[57] Such as experimental mathematics, string theory, etc.
[58] Interviews 10, 15 and 24.

'key holders' to scientific knowledge, and thus having a duty to give access to others so that the scientific knowledge may be of use to them. On a few occasions, interviewees would refer to "The Honest Broker" concept by Roger Pielke Jnr. which provides a theoretical framework for the roles scientists may take when engaging with policy-makers.[59] For some interviewees, being an 'honest broker of policy options' was something to strive for.[60] However, a few interviewees also expressed a frustration that successfully fulfilling the 'honest broker' role is virtually impossible, as one may be seen to engage in advocacy via the influence of contextual factors, as well as hidden or unknown bias.[61]

Whilst it may be impossible for scientists to ever perfect being an 'honest broker', interviewees did have opinions on how particular types of advocacy may not be compatible with the role that scientists should play in society:

> *"And I think there's a very fine but obvious threshold where scientists sometimes need to stop and I think the purpose, especially in the arena of climate change, is to provide the evidence to inform a policy. I don't think it's the job of a scientist to tell the politician what to do unless specifically […]the politician says what should we do, then obviously we have a personal viewpoint of what we should do but scientists aren't elected, so it's not up to scientists to say the UK should do this or that. It's the job of the scientific field to present the evidence to the policymakers and to step back and to keep their mouth closed when it's not their job to […] tell an office what to do."*[62]

Other interviewees described how they refrained (or witnessed others refraining) from engaging in advocacy as they did not want to risk losing trust (mainly from their colleagues, rather than from the public).[63] However, interviewees found it more difficult to describe a principles approach to this in practice, not least because of the close relationship between policy and scientific research.[64]

The concept of unsolicited advice, or 'speaking out of turn', was also raised by interviewees

59 As I will explain in the following chapter, I think this framework fails to capture what happens in practice but has provided a useful tool for thinking about approaches.
60 Interview 22.
61 Interview 10.
62 Interview 36.
63 Interviews 10 and 11.
64 Interviews 25 and 36.

when trying to define acceptable advocacy. For these interviewees, policy advocacy was only acceptable when it was expressly solicited by the audience:

> *"But my rule of thumb and my strong conviction is that as a scientist it has to be invited from the policymaker, especially when it's deviation. When it's deviation into policy formation, it's got to be the government saying, what do you think about this policy or we want to make a policy to do this, in your opinion how can we do it? In my opinion it can't come… I just don't think it should come from the scientist."* [65]

Other interviewees pointed out how this approach fails when presenting new science. This might not be in response to any policy question. For example, in the case of the ozone hole, a new problem was identified by the science, brought before policy makers, and new policy was made accordingly. It is not necessarily the case that any advocacy was engaged in by the scientist here, so just 'speaking when spoken to' fails to fully define what count as acceptable advocacy.[66] Similarly, speaking out in the defence of science, and correcting incorrect scientific statements was seen as acceptable advocacy, and does not require invitation from policy makers to be acceptable. This was also seen as a core part of scientists' role in society which I shall expand upon in section 3.4 of this chapter, when I cover how scientists viewed their role in society. For now, I shall return to the two objections made against advocacy. Each is presented as a reason for why it is unacceptable for scientists to engage in advocacy: (i) advocacy threatens scientists' credibility and the integrity of science by producing biased science, and (ii) advocacy results in scientists abusing their authoritative role as 'key holders' to scientific knowledge.

3.3. Biased science

Interviewees reported that merely the suspicion of biased science may be enough to call in to question the science's credibility and integrity.[67] Therefore, some interviewees deemed advocacy that resulted in calling into question the credibility and integrity of the science as being unacceptable.[68] However, as I shall explore in the next chapter, the presence of advocacy does not necessarily mean that biased science is present – it is difficult to see how a scientist's research would be biased as a result of their advocacy in defence of science, or advocacy on a policy topic unrelated to their scientific expertise (for example, for local green

[65] Interview 36.
[66] Interview 44.
[67] Interview 6.
[68] Interviews 3 and 6.

spaces, for better access to healthcare, or against a building's demolition). Scientists may also be accused of creating biased science without ever engaging in any form of public communication. When questioning interviewees further on biased science, it became clear that the core concern was related to losing credibility.

Interviewees were keen to tie a scientist's credibility to the scientific research that they are doing. Credibility fundamentally depends on the quality of their scientific research. Biased science is not science at all, and therefore if the scientist is found to be engaging in biased science, they will lose all credibility. In this way then, advocacy need not threaten a scientist's credibility so long as their scientific research is shown to be unbiased and credible. Yet, for some scientists, the concern remains that the 'mud will stick' when engaging in advocacy: that they will not be able to persuade people that their science is not biased and therefore credible.[69] Some were concerned about the damage that the mere perception of biased science might cause to the credibility and integrity of science, and therefore preferred to avoid advocacy altogether:[70]

> *"Because what we're protecting is much more valuable than anything […]I think the most important thing is to make hay in the integrity of science […] Because it makes the world better. And in the long term that is really what's gonna make a difference. In the short term, yeah, we might be able to take some shortcuts and push something here and push something there but that doesn't matter."*[71]

Interviewees were aware that establishing credibility with the public differs from establishing credibility with their peers. The public are reliant upon the scientific community to signpost credible expertise, and thus credibility is identified and established in a different way with the public, such as through tone and institutional affiliation.[72] Other interviewees thought that credibility with the public is established by maintaining the 'reputation' science has for being free from political influence,[73] and that advocacy would put this at risk. Indeed, some suggested that this relationship between advocacy and political bias in science is raised by those who do not like the implications of scientific research, and thus seek to discredit the science via accusations that the research scientist is biased because they engaged in advocacy:

[69] Interviews 3, 26 and 30.
[70] Interviews 3, 30, 34 and 47.
[71] Interview 7.
[72] Interviews 4 and 12.
[73] Interview 16.

"It's an us versus them and you need to automatically discredit scientists that you perceive as on the them side and also you're discrediting the scientist, not critiquing their arguments."[74]

Examples of these accusations are prolific, and many were given by interviewees in reference to their own experience, and that of their colleagues.[75] One common line is that scientists are exaggerating, or have concocted part or all of the climate change 'conspiracy' in order to make money.[76] Interestingly, the subject of advocating for funding highlighted another area where advocacy and bias was acceptable, so long as it did not influence the outcome of scientific research (which is the accusation some climate deniers make).

Advocating for funding is something all scientists were familiar with. As such, the act of engaging in advocacy for funding is not seen as being particularly controversial (depending on how scientists do it).[77] Whilst policy makers and funders do take advice from scientists on what new research needs to be undertaken, some interviewees raised the concern that research may be undertaken merely to raise the profile of a scientist by addressing questions that are popular, but may not actually be a novel contribution to scientific knowledge.[78] Scientists may engage in self-promotion, and there may be a temptation to over-state the importance of their research in order to get funding. For some interviewees, the more concerning aspect was the influence the funding source might have on the direction of the scientific research. This was so much so that they would completely dismiss research that was funded by particular groups:[79]

"Frankly, the best predictor of a biased paper has nothing to do with the opinions of the authors, it has to do with the funding source and the acknowledgements. […]It has to be in the acknowledgements, right, like where the funding comes from. But nobody talks about that."[80]

There was also the concern that some science may only engage in particular types of research because there seems to be funding for it. This in itself is not necessarily controversial, but if there were some concerns about the ethics of the research, or what it is the funder intended to do with the knowledge, then this could be seen as the scientists condoning such actions:

74 Interview 27.
75 Interviews 5, 6, 9, 10, 11, 21, 24, 26, 27, 34 and 42.
76 Interviews 6, 11, 12 and 16.
77 Interviews 4, 6, 16 and 26.
78 Interviews 29 and 44.
79 Interview 20.
80 Interview 12.

"I was just at the TED conference last week […] And so there's all these billionaires who are like "where should I put my money? Like how do I call climate change?" […] But they don't wanna fund the basic research. They want to fund […] the solutions. […] And I think they're very vulnerable. They're kind of like charlatans - people who are like "I have this nuclear reactor" or "I have this geoengineering solution" and so that kind of scares me. And so I do feel like even though I'm not in the energy policy space, […] I should warn them that it's not gonna be this simple. But, you know, not having expertise in that particular area, it's a tough line to navigate, you know?"[81]

Interviewees also expressed a concern that engaging in policy advocacy may pose a threat to a scientist's ability to obtain future funding, if their advocacy position is seen as being against the funder or the funder does not want science they fund to be associated with any form of political position.[82] Similarly, if the scientist hides their funding source and does not clearly demonstrate how their conclusions were not biased because of their funding, then they may be seen as pushing a particular agenda.[83] Therefore funding is also seen as a mechanism by which scientists can be held accountable – many said that as their science was funded by public money, that the public have a right to know what it is they discovered:

"There's not many ways we can be held accountable to the public, but you know funding is one of them."[84]

Whilst advocacy for funding carries tensions, the acceptability of engaging in policy advocacy also seemed to differ depending on upon how a scientist was funded, with some expressing a sense of duty to communicate in a way that did not engage in advocacy: [85]

"people who are academics I think […] it's easier probably for them to express their opinions a bit more freely. […]Because … they're not so directly funded by policy makers. So perhaps, because we're funded by policy makers, you sort of feel the science should be absolutely neutral, so that you haven't perhaps had a bias to that extent. Yeah. It's not something we necessarily talk about."[86]

The civil servants that I interviewed often described themselves as having greater restrictions

[81] Interview 11.
[82] Interview 35.
[83] Interviews 2, 20, and 26.
[84] Interview 44.
[85] Interviews 1, 24, and 36.
[86] Interview 43.

on what it is they could and could not say. Some referred to the rules that they have in their contracts, like periods of pre-election 'purdah', where they are not allowed to publish certain papers or results, or other restrictions where they cannot identify themselves as an employee of that organisation whilst publicly communicating.[87] There was also a sense that because of their role as civil servants, they have even greater demands to be seen as being non-partisan and in the service of policy-makers, and therefore risk more if they were to engage in policy advocacy:[88]

> *"I think that if I was not involved in the XXXX and in work for the XXXX government, I would feel a lot freer to advocate as a scientist but because those two roles are important to me, I feel that I don't want to risk the perception,[…]especially given the number of sceptics out there, a perception of distrust of the painstaking scientific work done by my teams over the years if I were to go out and actually advocate. So, that's why I stay away from that."*[89]

As such, many interviewees held the view that scientists in academia have more freedom to express their views without risking their job:[90]

> *"And I raise that because the distinction between someone who works at a university or a federal agency and somebody who works in an independent research institute is an important distinction in maybe both the perception of what they're allowed to do but also the ethics and legal issues around what they're allowed to do or what people think they should be doing. And specifically, it has always given me enormous freedom to do what I want to do, both on the research side but also on the public communication side."*[91]

Biased science is categorically unacceptable to all the scientists I interviewed. The accusation of biased science is therefore taken seriously, and scientists go to great efforts to avoid having that accusation made about their research. This avoidance includes steering clear of advocacy for some scientists, particularly those that work for governmental agencies. However, avoiding policy advocacy does not guarantee that accusations of biased science will not be tabled – for example, in putting in funding bids for research, or in naming the source of the scientist's funding. These concerns can be allayed in many ways, as explored in the next chapters on values in science and in the practical methods scientists raised in interview.

[87] Interviews 1, 6, 17 and 35.
[88] Interviews 6, 10 and 47.
[89] Interview 34.
[90] Interviews 6, 12, 15 and 47.
[91] Interview 25.

However, there is a second concern about advocacy in that scientists risk abusing their position in society if they engage in it.

3.4. Authority and abuse of position

Another area for concern is that scientists who engage in advocacy risk abusing their position. Interviewees said that scientists, by virtue of being key-holders to scientific knowledge, enjoy an authoritative role in society as experts in particular areas. Unacceptable advocacy may abuse this authoritative role by claiming authority in areas where they are not an expert, in an attempt to strengthen their arguments.[92] Typically, this abuse of advocacy occurs when the scientist is seen to be speaking out on topics that are not related to the scientist's expertise, and does so in such a way as to garner the same effect as if they were; they are trying to sound like an authority on an issue that they do not have authority in.[93] Indeed, as well as being unacceptable, some saw this action as actively working against the credibility of the scientist even within their area of expertise:

> *"And what's troubling I think is when people fluidly move across boundaries without declaring "I have expertise in this area, and not in that area" then it diminishes your credibility in areas where you do actually have um scientifically grounded expertise."*[94]

This 'overstepping' may look like a scientist using their expertise as giving authority to state how urgent an issue is in comparison to other issues – including issues that they do not have any expertise in. Respondents held that it is the job of the scientist to represent the scientific knowledge when giving policy advice, not their own beliefs (unless expressly asked for them – and even then, they should be careful in how they express these views).[95] Many repeated the IPCC statement "policy relevant but not prescriptive".[96] Therefore, if there is uncertainty in the science, or there are dissenting views within the community, failing to mention these may be a form of stealth advocacy or manipulation by the scientist - essentially creating a form of biased science by presenting only one side of the scientific view.[97]

For interviewees, tensions arose when a scientist wants to exercise their rights and duties as a citizen, whilst also managing their role that they have as a scientist. A perceived abuse of

[92] Interviews 7, 19, 24 and 36.
[93] Interviews 10, 21, 24 and 26.
[94] Interview 24.
[95] Interviews 10, 26, 34, 36 and 43.
[96] Interviews 19, 34 and 45.
[97] Interview 14.

position as a scientist may prevent them from acting in this role in the future – or at least being recognised as acting with credibility. As we will explore in section three of chapter five in this thesis, theories exist for how scientists can differentiate between communicating as a citizen and as a scientist to manage these tensions. But first, I shall describe in greater detail the tensions that interviewees described and what the source of the concern is.

Expertise was mentioned by practically every interviewee, particularly when trying to understand the difference between acceptable and unacceptable advocacy. Yet expertise is also something that is difficult to define. Whilst closely linked to other characteristics, expertise was seen as the main defining feature between acceptable and unacceptable advocacy for interviewees.[98] Advocating solely on subjects within the bounds of your expertise was deemed acceptable.[99] For example, a water-ecology expert advocating for lower levels of toxic chemicals in run-off water. However, real tensions arise when scientific experts are seen to be advocating for policy positions that are informed by opinions on topics outside of their expertise, such as when a meteorologist is advocating for a specific type of carbon tax.[100] Being able to define expertise is therefore important for identifying when someone is no longer speaking on topics bounded within their expertise. However, defining expertise is hard to do because, to some extent, it is always contextual, and reliant upon the knowledge people possess in comparison to one another. In this sense, some interviewees saw the boundaries of expertise as being very blurry:[101]

> *"On most of these things you're reporting hearsay that your friends have told you or something you read in a paper and I talked about this with the staffers and they said, well, you might not think you're expert on all these things but you know a lot more about all these things than we do. So, their attitude was relative to us you're an expert but relative to real experts, you're not."*[102]

However, defining expertise was quite hard to do as interviewees were aware that they may be seen as an expert in a topic compared to other non-experts, but feel that they were not actually expert in that topic.[103] Some suggested that humility was needed in making sure

[98] Interviews 1, 4, 14, 23, 25, 30 and 31.
[99] Interviews 3 and 10.
[100] Interview 30.
[101] Interview 10.
[102] Interview 26.
[103] Interviews 7, 10, 11 and 26.

scientists did not overstate their area of expertise,[104] and others suggested that having a PhD in a subject area was the absolute minimum requirement in order to claim any expertise in that area.[105] When I asked about understanding a spectrum of expertise, or assessing how one scientist could be more expert than another, interviewees moved to talking about having increased credibility, integrity, publishing in more highly regarded journals, having more citations, and other career progressions. These are all listed as evidence of possessing expertise. Expertise can mean both the act of narrowing down one's area of study and becoming more highly regarded as an authority in a subject area. A scientist can be considered a 'greater' expert when their area of expertise increases to cover a range of areas: expertise is therefore related to the breadth *and* depth of knowledge, with deeper and wider knowledge being seen as 'greater' than narrow but deep knowledge, or wide but shallow knowledge. Breadth and depth of knowledge, therefore, can only be assessed in comparison to others.[106] However, creating measurements such as possessing a PhD in a subject area provides a way in which to judge the evidence of expertise without needing a contextual comparison.

Whilst the boundaries of expertise may be blurred, interviewees did identify ways to distinguish between a lay-person with lots of knowledge and an expert. Having a doctorate in the field is seen as a minimum requirement for defining expertise, as well as being published in reputable journals.[107] Qualifications and publications are usually the basis on which scientists make the judgement about ranges of expertise. However, due to the scientific training and understanding a scientist has, they may also be able to understand science outside of their area of expertise. Speaking about other areas of science can therefore still fall within the scientist's area of 'expertise', but only to a certain extent. Interviewees expressed that leaning on other experts' expertise (i.e. quoting others) was a way to navigate the difference between areas of expertise. Similarly, speaking about other areas of science is acceptable, but only if what is being said is a fair representation of the expert consensus in that field. If the scientist were taking a view that was not the consensus view and did not declare this, then it could be seen as stealth advocacy.[108]

[104] Interviews 11, 14 and 39.
[105] Interviews 3 and 26.
[106] Interview 10.
[107] Interview 40.
[108] Interviews 4 and 31.

Related to speaking on issues outside of the scientist's area of expertise is when scientists make a claim as to how important an issue is. Importance, much like expertise, is contextual. Some interviewees saw that advocacy could threaten the credibility of scientists if they were seen to be single-mindedly advocating the importance and impact of climate-related issues.[109] This is not to say that climate-related issues are not important, but that an ignorance of other pressing issues, and the decision-making context for policy-makers and the lay public, could make the scientist appear unreasonable, and abusing their position in forcing their opinion. However, this is an issue with *how* a scientist engages in advocacy, not necessarily a problem with the advocacy itself.

Having an opinion about the importance of an issue is acceptable, however, as scientists are still citizens. They have their own values, and as such may have a desire to voice their opinions or engage in advocacy. However, they need to be careful that they do so in the right arena – expressing their views as a citizen whilst operating in the authoritative role of being an expert is problematic for scientists, as explored above. An abuse of position is not acceptable. Interviewees described a need to differentiate between speaking as a citizen and speaking as an expert in order to be able to voice their views.[110] This is because they were primarily concerned about the ethics of managing the amplification that expertise seems to provide to statements:

> *"That's why you're being interviewed, because you're a scientist, not because you're a random citizen they pick off the street. So, it's a challenge. 'Cos even if you do make that explicit […] your words are still gonna be having more weight."*[111]

Some expressed uncertainty around whether or not they could operate in more than one role – that by becoming a scientist, they may be 'forfeiting' the right to voice their views as a citizen on subjects related to their science:

> *"Or do you forfeit that right? […] And you're paid by the taxpayer, are you not forfeiting in some way your right to then be really…? I don't know."*[112]

Part of this uncertainty about operating as a citizen and a scientist was related to the fact that it can be quite difficult to differentiate the two. It may not matter how much the scientist

[109] Interviews 7 and 26.
[110] Interviews 4, 10, 11, 12 and 36.
[111] Interview 36.
[112] Interview 17.

emphasises that they are making a statement as a citizen and not as an expert, an audience may still see them as being an expert and still view them as an authoritative figure.[113] Therefore the tensions scientists experience are related to how to manage and communicate the values behind their statements.

Interviewees strongly believed that honestly stating one's values and reasoning for a particular advocacy position were important for ensuring that one was being heard as a citizen, and not abusing one's authority as an expert.[114] However, different tensions will be experienced depending upon whether the values that the scientists are stating are widely shared with the audience or disparate. For example, 'don't murder' is widely shared, whereas 'only the very rich should pay taxes' is quite disparate. Advocacy based on widely shared values are likely to be seen as less controversial than advocacy based on disparate values.[115] However, identifying shared values may not be straight forward. There is a danger that shared values are identified, but only from a fairly homogenous group, limiting the extent to which the value can be claimed to be shared:

> *"One challenge is what if the [..] the population of values within the scientific community is not represented in the population of values in society as a whole? Then we have an issue. Because then we have an elite that is isolated. […] [T]he academic system, does create and does filter for different values."*[116]

Therefore, if scientists are engaging in advocacy based on the assumption that their values are widely shared, when in fact the values are not, they may be surprised when their advocacy is seen to be controversial.

Another area deemed as acceptable advocacy by scientists was when the advocacy is related to a topic that is obviously not related to the scientist's area of expertise. This is because suspicions about biased science or an abuse of expertise are lessened as the subject is far enough away from the scientist's area of expertise that those values and opinions are seen to not influence how the scientist does their research:

> *"Maybe if I was working on, for the sake of argument, volcanology, right, which really hasn't got anything to do with climate change except the role of volcanoes affecting the climate, I*

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113 Interviews 1 and 10.
114 Interviews 6, 7, 10, 11, 12, 14, 20, 23, 24, 29, 31, 33 and 44.
115 Interviews 10, 14 and 30.
116 Interview 7.

probably would think that it would absolutely not matter at all if I started a blog on climate change and become an advocate, because I would be quite separate from what I did professionally. […] Because it's so close, I feel that there would be a danger of compromising the perception in all the work that I have ever done on this."[117]

However, advocacy on subjects unrelated to the scientist's expertise does not guarantee that their credibility or independence is not called into question. There remains the risk that the advocacy and values the scientist state are seen as being incongruous with the scientific method, such as making ill-founded claims or abusing uncertainties.[118]

At the other end of the scale, there is applied science (or mission-driven science), where the policy advice and scientific expertise are combined, and the advocacy subject matter is very much within the scientist's area of expertise. Here, science is created in order to specifically answer questions relevant to policy making or applying existing scientific knowledge to policy questions. In this sort of science-policy relationship, the values have already been set in setting the question – for example 'we want to take action on climate change, but which is the best way' already has a set value of 'we want to take action on climate change'. But values can still play a role in choosing the policy pathway to achieving that 'best' outcome. As such, applied science can very quickly come into contact with values-based decisions and tensions:

> *"If I talk about attribution, […] then there's a perception that you're pushing for a certain solution that you're advocating, that you have a vested interest or an agenda. And so in a way a lot of what I was then doing was just trying to understand the policy space and what was going on in other people's minds and ended up doing this like social science study in order to try and see where our science could fit in."*[119]

Most interviewees found that climate change research was often employed in answering policy questions, and that some values judgements did underlie their research, with some even saying that the point of their research was for it to be applied.[120] As such, they were

117 Interview 34.
118 Interview 4.
119 Interview 29.
120 Interviews 21, 25 and 26.

also conscious that there may be ethical implications to the way in which science was applied, such as the social impacts of using particular technologies.[121]

Interviewees saw it as part of their duty as a scientist to advocate in defence of science, such as when a policy maker may be misusing science to support a particular policy position.[122] This type of advocacy defends scientific consensus, and speaks out against the misquoting of science, as well as advocating that science be part of policy making decisions – that policies are evidence based:[123]

> *"My job is not to promote climate action, my job is to defend science. That is my number one."*[124]

Interviewees were aware of how this sort of advocacy could still be controversial for some audiences,[125] and expressed that advocacy for science may easily slip into other political commentaries that are not solely about the defence of science. For example, interviewees described some caution towards the 'March for Science' movement in the US:[126]

> *"I was really uncomfortable with the March for Science and didn't participate and it has to do with the fact that I'm concerned about aligning science with a specific ideological perspective. I think they've managed to do it in a fairly neutral way but if you look at the original pictures from the March for Science, there were a lot of anti-Trump signs, all these kinds of things that I really wonder whether or not that's what we wanna do as a scientific community […] Sure, if citizens wanna do that, that's fine, but as a professional scientist, what is appropriate in terms of participating in that? I stood on the side-lines and there's a part of me that wants to be out marching on the street but that is a very specific protest that I won't participate in."*[127]

A few interviewees mentioned that policy makers had directly asked them for their views on policy options.[128] However, interviewees were split on whether or not they thought it was acceptable to provide their personal opinion or not, often citing that it depends on the circumstance, the relationship with the policy maker, and how explicit the scientist is about providing their personal views.

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121 Interview 39.
122 Interviews 5, 6, 11, 24, 25, 31, 36, 38 and 42.
123 Interviews 5 and 36.
124 Interview 7.
125 Interview 16.
126 Interview 17.
127 Interview 16.
128 Interview 26.

The lay public's view of acceptable advocacy is related to their views of what science is and is valued for. One interviewee said that they found the public liked to hear certain statements, delivered with confidence and unequivocalness, as this is what the public see as being credible science.[129] Interviewees also discussed the difference between speaking at a public event and speaking to their friends and family. Most expressed that talking with close acquaintances about their policy preferences was acceptable, in large part because their friends are likely to know a lot more about them and their views on other things, and the scientist is not concerned about losing credibility because there is an established relationship.[130]

Interviewees said that they were most concerned with losing credibility with their scientific community, whose opinions are perceived to really affect their careers and credibility. They were fearful of being accused of getting the science wrong, and also of others speaking out incorrectly and damaging the credibility of fellow experts who work in that field:[131]

> *"It's better now but I think the reason why people don't want to talk out of science in part is not so much because they might do mistakes, […] [it] is the pressure of the research community, that they might make a mistake and people will hate them for that."*[132]

They even spoke of how the scientific community had approached them about their communications and accused them of engaging in unacceptable advocacy or presenting science in a way that would 'fuel climate sceptics':

> *"I've gone beyond this. I mean, people can hate me, that's okay, but I've been in tears several times in my career from… I remember two instances in particular where I was literally attacked, once publicly by a senior member of the research community […] He didn't mention me by name but it was clear that he was talking about me and my mates of the XXXX and he said that we were just doing this for exposure and fame and that we didn't know what we were talking about[…] it was really, really sort of shocking for me. […] I think it's the own community that does not support communication."*[133]

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[129] Interview 4.
[130] Interview 31.
[131] Interview 4.
[132] Interview 30.
[133] Interview 30.

Interviewees also commented that when scientists do speak outside of their area of expertise or start developing knowledge in areas outside of the natural sciences, they feel as if they are seen to have sullied their natural science work. By engaging in subjective activities, and therefore being perceived as not being cut out to be an objective scientist, they were getting involved in lesser pursuits because it was not natural science.[134]

Advocacy also appeared to be acceptable when it was advocating action based on more certain science as this was seen to be less of a threat than advocating based on very uncertain science. The perception is that more certain science has withstood the scientific community's testing over time, and thus has had more time to be proved incorrect or biased.[135] However, as mentioned in the introduction of this thesis, climate science by its very nature will certainly always be uncertain. This is all the more so as more is found out about climatic processes and variability. Interviewees felt that non-scientists did not understand this about climate science and that audiences therefore found climate science hard to trust because it is understood as being uncertain.[136] Interviewees felt that a non-scientist's perception of scientific progress was also different in that it saw correction as weakness and a failure in science.[137] As such, interviewees discussed the role of communicating the scientific consensus. Consensus building was raised in several contexts by interviewees and has been an important way by which scientists manage and reduce several types of tensions, as I shall now explain.

4. Reasons for engaging in advocacy and communication

Some scientists cited ethical concerns as a motivation for how they chose to communicate their science. For some, they felt that it is unethical to not communicate the social utility of their research,[138]and others said their main focus was to be a good scientist, and that means to do science well and should not be motivated about achieving social change:

> *"We have a graduate programme here and we get applications from graduate students every year and some students, they'll write essays "why I wanna be in the field" and some students write essays that they're really motivated by some social aspect of things and others are so interested in understanding how things work, the nature of things, but I have to say I am better disposed towards the people who are really interested in how things work 'cos I think that's just a*

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[134] Interview 30.
[135] Interview 14.
[136] Interview 2.
[137] Interview 1.
[138] Interview 5.

fundamental lifelong curiosity that's just fundamentally robust and if your primary motive is in science applications, that's really important stuff but I'm not sure that maps onto being the best possible scientist".[139]

Associated with this is the situation that many 'older' scientists find themselves in: they began working on climate change before it was a hotly discussed topic, and now they have communication demands made of them that they feel unable to fulfil.[140] Some scientists said they feel they should speak up more, but that they cannot do so until they retire.[141] Age was also identified as a mechanism by which motivations may change:

> *"The older you get you're more likely to have children and you're more likely to have a longer view of history, you're more likely to look outward rather than inward and that's my case. […] You know, Jim Hansen talks about his grandchildren. So, I think those are all factors in why maybe a lot of us [advocates] are somewhat more senior scientists."*[142]

Stating values, again, became a key aspect in motivations. There is a difference between communicating motivations for engaging in research and motivations for engaging in advocacy:

> *"I mean, I think simply discussing climate science in the context of one's faith is not advocacy. It depends what the context is. It's like if it's "my faith reinforces carbon tax in the US next year", that's advocacy. If it's "my faith makes me care a lot about the world and concerned about these broader trends in global temperatures that I study as a scientist", I don't think that's necessarily advocacy, it's just explaining your science and your research."*[143]

One particular type of motivation described by scientists were the obligations they felt they had to fulfil as part of being a scientist. Many expressed that there was a duty to communicate their science, particularly if their research is funded by the public.[144] Some interviewees wanted to differentiate between obligations on the scientific community, as a whole, and obligations on individuals. Whilst there may be a duty on scientists to communicate, that communication can be performed by the community, rather than each individual scientist:[145]

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139 Interview 4.
140 Interviews 9 and 10.
141 Interview 9.
142 Interview 25.
143 Interview 19.
144 Interviews 10, 15 and 24.
145 Interview 14.

"It's up to every individual to make a decision for themselves whether they want to play a role in speaking out on any subject and advocating anything. I have no criticism, no criticism at all of my colleagues who do not speak out. Some of them are in positions where they can't, some of them aren't good at it, some of them don't want to. That's completely fine from an individual perspective. I do believe that the climate science community as a community absolutely has a responsibility to speak out […] especially when it's a topic of global critical importance. Then it's more important that the community figure out a way to participate in […] policy advice, action advocacy and specific policy advocacy."[146]

Many scientists felt that there was an obligation, to a certain degree, to communicate their science, and to advocate for change, when the science showed that there was going to be harm: to not say anything in the face of knowledge that may make a difference was considered to be unethical.[147] Others were keen to also express the extent of this duty – that they believed it did not require scientists to convince people of the harm, but to merely communicate that there was harm:[148]

"But then people go, "if you're aware of the seriousness, you have a duty to tell people to do something". I'm like, no, you haven't. […] As a scientist it's a duty to give a public information talk, and I do, but then as uncomfortable as it is, […] it's up to people as individuals to then form decisions that then vote people into power."[149]

There were other obligations that were seen as part of being a good scientist, such as correcting false statements, being a reliable source, making sure they were understood correctly by their audience, and, as already mentioned above, in defence of science.

The duty, or obligation, of speaking out against false statements, or those using science incorrectly to bolster their arguments, was something that interviewees felt very strongly that they should do.[150] This duty to speak up and correct false statements was seen to be divided amongst the scientific community; each scientist fielded mischaracterisations in their own

[146] Interview 25.
[147] Interviews 6, 10, 14 and 38.
[148] Interview 44.
[149] Interview 31.
[150] Interviews 6, 11 and 24.

"intellectual wheelhouse" as "there are not many other people who are in a good position to rebut the incorrect claim" [151], and therefore may have greater responsibilities to do so.[152]

Related to correcting incorrect claims is responding to climate deniers. Although there was concern that this is a waste of time and energy, it was nevertheless seen by some as important for scientists to do.[153] Interviewees felt that it was important that scientists try to communicate well, and are careful in how they communicate and frame their science so that they limit, as best as they are able, the opportunities for misinterpretation of their science (and therefore avoid having to correct false statements):[154]

> *"There are some people who say "it doesn't matter that I was misquoted, it doesn't matter that I didn't give that context" […] "other people can misinterpret things and it's their own fault for misinterpreting things, and all those bad things that happen because of people misinterpreted what I said, that's not my problem that's their problem". Except that, if that was not predictable, then you'd be correct. If it was totally unpredictable that that piece of information would be put into the public realm was not going to misused by the same people that always misuse this information and not be transmitted to the people that are really trying to undermine everything that you do, […] I am able to see the consequences of my actions and if I can see the consequence of my action and I do nothing to prevent that, then I am culpable. If you can predict with some certainty what will be taken out of context and used against you, or used against the values that you support, you absolutely have an ethical duty to try and head that off".*[155]

This has implications for the intention of scientists' communications and might indicate that they need to take action (or possibly a level of responsibility) for trying to account for the influence of contextual factors on their communications. Relatedly, framing communications was also considered by some as related to ensuring clear communication - making sure that science reporting is framed for comprehension, and not to smuggle advocacy positions:

> *"But how do you also provide a narrative so that people have an understanding of what it's like to lose everything in a hurricane? […] [T]here's a lot of scholarship on how people deal with risk and*

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151 Interview 24.
152 Interview 38.
153 Interview 25.
154 Interview 21.
155 Interview 10.

whether they confer risk properly but I think that it is important to make sure that […] there's a sufficient narrative frame there so that people actually get what it means."[156]

5. Summary

The data from my interviews show how interviewees conceptualised advocacy, the tensions associated with it, and what counted as acceptable and unacceptable advocacy. Interviewees offered many definitions of advocacy, but their feedback about my advocacy spectrum was that it worked very well at explaining the different communication roles that exist for scientists, and the types of advocacy that interviewees were trying to describe, as well as the tensions they have witnessed. This included understanding how silence is seen as a form of advocacy and how the boundaries can be blurred between these roles depending on contextual factors.

Whilst most scientists seemed alive to the fallacy of the value-free ideal, many still talked about how interactions with policy makers and the public seemed to reflect this view. Being accused of creating biased science was a great concern for scientists, and it was seen to be quite a career-damaging accusation for many. This can only be guarded against by evidencing that one's science is not biased. Evidencing this includes being open about who funds the research. Those that worked in the civil service felt that they needed to make extra efforts in comparison to researchers in higher education to avoid engaging in actions that would raise the suspicion or concern about biased science.

Interviewees also expressed great concern that engaging in advocacy may be seen as an abuse of position. They were quick to tie this to the area of their expertise. Advocacy that existed *solely* within their area of expertise was acceptable *so long as* they could demonstrate that their science was not biased. However, this is a rare situation as often points of advocacy touch upon areas that are outside of one's area of expertise, particularly if it relates to a particular policy. Therefore, advocating outside of one's area of expertise whilst using their platform as a scientist was seen as an abuse of position. This was further abused if the scientist tried to claim expertise that was not theirs or did not explicitly state that they did not have expertise in this area. Advocacy outside of the scientist's area of expertise that referred to theories *outside* of the consensus in that subject was also deemed to be concerning, unless the scientist stated the value judgements they made that resulted in advocating a non-

[156] Interview 22.

consensus view. Interviewees demonstrated an awareness that the acceptability of advocacy differs depending on the audience and the perceptions that audience has of science. Often, it is the perception of their scientific community that scientists are most concerned about.

Many interviewees expressed that engaging in advocacy as a citizen was acceptable for a scientist to do. However, they were also aware that they may always be perceived as a scientist. Advocacy in the defence of science was also seen as acceptable, and indeed a requirement of what it means to be a good scientist. Motivations were therefore a key part of assessing how acceptable advocacy was. This was particularly when the scientist felt duty bound to engage in advocacy to alert the public to a concerning issue and correcting the misuse of science. Some interviewees also felt an obligation to make sure that the science was correctly understood by non-expert audiences. As such, framing communications did raise concerns about advocacy for interviewees as they were concerned about how different audiences might receive different frames, via different communication methods. But framing was seen as an important way for facilitating audience understanding of science.

The recurring theme in these interviews is that there is a tension between perception and intention. Indeed, interviewees struggled to clearly define acceptable and unacceptable advocacy, as any definition could be countered by an example which embodied all those defining characteristics, and yet would be considered the opposite. In defining advocacy, I argued that engaging in advocacy is closely linked to the perceptions of others because advocacy is not defined by intention alone, but how others perceive advocacy. Contextual factors have the ability to change the way in which communications are perceived and interpreted, regardless of the intentions of the communicator. By discussing the relevant literature in this next chapter, I will show that advocacy does not necessarily pose a threat to the independence and credibility of science; advocacy does not create biased science, and advocacy need not result in an abuse of position. However, the mere perception that it does may be enough to sow doubt and cause tensions, which may be managed to a greater or lesser extent.

5. Analysis and Theoretical Understandings of the Role of Science and Scientists

1. Introduction

In this chapter, I explore the theoretical responses to the two main concerns raised by interviewees in engaging in advocacy: that advocacy results in biased science, and that scientists engaging in advocacy overstep their role in society. This chapter will demonstrate how both of these objections are flawed whilst also recognising the important points they raise.

The first part of this chapter will address the objection that advocacy produces biased science. I will demonstrate that this is not necessarily the case, and how values (even political and ideological values) have a legitimate role to play in the creation of scientific knowledge. The second part will examine different theories relating to the role that science and scientists should play in society. These views are related to conceptions about value-free science and how scientific knowledge is used in policy making. In exploring these concerns, I will also demonstrate that there are theoretically acceptable ways for scientists to engage in policy advocacy. Practically demonstrating acceptable advocacy - demonstrating to others that there is no politically biased science happening, and that the scientist has not abused their position in society – is outlined in the next chapter as I return to the rich resource of my interviewees' experience.

2. Values in science resulting in biased science

Interviewees expressed the concern that by engaging in advocacy, they would be accused of creating biased science. That by engaging in advocacy, they were acting upon and voicing value-judgements which could then result in biased science if those value-judgements were also influential on the way in which the scientific knowledge was created. How could scientists be trusted to not tweak their science and bias it in order for it to support their views that they are advocating so vociferously for? That they somehow had an "axe to grind"?[1] They must be seen as being (and indeed, actually be) defenders of the credibility and integrity of science, and having people think that they are not doing that is troublesome. And I agree, this perception is troublesome for scientists, but it is a *perception*. The reaction to not engage in advocacy is seen to protect against biased science. But, unfortunately, this

[1] Interview 47.

is not guaranteed to prevent biased science, nor the perception of it. Biased science can still occur *without* the scientist engaging in advocacy. Avoiding advocacy, then, is done in order to not *provoke* the perception of biased science, and to try and avoid the tensions related to the suspicion that biased science is being created. However, biased science could still be happening. The real issue, therefore, is how to demonstrate that one's science is not biased, regardless if one is engaging in advocacy or not. So why is biased science such a problem? And when is the interference of values in science unacceptable?

'Values' relate to "those things that individuals think are worthy of being or ought to be promoted, advanced, and realized" (Kincaid *et al.*, 2007; p10), and therefore sit in contrast to a disinterested, 'objective',[2] separate science, as advocated by supporters of the value-free ideal. Some even argue that natural science is more capable of being insulated from society and its values than social science, as social sciences, by nature of its subject matter, cannot be investigated in a value-free way (Kuhn, 1977; Kincaid *et al.*, 2007). To describe natural science as value-free and social science as value-laden is to misunderstand how we formulate and understand scientific investigation.

When examining the principles of the value-free ideal, we can appreciate that it is important to have aspects of science that are unaffected by value judgements. However, articulating how and when these aspects may occur is difficult without making a value-judgement about how this should happen.

The case argued by those against the value-free ideal is that values are "involved in the very heart of good science in the confirmation process" (Kincaid, 2007; p222). The objection to biased science is not that values have played a role in science, but specifically that political values have played an unacceptable direct role in the way in which the scientific knowledge was created.

In this section, I shall identify the way in which science can become unacceptable because

[2] 'Objectivity' is a particularly interesting subject, however it is distinct from being value-free. Many philosophers of science discuss how science can be objective despite the influence of values (Wylie & Hankinson Nelson, 2007; Douglas, 2009) or how science attains its objectivity *because* of the values that it has (Nozick, 1998). Therefore, I shall refrain from using 'objectivity' in this thesis, wherever possible, to avoid this confusion.

of its bias and the methods used to ensure that this does not happen, as far as scientists are able.

2.1. Values in science

Many philosophers of science argue that science cannot be separated from values, and that in fact, what we determine to be 'science' is shaped by value judgements. These values can determine what science is, and what good science looks like. Values are part of how science operates; they are (legitimately) involved in scientific judgements made by scientists themselves, as well as in the understanding and assessment of the role that science is to play in society. Science is valued by society as it helps to produce new knowledge (Doppelt, 2007). Rather than get embroiled in a social constructivist debate, one might simply surmise that the possibility of scientific knowledge even existing is reliant upon society valuing science as a way to discover new knowledge; science produces a particular type of knowledge that society values in a particular way, and is "stunningly successful at producing accounts of the world" (Douglas, 2009; p8). Being a social construct therefore means that it is inevitable "that social factors – and thus values – are involved in confirmation" (Kincaid, 2007; p222) in science. This creates space for values to be at the heart of science. We can therefore concede that science's autonomy (and its authority) cannot be based on being free from every type of value judgement.

2.2. Types of values

Values have often been classed as having a suitable role in science in binary ways, either as 'acceptable epistemic vs. unacceptable non-epistemic values' or as 'constitutive vs. contextual factors', and described as having either a 'direct or indirect' influence. However, understanding the differences between these categories becomes very difficult as, for example, "epistemic values end up reflecting the non-epistemic values of the day" (Douglas, 2000; p90) and therefore are influenced by non-epistemic values. That is to say, different societies may have different opinions as to what 'simplicity' looks like, and therefore have different perceptions of what fulfilling that value entails. The binary distinction here fails. Similarly, contextual values can influence which of the constitutive values are acceptable. But it is not independence from these values that really sparks debate: "The question is, rather the *extent* to which science is free of personal, social, and cultural values," (Longino, 1990; p4 – emphasis added).

For example, there is some debate regarding the nature of value judgements in Conservation Biology – whether they are institutional and part of what it means to define the discipline, or if there are more invasive non-epistemic value judgements, in Harding's sense. Conservation biology has been described as being 'value-laden' and 'normative' due to value assumption that "biodiversity is good and ought to be conserved" (Noss, 2007; p18). In contrast to applied ecology, conservation biology as a discipline is explicitly based on this value (van Dijk, 2013). Often in conservation biology, we see examples of where language has both evaluative and factual components – using words such as '*degradation, improvement, good,* and *poor*' in relation to biodiversity has been described as being value-laden (Lackey, 2007). Some argue that "such value-laden words should not be used to convey information because they imply a preferred ecological state, a desired condition, a benchmark, or a preferred class of policy option" (Lackey, 2007; p14), whereas others argue that this is another example of the error of a fact-value dichotomy (Putnam, 2002; Dupré, 2007; Kincaid *et al.*, 2007). Nevertheless, if these statements are being made in line with non-epistemic values that are not held by the rest of society, then scientists "risk losing their scientific credibility not because of the quality of their work but because of the moral assumption that underlies it" (van Dijk, 2013; p2151). It is therefore not presence of non-epistemic values that is objectionable, but the type of presence and influence that they have.

Douglas, in her book '*Science, Policy, and the Value-free Ideal*' (2009), proposes an approach that assess the way in which values, both epistemic and non-epistemic, enter the scientific process, and proposes a way to constrain them to legitimate roles.
The direct role is where "values determine our decisions in and of themselves, acting as stand-alone reasons to motivate our choices" (Douglas, 2009; p96). Values in a direct role have a direct impact upon the decision-making process by strongly influencing the interpretation of outcomes, and the empirical claims made by scientists. This direct role is crucial for some decisions, such as the ethics of experimenting on humans, but this role must be restricted to certain decisions made in science. Whilst all science is value-laden, values cannot always be justified in having a direct role as "allowing a direct role for values throughout science is a common way to politicize science, and to undermine the reason we value it at all: to provide us with reliable knowledge about the world" (Douglas, 2009; p113).

In contrast, the indirect role for values "can completely saturate science, without threat to the integrity of science" (Douglas, 2009; p96). This role arises when there is some uncertainty, and thus "there are decisions to be made but the evidence or reason on which to make the decision are incomplete" (Douglas, 2009; p96). Values in this role "weight the importance of uncertainty about the claim, helping us to decide what should count as *sufficient* evidence for the claim" (Douglas, 2009; p96). Therefore, wherever there is a choice about which empirical claims to make, values should be restricted to this indirect role.

Examples of values playing a direct role is when they influence decisions about which scientific projects to undertake, funding decisions, or the ethical decisions about methodology. Generally speaking, direct roles for values tend to happen at the beginning of a research project. However, "one cannot use values to direct the selection of a problem and a formulation of a methodology that in combination predetermines (or substantially restricts) the outcome of a study" (Douglas, 2009; p100). For example, a study that looks at hormonal influences on behaviour in children and only measures hormone levels and behaviour, deliberately restricts the study and fails to account for other factors that influence behaviour. Scientists must be careful "that their methodology is such that it can genuinely address the problem" and that they have not "overly determined the outcome of their research" (Douglas, 2009; p101).

Values should play an indirect role when, for example, selecting standards for statistical significance, characterising evidence and its interpretation, or when deciding whether to accept or reject a theory. Here, value judgements in the indirect role "operate at the margins of scientific decision making rather than front and center as with the direct role" (Douglas, 2009; p103, sic.). Choosing what level of significance to accept in an experiment is to make a judgement about finding the appropriate balance between encountering false positives and false negatives. Making this decision necessarily involves weighing social, ethical, and cognitive values, as a false negative may end up deeming a drug dosage 'safe' when instead it was actually harmful. However, the problems arising from values acting in a direct role do not seem to disappear as hoped when operating in an indirect way, as it is not entirely clear how cases of politicised science cannot also be achieved through values playing an indirect role (Staley, 2014; Morgan, 2010). Douglas would mitigate this point by stating that values used in the indirect role should be made explicit and public as far as possible (Morgan, 2010), as that would maintain the integrity of the science, and "the advising process would become more readily accountable and thus democratic" (Douglas, 2009; p153). This would tally with interviewee's thoughts about the importance of communicating their motivations for engagement, and stating their values, in order that advocacy be deemed acceptable.

Whilst distinguishing between epistemic and non-epistemic values is something philosophers have yet to resolve, there is agreement about which types of values are clearly non-epistemic and should never have a (direct) role in science: political values. Even though the boundary between value types, and even between value roles, is blurred, we can confidently declare that political values must *never* play a direct role in science. To do so would be to undermine the very reason we value science: to be independent and non-partisan. Scientific knowledge would then only be applicable to those who also hold the same

Table 1: Types of Values - Throughout this chapter, I have referred to several ways of defining values and the role that they play in science, as this is how different philosophers have presented their ideas. The dichotomies are defined by referring either to value types, or the types of interaction values have with science. Below is a table briefly describing the difference between and within these dichotomies.

Epistemic Values Relate to how knowledge is made and are the characteristics of 'good' science as they help to judge if a theory is acceptable or not.	**Vs.**	**Non-epistemic Values** Relate to social and ethical considerations (such as political values) and are the not acceptable in creating science as they would create 'biased' science.
Constitutive Values Alternative name for 'epistemic values' but emphasises the process of science and how these determine what constitutes acceptable scientific practice.	**Vs.**	**Contextual Values** Alternative name for 'non-epistemic values', but emphasises how values play a role in judging how the constitutive values have been adhered to, and how to set priorities when they come into conflict.
Direct Role of Values In relation to the scientific method, values with direct influence are reasons for directly assessing choices. This role is only acceptable at the beginning of scientific research (i.e. research question).	**Vs.**	**Indirect Role of Values** The indirect influence of values help to, for example, assess if evidence is sufficient, but do not contribute to the evidence or reasons themselves. This role is acceptable throughout the scientific method.

political views. This is why policy advocacy prompts such concern as it is advocacy about political action, which necessarily involves political values.

Political values can be described as "the foundations of people's political behaviours… and orientations towards political objects" (Halman, 2007; p6). 'Political values' relate to the views held about the actions that should be taken by a society. They influence policy and governance choices in particular, and also help us find principles, processes, and forms of social cooperation that enable us to (try) to live together in peace. Political values reflect the way that we reason the world and our preferences for its construction of power. Political values can differ in the way that they value scientific knowledge. As such, if political values influenced the scientific process, the research produced would be biased towards enhancing that political view. The presence of political values in the science means the science is then only accepted by those that hold the same political view. Indeed, the conclusions that are made under the influence of political values are often referred to as pseudoscience, as it is actually a collection of beliefs rather than science (Hansson, 2017).

To be clear, I am not asserting that science is *not* political. Clearly, as outlined in the above section, science affects politics and politics affects what science gets done. By affecting politics, science is described by some as being political. But as Brown (2009) outlines, the views about what politics is differs according to different scholars, "leading some to conclude that everything is political" (p186). Rather than delve into the discussion about how science is politicized (and politics 'scientized') I am merely articulating that political values (views about how society should be organised) should *not* play a *direct* role in how scientists analyse and draw conclusions from their research. Political values may influence what is researched, but research results cannot differ depending on one's political values.[3] The function of the scientific method is to create new knowledge that is applicable across all ideologies and politics.

Therefore, possessing political values does *not* mean that those values *must* influence a scientist's reasoning as they conduct scientific research. Just as expressing political values by engaging in policy advocacy does not mean that those values must influence the scientist's research and result in biased science. Whilst Douglas (2009) demonstrated that it may be

[3] Implications and application of research findings to policy may differ between political values, but this is outside of the scientific method and into how society uses scientific knowledge.

entirely possible for political values to play an indirect role in science, the design of the scientific method, and the accountability contained within that, seek to limit the influence of political values purely to this indirect role. This means that whilst a scientist's political values about gender equality may be the reason they are interested in researching the impacts of natural disasters on food production (which is something that disproportionately affects women's livelihoods in poor countries), these political values should not influence how the scientist carries out statistical testing, according to criteria for scientific method. However, views about gender equality may influence how a scientist weighs "the importance of uncertainty, but not the claim itself" (Douglas, 2009; p103) as they may deem the uncertainty to have greater significance if results show there to be a disproportionate effect on the ability of women to contribute to the household. The scientist's political views may also influence how much they are willing to persevere with research that is proving difficult to yield results from. Therefore, it is possible for one to hold political opinions and values, without them influencing science in a *direct* way, and therefore destroying the independence of science.

To put it another way, just because one holds a whole host of non-epistemic values, does not mean that one's science becomes defined by them. Although, depending on the non-epistemic values one holds, it might be tempting to create scientific knowledge that seemingly lends support to one's political values. Epistemic values and the scientific method exist to ensure the creation of good scientific research, meaning that one does not lose the ability to conduct good scientific research, just because one possesses political values. However, there remains the possibility that 'bad science' has fanned-into-flame partisan advocacy.[4]

The Nazi state eugenics research is an example where the political values of the scientists, and the context they were in, had a direct influence on the way in which research was conducted, opening up space for research agendas reflecting the Nazi worldview. Their scientists went as far as to directly engage political values in scientific research too as it influenced the way in which research was designed and carried out by defining race and social class (such as classing Anglo-Saxon populations as being secondary to Aryan, and

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[4] By using the term 'bad science' I simply mean science that has allowed political values to corrupt the analysis of results. One could use the term 'pseudoscience' to describe some of the examples that I refer to below, but as there is disagreement over the use of the term, I find it more helpful to refer to 'bad science'. Alternatively, 'good science' refers to science that meets the epistemic standards and is not influenced by political values.

those of Chinese and Japanese origin as *Ehrenarien* – Honorary Aryans). These political values influenced the perception of the ethics of scientific experiments – classing some human subjects as 'subhuman' gave unlimited license for experimentation (Kühl, 1994).

The policies of the Nazi state were "applied biology" and included marriage loans for young, non-Jewish couples, that were free of mental or physical illness, specifically designed to encourage procreation among 'good stock' – a positive eugenics policy. These sorts of policies were supported by negative eugenics policies such as the Law on Preventing Hereditarily Ill Progeny which sterilised people with different mental and physical afflictions, and the Law against Dangerous Habitual Criminals, sterilised and castrated criminals, as ideology concluded that genetics determined behaviour, and criminal behaviour needed to be eliminated (Kühl, 1994). This example shows how science and policy advocacy became so intermingled with political values that it became impossible to separate the two. Here, 'bad science' led to policy advocacy that appealed for more 'bad science' and dealt harshly with those who appealed it.

However, other events involving partisan advocacy (such as the tobacco industry and links between smoking and cancer) have included 'good science', thus demonstrating that not all science used in advocacy is 'bad science'. Indeed, interviewees raised the issue of advocating in defence of science and against the misuse of science – others misusing 'good science' for their political position is not acceptable to scientists. Conservation biology is a scientific discipline that is also premised on political values and is interesting for demonstrating how political values in science is, in this case, permissible. Therefore, it is crucial to understand where, how, and to what extent political values can enter into the creation and communication of scientific knowledge, and when this is deemed to be acceptable or unacceptable.

Ernst Nagel (1961) identified four potential places where the influence of values might be present in science:

1. The selection of problems
2. The determination of the contents of conclusions
3. The identification of fact
4. The assessment of evidence[5]

[5] This, Nagel said, was true of both natural *and* social sciences.

Nazi research is an example of where political values were present in all four places. Whilst Nagel addresses the key areas that exist before and during the scientific process, he does not address how the communication of science by scientists can also be influenced by values. The area where we are most concerned about the presence of political values, and thus creating the biased science that engaging in advocacy has been accused of creating, is in the assessment of evidence. There may be concern about the direct role of political values in other aspects of science as a result of advocacy, but that is still only due to the extent that they effect scientific outcomes.

As such political values can influence which constitutive values are held for science. Similarly, political values can influence the direction of research, defining the research project, most explicitly in which research receives funding, and the research interests of scientists themselves. This is acceptable as long as these political values do not influence the way the science is conducted or in how conclusions are made.

For example, if users of science are looking to take action in a particular area, motivated by their political values, they may seek to fund new scientific research to gain more knowledge in this area. For example, the United Kingdom's Research and Innovation (UKRI) fund are, at the time of writing, accepting funding bids relating to artificial intelligence, and the Natural Environment Research Council have funding available for research into understanding the impact of plastic pollution in marine ecosystems in South East Asia. This is how non-epistemic values can influence funding, and thus the direction of scientific research. But this is a far cry from "showing that the internal, real practice of science is affected by contextual values" (Longino, 1990; p6) as this does not prevent a scientist from then being able to act independently of political values.

Similarly, a scientist's own political values (and other non-epistemic values) may influence their research interests both in setting what it is they will study, and also in which scientific concepts and methods they use (Roush, 2007),[6] even if only in a weak sense (Okasha, 2016) – i.e. a scientist may consider studying butterflies more aesthetically pleasing to study than slugs. Similarly, advocating for funding is not without its own tensions, as covered in section 3.3 of Chapter Four, where the concern may be that research may be undertaken merely to raise the profile of the scientist.

[6] Explored below in 'theory choice'.

Another suggestion for the influence of research interests is that "scientific knowledge cannot be divorced from its intended applications in the way that value-freedom would require" (Okasha, 2016; p124). This means that the reasons why scientists do their research, and their thoughts about how their research contributes to new knowledge and to society, are also value-laden.[7] And yet the influence of political values here would not necessarily result in 'bad biased science'.

The scientific community have sought to develop methods of observation and calculation to ensure that political bias does not influence data collection (Brosnan & Groom, 2006).[8] The scientific method is how scientists can ensure that they produce unbiased research *as far as they are able*, even if values have played an obvious role in setting the research agenda.[9] This 'unbiased' research can be regarded as shorthand for making sure that "non-epistemic values have no further role to play" despite "whatever considerations might have affected the selection of the research question" (Staley, 2014; p233). However, the nature of unconscious bias is that you are not aware that it is going on, and thus do not create methodologies to reveal it. Unconscious bias is the most problematic as one's values infiltrate enquiry without one's awareness (Nagel, 1961). Whilst these methods based on the current epistemic values of science may work to reveal some biases, we cannot say for certain that they reveal *all* bias. To this extent, it is only necessary that scientists are satisfied that there has not been an unacceptable direct role of political values in the scientific method. Future contexts may reveal unconscious bias, and thus be able to judge 'new' unacceptable bias in the older science.

This is similar to how science investigates hypotheses in order to establish support for or against a hypothesis, which is generated by a background theory. Most obviously, theories that fulfil the epistemic criteria are most likely to be successful. However, scientists may rank epistemic criteria differently, and there may be disagreement over which theory is best, or best fits the data, which puts values at the heart of science (Kuhn, 1977; Kincaid *et al.*, 2007). When it comes to choosing between competing theories, whilst the debate may be about the

[7] We will discuss this in more depth in the section on 'forming conclusions'.
[8] This has echoes of the value-free ideal, but the difference here is that there is not a denial about the presence of values in the agenda setting of science.
[9] We will not discuss all of these different methodologies now, as there are so many and they vary between disciplines, but it is enough to note that there are methods that scientists use when gathering and analysing data that seek to remove any bias in observation.

fulfilment of epistemic criteria, non-epistemic values are present in judging and defining what fulfilment looks like (Sober, 2007; Roush, 2007).

Similar to this predicament is underdetermination of theory by data (Longino, 1990). This is where "even if we had all possible data, there would still be multiple hypotheses compatible with the data" (Kincaid, 2007; p221). When this happens, there is the possibility that "values enter into the use of evidence in support of scientific theories" (Staley, 2014; p254). However, Intemann (2005) points out that contextual values (such as political values) may not be legitimate in forming a relationship between data and a favoured theory in this way. In the light of underdetermination, the epistemically responsible choice for scientists might be to suspend making a judgement about which theory is best. Therefore, it is understandable for there to be a concern that biased science is occurring if a scientist advocates a particular theory whilst seeking to explore explanatory theories – we may be suspicious that their research ends up favouring their theory.

Douglas (2009) explains how she sees a legitimate role for scientists including non-epistemic values (including political values) in their weighing up of uncertainties because scientists cannot abandon their general moral responsibilities – for example, their responsibility to not cause avoidable harm. Some have suggested that scientists could be separated from these moral responsibilities to consider the consequences of error by creating an ethical review panel, or bestowing that responsibility on some other area of society. This, they argue, would allow scientists to be free from considering non-epistemic values and the potential consequences of their work in a broad social context, and so to carry out science in a way that allows them to not consider non-epistemic values in the acceptance or rejection of theories (Lübbe, 1986; Bridgman, 1947; Levi, 1960). However, Douglas argues that this is not ideal, nor even truly possible, as "sharing of the burden is the most that can be accomplished because scientists often encounter the unexpected and are the only ones aware of its presence, nature, and novelty" (Douglas, 2009; p74). Thus, the *total* removal of non-epistemic values in the weighing of uncertainties by scientists is not a viable option (Betz, 2013). Some even counter that scientists should explicitly consider the social and ethical implications of their research as "the more power, control, and ability to foresee consequences of action agents have, the greater responsibility for beings-values occurring within the realm of their causal influence they bear" (Lekka-Kowalik, 2010; p39). This notion that a scientist still can only share the burden of communication, and not be rid of it entirely, supports the theory that silence can be interpreted as an act of advocacy.

Though non-epistemic values are present in the weighing of uncertainties, another proposal, set out by Betz (2013), describes how science can systematically avoid "allegedly arbitrary and value-laden decisions… by making uncertainties explicit and articulating findings carefully" (p209). Examples of trying to appropriately describe uncertainty include risk analysis, the process of expert elicitation, and using 'Bayesian beliefs', such as those used by the Intergovernmental Panel on Climate Change which are outlined in the guidance note for the consistent treatment of uncertainties (Manstrandrea *et al.*, 2010).

Risk analysis attempts to separate the scientific process of quantifying uncertainty from the social and political component of deciding what to do about the risk. Even if this was possible, devising guidelines for estimating levels of uncertainty still draw upon non-epistemic values, even if they do so in an indirect, systematic and transparent way. Attempts may be made to form a quantification of uncertainties that are at least informed by widely held non-epistemic beliefs. This is expert elicitation and the forming of scientific consensus.

The aim of consensus is to agree on an outcome that each party can live with. This means that alternative theories that could be explained by the data have been set aside in favour for one theory. Indeed, reaching consensus may restrict the act of research itself, as Oreskes (2004) outlines in their study looking at how research that is published reflects the current IPCC consensus view; consensus views can act as an agenda setter in research, and alternative views are not necessarily given the same energy or attention. Similarly, there is also the potential for non-epistemic values to play a role in reaching a consensus, as there may be bias as a result of the way in which "characteristics of the events [are] described or they may be due to group dynamics and heterogeneity of contributing authors" (Adler & Hadorn, 2014; p666) and result in 'groupthink' (Jasanoff, 2010). This means that consensus often excludes state-of-the-art science as there has not been a critical mass of agreement yet to warrant consensus (Douglas, 2009), and also tends to create a bias towards being overly conservative (Brysse *et al.,* 2013). Consensus is therefore sensitive to group composition and the way in which the group use non-epistemic values to assess uncertainty. These concerns regarding forming a consensus were identified by interviewees who were aware of its limitations and how the consensus can end up being a conservative view. Advocacy based on views outside of the scientific consensus (or indeed, in opposition to it) were seen to be riskier than other forms of advocacy as it would identify the scientist as being an outlier. Forming consensus, and the process of expert elicitation are therefore methods of formalising the role of non-epistemic values in science. However, this still does not mean that the scientist was allowing political values to play a direct role in the way in which they used the scientific method.

2.3. Summary

Science is value-laden. The roles that values play in science may differ depending on what type of value they are, the aspect of science that they interact with, and the way in which they influence science. Values, therefore, do have a role to play in science. The role of epistemic values is widely accepted, whereas the role of non-epistemic values in science is more hotly debated. What is essentially universally agreed upon is that non-epistemic values should *not* play a direct role in empirical analysis – to do so would be to undermine the very reason why we value science: to produce knowledge that is applicable across political views.

Problems arise when discerning the difference between epistemic and non-epistemic values. The scientist may also be unaware of the non-epistemic values influencing their empirical analysis. It is therefore important to make sure that others are able to scrutinise scientific methodologies to reveal these non-epistemic values. Non-epistemic values do have a role to play in choosing topics for scientific research, judging the ethics of scientific investigation, and in weighing up uncertainties. Therefore, the pursuit of a value-free science is not only impossible, but unwanted as science can only be deemed to be 'good science' when it satisfies value judgements. However, there is general agreement that *political values* should not be allowed to play a direct role in the scientific process as this would completely undermine the whole scientific enterprise: politically biased science is not permissible.

This section demonstrates that the first concern about advocacy causing biased science is ill-founded. Engaging in advocacy does not mean that science then becomes value-laden and worthless – indeed, it is valued *because* it is laden with *particular* values. The concern about advocacy is that it may infiltrate and stain science with *unacceptable* values – political values – in ways that go against the scientific method and the aim of science to be applicable regardless of political views, and thus create biased science. However, engaging in advocacy does not mean that biased science has been created – just as not engaging in advocacy does not stop science from being biased. The scientific method works to ensure that such bias is not present. Therefore, if scientists can demonstrate that their research has fulfilled the requirements of the scientific method, then they can engage in policy advocacy, and rebut accusations and address concerns that their science is biased using this evidence. They might not be able to dismiss concerns completely for some audiences (due to the influence of contextual factors, or lack of transparency in how the scientific process is done), but can go some way towards reducing this tension – particularly in demonstrating to their peers that their research has not been 'tainted' by their political views.

There remains the concern, however, that scientists 'abuse their authoritative role' in society when they engage in policy advocacy. This can happen in two main ways. First, that they use their position as an expert, and therefore their 'platform' and audience, to advocate about issues that are outside of their expertise. This expert position is a privileged position that is not granted to every citizen, and has been given to the scientist by virtue of their expertise in order to hear their expertise. Therefore, it can be considered an abuse when a scientist uses this position to advocate on issues unrelated to their expertise – they are gaining an audience and a platform not afforded to other citizens to talk about their own views as a citizen. Secondly, this abuse of position can raise concerns that scientists are not honest about their area of expertise and that they speak out on areas not related to their expertise, but with all the air and authority of an expert – misleading the audience into thinking that what they are articulating is a 'fact of science' rather than their political opinion.
This next section explores the concern about abuse of position and seeks to understand why interviewees expressed this as a tension, and if the theory can provide a way to reduce this tension. I shall explore the different conceptions around the role of science and scientists in society to understand more about the tensions interviewees expressed they felt.

3. Scientists' role in society and abuse of position

I have already discussed the type of knowledge that science creates: the value-free ideal is impossible, and indeed undesirable, for science to achieve. Models of science-policy interaction that perceive science as creating value-free certain facts that never change are mistaken. However social constructivist critiques that dismiss any particular value of scientific knowledge fail to recognise that the scientific method produces a particular type of knowledge that society values as the knowledge production strives to be free from the direct influence of political values. Nevertheless, societies may base their valuation of science on the type of knowledge they think it creates.

Societies that do not value science may not object to scientists engaging in advocacy. However, they may object to scientist *qua* scientist claiming a scientific authority when they advocate – for some constructivists, scientific knowledge has no special standing and therefore has no authority to claim. We can see glimpses of this in the recent rise of 'anti-science' in the dismissal of experts. However, I have argued above that science does create a particular type of useful science that is independent from the direct influence of political values. This is of value to society in two main ways: 1) that scientific knowledge is intrinsically valuable, and 2) extrinsically valuable in that it provides information that can be used by decision-makers regardless of their partisan beliefs. The role of scientists in society therefore relate to the ways in which science is valued.

As already outlined in the introduction of this thesis, when society values science intrinsically, scientists are valued because they contribute to this body of knowledge. Their role then is to contribute to scientific knowledge. When society values science extrinsically – for its usefulness – scientists are valued slightly differently. Scientists, by virtue of contributing to scientific knowledge, can be described as having *expert* knowledge. As mentioned in the introduction of this thesis, this expertise means that they have the ability to understand the scientific knowledge in a way that non-experts cannot. Therefore, when science is valued for its usefulness, the scientist is valued for their ability to *communicate* the scientific knowledge to non-experts in order that they can then make use of it. Science can be valued intrinsically and extrinsically at the same time, and thus scientists can have the simultaneous valued roles of contributor and communicator.

I have already described how engaging in advocacy may be perceived as being a threat to the scientist's role as contributor in the concern that the scientist is contributing biased science. However, advocacy does not always equate to biased science as the scientific method acts to filter out biased science. This concern relates to the scientist's role as a contributor. When scientists engage in advocacy in the role of science communicator another concern is raised – that the scientist will abuse the trusted position of communicating the science to give a platform to their political views. This is not acceptable. Scientists experience a privileged position in society as they are seen to be key holders to incomprehensible science. I call this their 'platform'. They are trusted to provide accurate descriptions of the scientific knowledge and are listened to and consulted because of their knowledge of the science. The concern is that they use this platform to advance their political opinions is to use their platform for a use that it was not given for. I call this 'abuse of position'.

In the science communication literature, there exist many descriptions of the different ways in which scientists can interact with policy makers and the public. All of these assume that scientists are valued by virtue of their contribution to and understanding of the science. Only Pielke's book *The Honest Broker: making sense of Science in Policy and Politics* (2007) includes an advocacy role for scientists. He states that all four of the roles he describes (*Pure Scientist, Science Arbiter, Issue Advocate,* and *Honest Broker of Policy Alternatives*) are "critically important and necessary in a functioning democracy" (Pielke, 2007; p7). Pielke describes the *Issue Advocate* as aligning themselves with "a group (a faction) seeking to advance its interests through policy and politics" (Pielke, 2007, p15). He also states that *stealth advocacy* is a role that poses threats to the scientific enterprise as:

> *"if the public or policy-makers begin to believe that scientific findings are simply an extension of a scientist's political beliefs, then scientific information will play an increasingly diminishing role in policy-making, and a correspondingly larger role in the marketing of particular political agendas." (Pielke, 2007; p95)*

Stealth Advocacy therefore raises suspicions about biased science, which I have argued has no place in society. Whilst Pielke stated that there is a role for scientists engaging as *Issue Advocates* he does not explain *how* they can do this, what it entails, or how they can guard against engaging in, or being seen to engage in, stealth advocacy.

As previously mentioned, contextual factors influence the way in which one is heard. Whilst a scientist may go to great lengths to explain that they are expressing personal views about policy that is not related to their field of expertise, the scientist may still be given heightened attention by the audience by virtue of their expertise in other areas: the scientist finds that they cannot step off their platform. As this is not what the scientists' platform is for, whether the scientist *intended* to use their platform in this way or were merely *perceived* as using it in this way, concerns may still be raised about misuse of their platform, surmounting to an abuse of position.

The theory fails to fully describe *how* a scientist can engage in advocacy *qua* scientist. Scientists may, of course, engage in advocacy in the defence of science, for scientific funding, and for the role of science in policy making. These are all permissible as they are seen to relate to the scientist's area of expertise and are about the preservation and progression of science that society so values. The theory states that the scientist may engage in advocacy as a citizen without raising concern (so long as their science is not biased) – indeed, interviewees said that this would be acceptable - but not how they can engage in policy advocacy as a scientist. However, the way in which medics, for example, engage in policy advocacy and use the full weight of their expertise seems to suggest that there may exist certain conditions about advocacy that do not surmount to an abuse of position. Indeed, interviewees expressed that, for them, there was a relationship between acceptable advocacy and the extent of their expertise. One could comment and advocate for particular policies as an expert so long as they possessed all the expertise to do so. This is what Brussard and Tull (2007) described as *professional advocacy* as it involves informing others about the issues that arise in one's area of expertise. However, as policies often touch on many different areas, it is quite rare that an expert will possess all of the expertise needed to engage in acceptable advocacy. The expert would have to have expertise in natural science, economics, civil engineering, and behavioural change for many policies relating to climate change. This may explain some interviewees' reluctance to engage in advocacy at all. Indeed, as I shall explore in the following chapter, some said that they felt as though they did not possess the expertise to engage in advocacy.

Advocating within one's area of expertise, however, does not completely resolve these tensions, as defining expertise faces difficulties, as interviewees also raised. The theory also finds this. Oppenheimer *et al.*, (2019) state that "expertise is itself a matter of expert judgement; there are no formal rules for defining who counts as a relevant expert, and tacit assumptions about expertise may cause some experts to be overlooked or deliberately excluded" (p215). Some may argue that in some domains expertise can be defined by "'gold standards' - documentation that exhausts the domain knowledge - or senior experts who establish the standards and procedures that are used by the other practitioners in the domain" (Hoffman, 1998; p82). But this is separate from defining the limits of expertise. Brown (2009) even postulates that "what counts as expertise is not definitively settled until after controversies have come to an end" (p11). Therefore, trying to define acceptable expertise by defining the limitations of a scientist's expertise is never going to be possible. Even if it were, there's a chance that others may dispute this due to contextual factors, and the scientist would still experience the tensions associated with being accused of abusing their positions. Therefore, this remains unresolved. As it stands, advocacy is acceptable and not an abuse of position only when:

a) The scientist steps down from their platform and is advocating as a citizen (but it is impossible to divorce being a citizen from being a scientist, and audiences may still hear the scientist as standing on their expert platform, particularly if the audience deem the issue as being related in some way to the scientist's area of expertise);

b) The scientist is on their expert platform, advocating as a scientist about issues that relate to the defence and progress of science (i.e. against other misquoting science and for scientific funding).

c) The scientist is on their expert platform, advocating as a scientist about policies that *solely* relate to their area of expertise (which is highly unlikely).

These three options seem to rule out the possibility of scientists standing on their expert platform advocating about policies that are not related to their area of expertise. Indeed, we might think it odd that a coral reef scientist is trying to use their expert platform to advocate a particular policy approach to pensions. This would be an abuse of position, as the likelihood that the audience see this as being related to the scientist's area of expertise is very slim. In this case, it would be fairly easy for the scientist to step down and advocate as a citizen and be seen to be doing so.

These three options also fail to describe how scientists can stand on their expert platform and engage in policy advocacy on a subject that is related to their expertise *and* other disciplines. An example of this would be an atmospheric scientist advocating for a particular policy pathway to achieve a particular level of warming. It is not clear if this is acceptable (so long as they can demonstrate their science is not biased) or wholly unacceptable as they are talking about their political values which is nothing to do with their area of expertise.

4. Summary

The theory states that advocacy does not pose a threat to the integrity and credibility of science so long as scientists can demonstrate that their research has not been (unacceptably) biased and that they are not abusing their platform as an expert to talk about areas that are unrelated to their expertise.

Related to conceptions of acceptable advocacy is the way in which scientists engage as citizens. Other research has shown that scientists may still be perceived as having an authority by virtue of them being a scientist – hence the concerns about advocacy and the abuse of expert authority. As such, there appears to be a tension between advocating as a scientist and advocating as a citizen. Relatedly, contextual factors influence the way in which communications are received and interpreted. The theory indicates that there are potential actions that may help to reduce tensions and help to match audience perception with communicator intention, such as communicating in a group, forming scientific consensus, engaging in a dialogue with the audience, and stating one's values. However, the theory does not describe how to go about doing these actions successfully in practice.

In the following chapter, I return to my interview data to investigate if scientists can provide answers to these practical questions about how to enable acceptable advocacy. In doing so, I have identified ways in which scientists can engage in acceptable policy advocacy qua scientists that overcomes concerns about biased advocacy and abuse of position. This analysis adds in particular to the concern about scientists abusing their position in two ways: by providing methods for more clearly trying to differentiate between citizen views (enabling the scientist to 'step off their platform' by clearly stating their values to the audience), and methods to engage in policy advocacy qua scientist. This latter tension is mainly overcome by engaging in advocacy *with* other experts and or referring to expertise from consensus views in other disciplines - taking a joint platform and recognising other expertise. Tensions can be reduced by engaging in advocacy as a diverse group agreeing on a particular policy direction, clearly communicating uncertainties, and stating the influence of political values (and whether these are widely shared or highly partisan) on what is being advocated. Other methods are also identified for managing the impact that contextual values have on the perception of communications, and thus whether or not these tensions are experienced.

6. Scientists' Communication Methods

1. Introduction

In previous chapters, I have outlined the viewpoints held in political theory about scientists' engagement in policy advocacy. The theory suggests that there need not be a tension for scientists engaging in policy advocacy; scientists are citizens as well as scientists, values play a role in science, and the scientific method, when adopted correctly, acts as a filter to prevent unwanted values influencing on scientific research. Important characteristics required for trusting science - such as integrity, credibility, and authority - are intrinsically bound up in the audience's perception of the extent to which the scientist possesses such characteristics. In this sense, the scientist may believe themselves as being wholly credible, but self-perception does not count for much, as credibility is about the extent to which others see you as being credible. Therefore, it does not matter how credible, or integrous, or authoritative the climate scientist(s) may believe themselves be - it is irrelevant if the audience does not recognise those traits in them.

Engaging in acceptable policy advocacy therefore requires the scientist(s) to be *seen and understood* as being credible and integrous. As discussed in the last chapter, the theory offers little advice in how to be *seen and understood* as possessing those characteristics. However, the interview data I gathered from the scientific community was rich in methods and examples on how they believe they achieve being seen and understood as protecting these important characteristics of scientists and science. In this chapter, I explore how scientists handle the tensions of perception, the practical methods they employ to demonstrate their credibility, integrity, and authority, and the limits of those characteristics. I will also cover how interviewees described different contextual factors and how they felt they were able to manage or limit the effect that these factors have on their communications. These practical approaches by scientists demonstrate that what the theory outlines in terms of engaging in advocacy, and managing the influence of contextual factors, is actually sometimes successfully practised by scientists, thus supporting the theoretical frame of engaging in advocacy that I have developed.

This chapter is organised into three parts. The first part outlines how scientists demonstrate that they are communicating in a way that preserves scientific credibility and independence (i.e. not creating biased science or abusing their position). These actions are useful for demonstrating credibility and integrity in all communication positions on the advocacy spectrum, and provide reassurances that the scientist is engaging in these acceptable roles, and not, for example, stealth advocacy.

The second part covers how scientists accurately communicate which role they are attempting to communicate in. Here, I outline how interviewees discussed contextual factors, their effects, and how they manage them. These actions include how scientists can improve their communication skills, increase their awareness of the effects of contextual factors, and deploy specific methods for influencing and managing the effect of contextual factors. The third and final part of this chapter will present a set of 'methods for managing contextual factors'.

2. How do scientists demonstrate that their science is not biased, nor an abuse of position?

Interviewees said that they felt a need to preserve and demonstrate the credibility and integrity of their scientific research when communicating. This was important both for demonstrating that their scientific research was not biased and for showing that they could be trusted not to abuse their authoritative position as an expert. Whilst advocacy may not in theory threaten the credibility and independence of their research, interviewees were very aware that they could lose the trust of others just through the perception that advocacy had compromised their credibility and independence. Interviewees were all too aware of the decisions they have to make when communicating their science, and how some decisions may be better than others:[1]

> *"We all summarise science. We all synthesise and integrate, and that requires making decisions about what you include and what you don't include, or how you value one piece of evidence over another piece of evidence. And those decisions are subjective. So, summaries are always imperfect but a good summary does a good job of reflecting uncertainty and a bad summary cherry-picks - and this is another of the classic tools of misuse of science, is cherry-picking, and there's a big danger of that for all of us, cherry-picking."*[2]

As I demonstrated earlier in chapter five, it is possible to engage in advocacy and not have biased science. However, the suspicion of bias in the science can be enough to cause a tension for scientists. Therefore, I asked interviewees about how they ensure that science is

[1] Interview 12.
[2] Interview 25.

not biased and how this can be communicated to non-experts so as to address suspicions of bias, as well as how they demonstrate that they are not abusing their position.

2.1. Peer review

Scientists identified peer review and publishing research as a key way in which the unbiased character of science can be demonstrated. However, they were also aware of the limitations of peer review and the publication process, from the way in which papers are selected for publication, through to the quality and rigour of the review process.[3] The peer-review process for publication attracted significant criticism. It was generally agreed that peer review is still the best form for publishing research, but that a lot could be done to improve the process.[4] For example, reviewing the influence that editors have on what is published, so that it is not just 'doom and gloom' articles that are successfully published,[5] changing the process to include more formal recognition of the time and energy put in to reviewing articles,[6] and greater analysis of the bias present in review and rigour of review.[7]

2.2. Consensus

To this extent then, the peer-review and publishing process can help guard against the concerns of producing biased research, but may not allay concerns about abuse of authority. Forming consensus was therefore seen as a main way in which a scientist can demonstrate credibility and independence, both to others in their community and outside the scientific community.

There are a number of ways in which consensus helps to ease the tensions that arise when there is a suspicion of biased science or an abuse of authority. Having a group that agree on the same thing creates a particular type of authority that an individual cannot replicate. [8] As such, forming consensus is an important part of forming scientific knowledge, because replicability is bound up with establishing that others can agree the findings are reliable. Consensus can be helpful for forming a type of certainty about uncertain science. These Bayesian beliefs and expert elicitation methods can be particularly helpful for communicating uncertain science to policy makers and helping them to make decisions:

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[3] Interviews 4 and 12.
[4] Interviews 4, 6, 20, and 42.
[5] Interview 1.
[6] Interview 1.
[7] Interview 12, 23, and 27.
[8] Interviews 12, 14, 16, and 24.

"That's one of the reasons why the consensus papers of the science community that have been written, John Cook's and everybody else, there's a 97% consensus, is so powerful and so hated by climate deniers because it's so powerful because people do make decisions based on consensus and when you have a strong consensus, you don't have to go back to the original research to have an opinion about something."[9]

For this reason, the reports published by the IPCC were seen as valuable resource for providing authoritative consensus statements.[10] By having a consensus view that scientists can refer to, they can try to guard against accusations that they are trying to push their own views about the science and not accurately reflect the state of the scientific knowledge. For instance, in circumstances where there are many conflicting views about the methods, the consensus view may be that there are just too many differing possibilities. Thus, policy advocacy relating to this area will be based on other factors rather than an agreed scientific consensus.

Forming a consensus is far from a perfect process. Susceptible to group think and dominance by a few individuals, consensus forming can lead to a suppression of alternative ideas, and can reinforce false views of science (i.e. that it can provide complete certainty).[11] This suppression of ideas is particularly damaging if those that disagree with the consensus are labelled as climate deniers – a particularly strong, politically charged term to use.[12] Interviewees also described the need for the process of consensus formation to be as transparent and understandable as possible for a lay audience, in order to demonstrate that there has not been a group conspiracy or that the process has been dominated by the views of a particular individual or demographic.[13]

By referring to the consensus views, one uses the authority of the expert consensus without having to be a part of that group of experts or having to possess all of the relevant expertise. The individual need not possess scientific expertise that the consensus relates to in order to present the consensus view with authority, because the authority comes from the consensus making, not the individual:

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[9] Interview 25.
[10] Interviews 14 and 41.
[11] Interviews 16 and 27.
[12] Interview 27.
[13] Interview 14, 24, and 40.

"And I always thought that the most important function was this script function which allows people to talk about the nature of the problem without stumbling across their disciplinary boundary."[14]

As explored in the previous chapter, the concern that the scientist is abusing their authority is closely linked to how their advocacy relates to their area of expertise. Scientific consensus allows experts and non-experts to have an understanding of the state of the science. As such, both experts and non-experts can talk about the scientific consensus and with authority, as the authority lies in the scientific consensus – not the expertise of the person talking about it.[15] Therefore, as the authority is situated in the scientific consensus, the type of 'abuse of authority' we may be concerned about changes. Any abuse here is not dependent upon the scientists' realm of expertise, but depends instead on if they are accurately communicating the consensus.[16]

2.3. Limits of expertise

If a scientist goes beyond just communicating the scientific consensus, then the concerns relating to their realm of expertise may emerge again. Indeed, interviewees expressed discomfort about speaking to non-experts about things that the scientist did not consider to be within their own area of scientific expertise. This was cited as a reason not to engage in advocacy because they felt that did not possess the relevant expertise needed to be able to advocate for a particular policy action.[17] Others expressed that some people might mis-quote or interpret a scientist as having particular expertise, even when the scientist made explicit efforts not to claim such expertise.[18] Therefore, one of the mechanisms that some interviewees deploy is to direct questions to other experts, rather than attempt to address them themselves. This is beneficial for some scientists in trying to ensure that they are not misinterpreted as acting in a different communication role to the one they intended (i.e. as an advocate as opposed to providing policy advice),[19] as well as acting as a way of defining expertise by referring to someone else the scientist identifies as having greater expertise than them.

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14 Interview 14.
15 Interview 14.
16 Interview 12.
17 Interview 29.
18 Interviews 19 and 30.
19 Interviews 1, 3, 10, 11, and 26.

2.4. Speaking as a group

Referring to other scientists, and speaking with other scientists as a group, is another mechanism that influences the perception of scientists abusing their position of authority or engaging in biased science. Some interviewees discussed how they have experienced personal attacks when they have been seen to be communicating on their own, or as the figure head,[20] and that speaking out as a group provided some protection from personal attack:

> *"In fact, one of the reasons why consensus has become a model for assessment(…) is partly because scientists thought if their voices were uni-vocal they would be heard better by the policy arena than if they presented divergent messages. And, secondly, because of this protective thing where they're surrounded by a community and you feel more comfortable and less subject to being attacked, it's not clear that the second thing actually works - the attacks haven't stopped, just because there's big institutions wrapped around science - but at least makes certain people at certain times feel better."*[21]

However, speaking as a group does not guarantee that there has been no biased science or abuse of authority – interviewees suggested the audience may still be convinced there is a group conspiracy, particularly if the group look homogeneous in any way.[22] Boundary group affiliations may be used by scientists to speak out as a group. Boundary groups are different from scientific consensus groups as they tend to be formed around a policy issue, or with other experts and non-experts, such a charity, a community action group, or some other form of NGO. Some interviewees expressed that the need for more of these types of organisations that help to communicate the science to policy makers, and how particular types of communities, such as national academies or learned societies, carry a particular credibility.[23] Whilst being in a collective may protect the individual scientist from being singled out, depending on the role that the collective plays, and whether or not it engages in any particular type of advocacy, the scientist may still experience some tensions. Indeed, membership of a particular boundary group may 'tarnish' the scientist, and make the audience concerned about biased science.[24]

Interviewees suggested that one way to allay the concerns about bias in peer-review,

[20] Interview 10, 24, 27, 38, and 42.
[21] Interview 14.
[22] Interview 11.
[23] Interview 3 and 16.
[24] Interviews 16, 17, and 31.

consensus forming, and in the influence of these boundary groups, can be through ensuring that these groups contain a diverse range of views – not just on scientific methodology, but also in background, political views, and so on.[25] Interviewees recognised that diversity in science influences how science is done, and that lack of diversity can restrict the applicability and authority of science. For example, the lack of diversity may lead to a bias in the way that science is conducted,[26] and that diversity can lead to 'better science'.[27] A particular concern for interviewees was diversity in the demographics of scientists. They recognised that the lack of demographic diversity was down to many different factors, including the institutional structures in education, and the way in which scientific careers progress:[28]

> *"Well, this is a very real problem that IPCC in particular faces all the time. Despite what are now very serious attempts at diversity, the number of women, the number of people of colour, of various characterisations is limited and there is a strong attempt to do something about it and that attempt has made progress. On the other hand, we're drawing off a set of fields that from the root are biased and have been hostile for various reasons to people who aren't white males."*[29]

2.5. Disciplinary diversity

Diversity was also seen to change the way in which scientists interact with non-scientists, with a lack of diversity pushing away and excluding some audiences,[30] and also as an important factor in building credibility with audiences. If all scientists are seen to have the same background, interviewees were concerned that they would then not be received well by communities that have different backgrounds:

> *"I think the fact that science is […]an existential threat [.]… I do kind of feel like if you don't have a diverse group of scientists talking about their work, you know, like obviously like somebody from like Flint, Michigan is gonna be like '*why are you telling me about climate change when I don't have clean water and I don't trust our government? Like who are you?" *You know? And like, you know, on the flipside, like somebody in like rural Texas is gonna be like* "you're not speaking my language, I don't trust you," *you know, you're like urban elite, whatever, and so I really do think it's important, the fact like we have... It's not just like all bald white dudes."*[31]

[25] Interview 7, 11, 14, 15, 24, 27, 36, and 41.
[26] Interview 14.
[27] Interview 24.
[28] Interviews 7, 11, 14, 15, 17, 24, 36, 41, and 43.
[29] Interview 14.
[30] Interviews 15 and 41.
[31] Interview 11.

However, there was also the reflection that improving diversity in science may be a slow process as often the most prestigious positions are given to those who have served longest in the field – it takes a long time in this type of institutional set up for change to filter through. As science is still improving its diversity, it is likely that the most senior scientists (in terms of the longest careers, as well as promotion) are likely to older, white, middle class, politically left-leaning, males.[32]

Interviewees also expressed the importance and need for more diversity in the types of research being done, with an emphasis on conducting more interdisciplinary research. However, they also expressed frustration at the way the structure of many academic institutions still failed to encourage and recognise interdisciplinary research approaches,[33] including citizen science and scientific research that is co-created with stakeholders.[34] Similarly, interviewees felt that public engagement and outreach were not adequately recognised.[35] Career progression and recognition was perceived to be too heavily based upon publishing papers and gaining citations:[36]

> *"because publishing papers is how you get tenure, how you get promoted, it's worth a lot to people."*[37]

2.6. Career progression

Career progress was also seen as an indicator about biased science and abuse of authority. A lot of interviewees stated that many more tensions presented themselves when Early Career Researchers (ECRs) engage in policy advocacy than for senior research scientists.[38] This was said to be because ECRs do not yet have a back-catalogue of work that acts as evidence of their ability to carry out unbiased scientific research. Also, commonly used proxy for expertise is the amount of time and work produced by someone in a specific field. As ECRs do not yet have this, their standing as an expert is not as established as senior research scientists; the evidence that they can produce unbiased scientific research is not as established as senior researchers:

> *"So, I think that you're right, that there are actually people that at later stages in their careers perhaps feel more able to act as advocates because they're... Even if somebody did question*

[32] Interview 36.
[33] Interviews 14 and 24.
[34] Interviews 29 and 47.
[35] Interviews 8, 23, 25, 30, and 45.
[36] Interview 25.
[37] Interview 4.
[38] Interviews 9, 12, 14, 23, 25, 29, 34, 36, and 47.

science, that point doesn't really matter as much, at least, because it would be dismissed because you've been publishing for 30 years and have already got this great reputation, like you say."[39]

Therefore, in the US, achieving tenure was seen as a moment where one possesses a level of seniority and job security that means that some people then feel comfortable engaging in advocacy:[40]

"Well, the insulation is an important part of it. So, in the academic world tenure gives […] some job security to academics. […] I'm a member of the US National Academy of Sciences, I have accolades, I've won awards for my science that they can't take away from me because I speak out publicly. So, that's a form of insulation. And reputation, again, is a form of insulation."[41]

"I'm gonna go and play a very conservative game up until tenure and then once, hopefully, right, if one is to get tenure, that allows you to be brave, in some respects, and to not have to worry about that side of things and to go and publish that work that is a little bit, you know, because then you have a platform in support of your institution, you know, to try to kind of play your more wild cards, right, and so… And that's really what I'm looking forward to because the thing is that I would like to at some point be able to advocate a practice like SRI if it works, right, if it does show that it works."[42]

Those interviewees with tenure or a longer career expressed that they felt they were less likely to experience the same degree of tensions if they engaged in advocacy in comparison to an ECR:[43]

"If they're in academia they're judged on the number of peer review articles and the rewards they get and the research dollars they bring in and it's more difficult for them to speak out, which makes it, frankly, in my opinion, even more important that some of us who are established in our careers and somewhat insulated from the negative consequences of speaking out play a bigger role."[44]

However, interviewees were unable to offer a distinct point in time when one will have

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39 Interview 34.
40 Interview 4, 14, and 23.
41 Interview 25.
42 Interview 12.
43 Interviews 5, 9, and 34.
44 Interview 25.

accumulated enough evidence to rebut the concerns about engaging in advocacy that ECRs experience, other than when one has been given tenure. Tenure, in this case, acts as an indicator that there is enough evidence to support their permanent employment - evidence of good science that is unbiased.

2.7. Summary

The methods employed by scientists to demonstrate that they are not producing biased science or abusing their authority are:

- The process of peer review, and making the scientific method more transparent to non-scientists;
- Forming points of consensus, particularly on uncertain science;
- Delineating their expertise, such as passing on to other more relevant experts, and recognising where expertise has been evidenced by career progress;
- Speaking as a diverse group, rather than as individuals, and ensuring that group is made up of a range of people, and, where appropriate, disciplines (possibly including boundary groups).

These methods of demonstrating credibility and independence relate to how science is done and seen to be done. They also relate to the values that make up the scientific method (such as reliability, replicability, conservativeness). Being able to demonstrate credibility (no abuse of authority) and independence (no biased science) whilst engaging in advocacy will mean that the scientist has created the possibility of engaging in acceptable advocacy.[45] This confirms the points made in the theory that there exists a way of engaging in acceptable advocacy, and these methods outline ways in which it can be done. However, each of these points also has tensions as, depending on how they are done, these methods may not completely convince the audience that there has not been an abuse of authority or biased science. As such, the scientist may not be perceived as engaging in acceptable advocacy. For example, climate scientists are sometimes criticised for focussing on discussing the uncertainties in the science, and others have argued that emphasising the "97%" in

[45] As mentioned in the previous chapter, we still may take issue with the content of their advocacy (and this may actually in turn make us concerned about their credibility and independence if what they are advocating for goes against the values that need to be upheld for the scientific method – i.e. if they are advocating for no peer-review process, this would go against the value of scientific rigour, and as such, the audience may have concerns about the scientist's credibility and independence). However, the possibility for acceptable advocacy has been created.

consensus does little to aid engagement in action on climate change (Pearce *et al.,* 2017). The public may interpret scientists as not being able to agree on anything and, due to differences in the perception of risk and uncertainty, that scientists know next to nothing as they are talking about uncertainties all the time.[46] Any advocacy that follows may sound like other values are at play. Similarly, defining 'expertise' may differ for an audience, as well as what they consider diversity to look like. Again, engaging in advocacy could sound like biased science if the so-called diverse group is not recognised as being diverse. Indeed, Therefore, it is important to know how to successfully deploy these methods in order to demonstrate independence and credibility. Part of any successful engagement will need to take into account the effect of contextual factors, as these relate to audience perception. Contextual factors are also important in the perception of which communication role a scientist is intending to communicate in. For example, in a survey conducted in 2016 in the US, the public's views of scientists and their trust in science was closely linked to their political views (Pew Research Centre, 2016). Climate scientists were viewed with scepticism by a relatively large share of the American population, but scientists overall (particularly medical scientists) are viewed as relatively trustworthy (Pew Research Centre, 2016).

Therefore, understanding and mastering the influence of contextual factors will help scientists to clearly demonstrate their credibility and independence to an audience, as well as to help align their intended communication role with the role the audience perceive them to be communicating. To return to the archer analogy, understanding and adapting to the influence of contextual factors means that our scientists are able to become more accurate archers – landing on the spectrum in the way they intended. In this next section, I outline the methods and approaches interviewees gave for managing the influence of contextual factors.

3. How do scientists reduce the tensions they may experience when communicating?

As stated previously, many of the tensions surrounding advocacy relate to differences between the intention of the communicator and the perception of the communication; the scientist may be perceived as engaging in (unacceptable) advocacy whether they intended to or not. This is due to the influence of contextual factors which I described as relating to three parts: the voice, the content, and the audience position (Chapter Two). They influence

[46] Interviews 4, 19, and 25.

the perception of the 'who, what, where, when, why, and how' of a communication. The voice relates to how the audience understand the scientist – who they are, and why they are communicating, etc. The content relates to how the audience understand what is actually being said – what topic is being talked about, and how it is being presented. The audience position relates to the worldviews of the audience and the political conditions, and how they may affect the interpretation of the communication – where the audience find themselves, and when the communication is happening. It was interesting to hear how, to a greater and lesser extent, interviewees were aware of how they needed to change their communications for different audiences – i.e. that they were already aware of and seeking to manage the influence of contextual factors. The methods that interviewees suggested in managing these contextual factors often applied to several factors, and were often already used by scientists to help demonstrate that they were not engaging in unacceptable advocacy. I have clustered their methods under three key principles: create dialogue, communicate motivations, and do your homework.

3.1. Creating dialogue

Creating a dialogue with the audience is fundamental for being able to understand and adapt to the influence of contextual factors. Listening is a key part of enabling the scientist to match their intention for a communication with how it is perceived.[47] Crucially, creating communication frames is dependent upon having an understanding of the audience one is talking to, which can only be done through a dialogue. In having a conversation with the audience before having another conversation about climate change, the scientist can learn more about which contextual factors are likely to be influential. Engaging in a dialogue can, for example, inform the scientist of the audience's world views, values, how they see the scientist, and about other issues vying for the audience's attention. Interviewees identified that engaging in dialogue helps them to identify which communication frames may be seen as a form of advocacy.[48]

Interviewees found that when the audience perceive climate change to be discordant with their worldviews and politics, any kind of communication related to climate science has the strong potential for being seen as a form of political advocacy:[49]

[47] Interview 24.
[48] Interview 30.
[49] Interview 8.

> *"But I don't think with climate science we're at that stage where nobody is listening. People are listening, it's just that it's a polarised discussion and […] if you are convinced that climate action is important, then your enemy isn't that nobody's listening. People are. It's that there's this massive polarisation."*[50]

In the example below, the scientist recounts a time where they engaged in dialogue with a member of the public who was initially hostile to taking action on climate change. By conversing with them, the scientist was able to learn more about what they cared about, and reframe climate change. By the end of the conversation, the member of the public was the one asking for more information on climate change and how to take action:

> *"This father came to me and like,* "you know what, I don't want you telling my kid, you know, that he... that we need to stop driving our truck in a way". *I don't wanna tell anyone to stop driving their truck. I love trucks. Right? And, and he's like,* "well, but... you know", *and the next thing I was talking to him about fishing and trucks and stuff and then he... And then I just let him alone, didn't pull him anywhere, and then he started saying,* "so why do you think you can tell us about climate change" *and I'm like, I just... You know, I was like,* "listen, let's not talk about climate... let me talk to you about the annual cycle" *and I told them about the annual cycle and I said,* "climate change, you know, there are some similarities, right, we know"*, and then talked to him a little bit and then I was like, yeah, and then I started talking about fish again and, and then he came back and he's like,* "whoa, but..." *You know, he asked me a few more questions and he was like*, "how do you know?", *and I'm like,* "well, it's a really tough question to answer but, you know, we have to... Because imagine, how are we going to know what temperature we were 5,000 years ago?" *And then I talked to him about* "it's kinda cool, you can see it in the skeletons of animals, you can see it..." *And he's like,* "really?" "Yeah, it's kinda neat, right? It's like wizard stuff." *And then he really got into it and he's like... And then he said,* "well, that's..." *And I'm like,* "yeah, it's, it's real" *and then we move on to something... And he's like,* "but wait a second, what can we do?" *And next thing you know it became... From a push it was a pull and I was like,* "well, I don't know, that's where it gets tough because we all need to live our lives". *And he's like,* "oh, okay"*."*[51]

[50] Interview 7.
[51] Interview 7.

Interviewees also identified how different methods of communication can either facilitate or hinder dialogue. In the above example, face-to-face one-to-one non-threatening interaction facilitated that dialogue. Interviewees found that other mechanisms can influence the type of dialogue that can be achieved.[52] Internet conversations can actually result in many years of exchange without ever meeting the person, and have the potential to reach an enormous number of people.[53] In a media interview, the scientist can only interact with (often) one member of the audience – the interviewer – and is restricted in the type of dialogue that can be had:

> *"They don't start the BBC news with you know "*We're interviewing such and such on ice sheets, by the way, it's really important that you know they're left wing.*" [laughing]"*[54]

Interviewees also identified that engaging in dialogue can help the audience to form a relationship with the scientist. This means that, depending on the type of relationship, the audience can begin to provide cues and recognise when the scientist is trying to engage in different communication roles.[55] For example, this interviewee describes how their relationship with a policy maker meant that the scientist could accurately convey which role they were communicating in, and frequently change which advocacy spectrum role that was:

> *"And she said what she liked about me, I wasn't always pushing - she felt that she could raise issues and we would chat about them […] they want actually to have a conversation across here [the advocacy spectrum] in many ways I think or at least parts of it."*[56]

Some interviewees they felt that trust in the credibility and independence of the science needed to be built first with an audience, before the scientist could start discussing advocacy positions.[57] Part of building this rapport was to communicate the motivations that the scientist had for engaging in dialogue with the audience.

52 Interview 10.
53 Interview 44.
54 Interview 44.
55 Interviews 23 and 36.
56 Interview 41.
57 Interview 36.

3.2. Understanding motivations for communicating

Interviewees emphasised that it is for each individual scientist to choose how to communicate.[58] They also reflected that particular personality traits and personal skills influenced how good a scientist was at communicating, and that not everyone possessed these,[59] and therefore scientists should not be forced to communicate when they are not very good at it.[60] Some interviewees expressed that they felt they lacked certain characteristics, such as patience or resilience, to engage in advocacy in particular:[61]

> *"I don't know how either XXXX or XXXX survived that episode mentally and I don't think I could. So, I think that that is another reason why I like to steer clear of advocacy, because I don't think that I am personally strong enough to deal with putting myself in a position where I may be attacked personally. It's easy to ignore if you get nasty e-mails but if it starts becoming very persistent and serious, then I don't think I could do it."*[62]

Some described it as being an 'instinct' to avoid advocacy, or avoided advocacy because of a lack of confidence.[63] As a result of not possessing these characteristics, some interviewees did not consider engaging in some forms of communication: advocacy was 'not for me'. For other interviewees, it was not that they did not possess any particular characteristic, but that the perceived threat that advocacy presents is enough to make them want to steer clear of it and other forms of communication that may be interpreted as advocacy.[64] However, as the previous chapters have demonstrated, advocacy need not pose a threat to the integrity and independence of a scientist. Others refrain from advocacy because they are not confident that they would be able to do a good job of it, or that it would take up too much of their time.[65] Still, for other interviewees, motivations for engaging in communication outweighed these concerns. The main reasons were due to a sense of inaction from policy makers, speaking in defence of the science, wanting to express their findings in a useful way for policy makers and the lay public, and to ensure that they had a correct understanding of the risks and uncertainties.[66]

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58 Interviews 20, 24, and 26.
59 Interview 3.
60 Interviews 7, 8, and 25.
61 Interview 8.
62 Interview 34.
63 Interview 34.
64 Interviews 16, 20, 24, and 36.
65 Interview 8 and 45.
66 Interviews 15, 16, and 26.

Therefore, when engaging in communication, particularly in advocacy, interviewees said that explaining one's motivations would be an important part of helping the audience understand which role you intend to be communicating within.[67]

One method used by interviewees is to state upfront what their values are:

> *"Sometimes it's absolutely necessary to say, look, I just put, you know, saving endangered species of, you know, thumbnail mites or something nobody gives a shit about, you know, I just happen to like them, so I want you to pay attention to this thing […] I can't prove this is the end of the world but to me it's the end of the world - something which contextualises so the audience can understand why you're bothering to put up the effort to talk about this."*[68]

Interviewees also said that part of the motivation for stating their values is to try and differentiate between communicating as a scientist and communicating as a citizen; that scientists can make this distinction by telling the audience when they are speaking as a concerned citizen.[69] However, as also discussed in previous chapters, whilst this may help in some audience interactions, interviewees expressed that the audience may still interpret communications as being from a scientist:[70] [71]

> *"People may then associate that element of subjectivity to the natural science part of it. Which is a worry but, […] If you're doing full disclosure, then that's probably fair enough."*[72]

To take this further, one interviewee suggested that if the motivation is to open discussion on policy and to be more transparent about the scientific process, that in order to ensure that one is not accused of abusing their position of authority in expressing their own personal views, scientists should also refer to other viewpoints:

> *"And even at the basic levels of scientists coming out and speaking out and communicating, they can say this is my position but there are other views available here, even within the science community and outside of the science community. Now, the concern there for scientists is that that lessens the impact and makes it kind of the idea we're opening up, then even at the basic level of kind of communicating your science or moving into the policy world, there is a kind of*

[67] Interviews 10, and 24.
[68] Interview 14.
[69] Interviews 11, 25, and 38.
[70] Or conversely, as a citizen. For example, it may be difficult for some scientists to communicate with an audience from their past or hometown, who remember the scientist from before they gained their expertise, and therefore do not perceive them as having expertise.
[71] Interview 23.
[72] Interview 31.

responsibility - and there's that word, I'm probably gonna use that quite a lot - responsibility to communicate your science in a way that pays attention to the wider controversy and debate that exists out there. And almost to kind of situate it within the context of those other viewpoints and debates, whether they're debates around facts or values."[73]

Stating values and motivations also meant stating your funding sources. Scientists frequently do this when communicating with each other (in papers, organisation websites, etc.,) but interviewees expressed that it is also important to communicate this to policy makers and the public.[74] This is because they felt there may be a suspicion, and possibly a fair one, that depending on the funding source, the scientist may be under pressure to produce certain outcomes in the science – to create biased science:

> *"… it took me a really long time to get to that point with the work around the UNFCCC where I understood enough what was going on in their world […] if I wanted them to hear me without assuming some kind of vested interest, I would like straightaway be like* "my funding is coming from a science council and I'm doing this because of this […]By the way, our research study, we're just doing it because we're interested in how the atmosphere works" *[…] I'd been talking with certain people from the Secretariat for like a couple of years and then I said that and they were like,* "oh"*, like they thought that we were doing the research because we were interested in litigation and like informing the law students about climate change."*[75]

Interviewees said that stating their funding source was a way of demonstrating that, in the case of publicly funded scientists, there are no private interests at play – at least not in the same sense that there might be with privately funded individuals:[76]

> *"You know, frankly, the best predictor of a biased paper has nothing to do with the opinions of the authors, it has to do with the funding source and the acknowledgements."*[77]

As covered in the previous chapter, funding sources were seen to have an influence on the way in which scientists felt obliged to communicate their science, and avoid or engage in advocacy, particularly if they felt their funding source may be at risk.

[73] Interview 39.
[74] Interview 29.
[75] Interview 29.
[76] Interviews 6 and 20
[77] Interview 12.

Honestly discussing values and motivations was often accompanied by comments about being more personable and revealing other personal details. Being personable was seen by interviewees as a way of demonstrating their values and the fact that scientists still have passions outside of science:[78]

> *"It was just a personal conversation about this is what I do and here's what I know about it […] she reflected back to me was* "you don't seem like a climate scientist and you're not what I imagine". *And I think she heard some of what I told her in a way that was different than, first of all, if I was the same person but wearing the sort of Ivy League mantle or whatever […] but that interaction where people actually have a chance to sort of see you as an individual and understand how you got to this place and you're thinking, but also just see you somewhat as a human being thinking about this issue is powerful."*[79]

Relating to the previous point about establishing dialogue, interviewees found that being personable helped them to establish a relationship and dialogue with audiences:

> *"That, I've found, has made it much easier for people to get to the science – if they accept you as a human being – if they think* 'well, this person seems to be normal' *[laughing]. So, declare your values. Declare your humanity, and just maybe that will make it a little bit easier for people to get to the science."*[80]

By being more personable, and showing the human side of science, interviewees felt that they could more easily engage in a dialogue and discuss their values. This dialogue was seen by interviewee as a way for the scientist to learn about and address the influence of contextual factors that may exist for that audience. As a result of this sort of dialogue and learning more about the audience's values and worldviews, the scientist can learn how best to frame their communications, and which communication method is most appropriate, and therefore continue the dialogue in a way that engages the audience. Interviewees also said that dialogue and stating values can also reveal more about the scientist to the audience, showing them their background. This can be background to their expertise, training and funding, but also their values and motivations. However, this would not be enough to control the influence of contextual factors. Indeed, interviewees offered other methods for further managing the tensions they experienced when communicating. I would describe these other actions as referring to developing the *substance* of their communications, learning more about

[78] Interview 7 and 24.
[79] Interview 16.
[80] Interview 24.

communication methods and suitable communication *frames*, and an awareness of the *political conditions* that they are communicating within.

3.3. Doing the groundwork

Interviewees were aware of how the delivery of a communication - that is to say the medium it is communicated in, the framing, tone, and how the scientist presents themselves - is important for influencing how an audience receive a message:[81]

> *"It matters, you know, being reasonably well dressed so you show your audience* "I respect you, I'm not going to turn up looking like I just rolled out of bed" – *all of these things matter their overall willingness to listen to you and absorb what you have to say."*[82]

Whilst engaging in dialogue is important for learning about the audience and how best to communicate with them, interviewees also suggested that engaging in some groundwork before initiating a conversation is useful in order to establish which methods are likely to be more successful than others, such as in the way they present themselves:

> *"I try and figure out what it is that they know already, who they've talked to and what their local interests are 'cos often when - at least working with politicians - they have local interests that are important to them. And so I try and connect it back to them based on their local interests of what they need to know as well. So, I give them bigger picture information for their broader picture stuff but then I also really try and connect it back to where they are, their constituency, and what they're facing potentially."*[83]

The use of frames and the forming of content, such as climate influencing wedding weather,[84] is different for different audiences. As mentioned in chapter four, developing knowledge of the scientific consensus was seen as a key way to maintain one's credibility and independence when communicating, as it allowed the scientist to speak authoritatively about areas that they are not experts in. Some interviewees saw this knowledge development as a useful way to become a more confident communicator, and allowed the scientist to speak to different audiences about different issues relating to the consensus science. This was seen to be particularly useful when talking about subject and answering questions on areas outside of the scientist's expertise:

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[81] Interview 15.
[82] Interview 24.
[83] Interview 15.
[84] Interview 15.

> *"I'm astonished how little homework scientists do. I mean, it's really not difficult, when you're a scientist, to read the IPCC summary for policymakers and to memorise what your community has said and stick to that. […] I mean, this is the consensus on climate change and it's perfectly safe to say we'll have more heavy rainfall in the future because the air is warmer and you can just study it. […] I've been repeatedly astonished that scientists don't even do that and they say* "I can't talk about this bit 'cos I don't know nothing". *[…] Just do your homework and then you'll be comfortable talking about the things."*[85]

Whilst communicating content formed on consensus science was seen to provide a scientific authority even when the scientist if not an expert in that area, Interviewees outlined how difficult it can still be to communicate complex subjects, even within their area of expertise. As the theory suggested, interviewees felt that they would have to make a judgement about what to communicate which might be influenced by other values.[86] Related to this judgement about how to communicate complex science is how to communicate uncertainties, and the different types of uncertainty that exist in science. Interviewees felt that discussing uncertainties was important to do, particularly as their training emphasises the need to always state the level of uncertainty. [87] Interviewees also highlighted that in seeking to communicate the uncertainties better to a lay audience, scientists may be in danger of over-emphasising what is uncertain about the science and neglect to talk about what is (virtually) certain.[88]

Interviewees perceived communicating risk to be something that non-experts were more familiar with, and would help reduce the likelihood that conversations would get stuck debating the certainty of the science:

> *"The public doesn't seem to have a problem understanding the risks of cancer, which is always frustrating but, I mean, we haven't translated that very well."*[89]

Some interviewees also said that speaking to journalists and receiving media training helped them learn about how uncertainties can be interpreted by different audiences, and non-expert audiences,[90] and also helped them learn how to better communicate uncertainties:

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[85] Interview 30.
[86] Interviews 23 and 46.
[87] Interviews 3 and 6.
[88] Interview 44.
[89] Interview 4.
[90] Interview 19.

> *"I learnt more about how to communicate flood risks and storm risks from the journalists and all the discussions we had afterwards than I have from anyone else on how to communicate certain extremes and now it's fed back into how I think I need to communicate going forward those issues."*[91]

Talking about risk also allows scientists to discuss outcomes in a different way to discussing uncertainties, changing the way in which conservative scientific approaches (i.e. avoiding Type I errors) affect descriptions of outcomes:

> *"And, I mean, the overwhelming advice is just to represent the uncertainty but like it seemed strange to me that sometimes that approach of kind of, okay, let's use a conservative method. Well, just because it's been called conservative… Because if you're thinking about it in terms of like risk analysis, then to be conservative would be to consider like the worst-case scenario."*[92]

However, depending on the framing of the risk, communications could sound like a form of advocacy:

> *"Climate change is not gonna be the end of the world. It's not a good thing, it's something we have to deal with but… It's also not gonna lead to the extinction of humanity and saying it is a very problematic framing in its own right."*[93]

Therefore, groundwork in understanding how policy making works is important for understanding how communications of risk and uncertainty may be interpreted and used.

3.4. Additional training

Interviewees highlighted that engaging in dialogue, stating their values, and communicating the science is not something they usually receive training for. Whilst there may be media training, interviewees found there was very little or no training for public speaking or how to best communicate the science.[94] Interviewees also expressed that they do not receive any training or only very little information about how to communicate with policy makers, or how the policy making process works,[95] and that they wanted to learn more about the philosophy of science, ethical research and communication:

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[91] Interview 15.
[92] Interview 29.
[93] Interview 19.
[94] Interviews 10, 12, 14, 24, and 37.
[95] Interviews 24, 26, and 27.

"The one idea I have had is at universities, much as medical schools, force their students to take courses in ethics, for instance, that there should be courses which are mandatory in the science society interaction which include what's ethical and what isn't and some of these questions really are matters of ethics. What context your scientific information will be received by, how to increase the likelihood someone is listening if you wanna say anything even strictly scientific. Much less on the policy side but, yes, also on the policy side. What reaction you can expect, including the high level of contention in the public discussion around an issue like climate change, and then people come out of graduate school more prepared. That's the only idea I've had."[96]

The other training that interviewees suggested would be helpful is in how to speak to specific audiences, or in response to particular attacks on the science.[97] They saw this as a way to help them to make sure that they communicate more clearly which communication role they are engaging in. Interviewees were also keen to promote science education – what it is science can actually provide, and what uncertainties mean - as they saw this as being a way to reduce the tensions they experienced when they communicate.[98]

3.5. Summary

The theory suggests that scientists can indicate when they are seeking to engage in advocacy as a citizen in order to alleviate concerns about biased science or abuse of position. However, achieving this in practice is more difficult. Interviewees identified that advocating solely *within* their area of expertise as a scientist was permissible, so long as they could demonstrate that this advocacy did not result in biased science. The difficulty here is that the scope of a scientist's expertise may be quite limited, and most policy positions touch on aspects outside of their expertise. To this end, consensus groups that were made up of different disciplines were seen as being able to acceptably advocate on a wider range of issues than the individual expert, so long as their collective expertise covers all of the subjects that the advocacy topic covers. As such peer review and forming consensus was seen as a key method for demonstrating that the science is not biased – or at least limited in how biased it may be. However, demographic diversity is also important for ensuring that this consensus group does not appear to be creating biased science.

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[96] Interview 14.
[97] Interview 26.
[98] Interviews 1, 2, 17, 24, and 34.

Interviewees described how career progress can also influence audience perceptions. It was felt that with career progression, particularly to tenure, that the scientist gains the personal evidence of contributing to credible science. As such, interviewees felt that more senior scientists had more protection against the concern that their science was biased.

The concern about abuse of position is related to how well the scientist communicates the role they are intending to engage in. Part of this is how successfully they manage to communicate this intention to audiences, and then actually be interpreted as communicating as a citizen.[99] Therefore, interviewees explained that, from their view, communicating the motivations for communicating seemed to be a key factor in demonstrating that there had not been an abuse of position, and helped them to circumnavigate the difficulties of separating out speaking as a citizen and speaking as an expert. Communicating motivations was understood to help the audience to see that the scientist is not trying to abuse their position - using their scientific authority to claim authority in areas outside of their area of expertise. Interviewees said this was true of any role that the scientist was seeking to engage in. They also said that stating one's values can help the audience to assess the bias of the science.

Being personable was seen as a way of demonstrating the scientist's humanity – that they are a citizen as well as a scientist. Values influence other life choices and views, so in retelling personal stories and preferences, interviewees felt that the audience would be able to see evidence of these values at work, and see the scientist acting as a citizen. Often, interviewee would emphasise that communicating and demonstrating values is done best in dialogue as the citizen can ask questions and have a response from the scientist, and the scientist can listen to the concerns of the audience and be able to respond to them, adjusting their communications accordingly.

Advocating qua citizen may not be possible for the scientist, as the audience may still interpret them as communicating as an expert. Stating the values that the scientist holds as a citizen (i.e. political values), as the interviewees suggested, may therefore reduce the tensions experienced when engaging in advocacy: by virtue of the values that a scientist, they have a particular concern that they want to advocate. This may then facilitate the scientist in

[99] A scientist may successfully communicate their intention to communicate as a citizen, but then still be interpreted as communicating as an expert.

communicating both as a citizen and as a scientist at the same time, and thus helps to address the practical difficulties of trying to communicate just as a citizen.

However, advocating qua scientist is only acceptable when it is based solely on scientific values. This is why engaging in advocacy for scientific funding, in defence of science, and so on, are deemed acceptable. Scientists will always need to state their values when advocating for anything else, even if the value is something as widely shared as 'equality'. Advocacy based on widely shared values, such as equality, were seen to be more acceptable than advocacy based on disparate values, partly as one is more likely to find other people supporting your views and therefore find it not as controversial. Advocacy based on disparate values, such as political values, was therefore seen to be more controversial – or at least more likely to cause tensions for scientists. Therefore, the methods to demonstrate that their science is not biased nor are they abusing their position are most useful when engaging on advocacy based on these disparate values. Of course, there is a possibility that there are widely shared political values, in which case, the tensions are likely to be lesser.

Establishing a dialogue, then, is seen as a main way to be aware of the influence of contextual factors. Establishing a dialogue based on values and interests was said to help inform the scientist about how best to frame their communications. Interviewees also suggested that dialogue and stating values can also reveal more about the scientist to the audience, showing them their background and motivations. This can be background to their expertise, training and funding, but also their values and motivations. In order to do this, scientists need to be aware of their own values and motivations – they suggested that dialogue with others can also help scientists understand which values are widely shared, and which are disparate. Dialogue can also help the scientist to learn which communication method is most appropriate for different audiences, and which frames will work best in engaging the audience and facilitating understanding. The scientist then needs to do some groundwork in the substance of the communication: learning how to communicate uncertain science, how to talk about science outside of their area of expertise, and to understand more about the contexts they will be speaking in to. This might include getting training in how to engage different audiences.

4. Methods for matching mapping

Managing the influence of contextual factors is important for any role that the scientist chooses to communicate in. Contextual factors can influence how the scientist is heard to be communicating. If, as a result of the influence of contextual factors, scientists are seen to be creating biased science or abusing their position, then they will be seen as engaging in unacceptable advocacy and therefore not map on this spectrum. Being able to manage these contextual factors means that the scientist can increase the likelihood that the audience interprets them as communicating in an acceptable role, and indeed, the role that the scientist was aiming for.

These methods outlined below (Figure 6) help the scientist(s) to demonstrate to the rest of the scientific community that they are not engaging in unacceptable advocacy (biased science or abuse of position) as well as helping the scientist to communicate which role they are trying to communicate in.[100] Whilst these methods might be useful for managing the contextual factors of the target audience too, the methods I list here have been formed based on interviewee's descriptions of how they perceive the effects of contextual factors on their own and colleagues' communications. As such, they are for satisfying the scientific community that there has not been an abuse of position or biased science, and thus can help provide a way to engage in policy advocacy whilst also maintaining their scientific credibility and independence. There may be more methods to add, but that can only come from speaking to non-scientists, which I have not done in this thesis.

The preceding chapters have demonstrated how engaging in advocacy as a scientist is perceived as acceptable, so long as they are not creating biased science, or abusing their position as a scientist. Scientists can show that they have not engaged in biased science by demonstrating that they have created science using the scientific methods, stating their values, framing uncertainties well, and speaking out as a diverse group. Separating out being a scientist from being a citizen can be difficult to do in practice, as contextual factors can influence how the audience interprets the scientist (and therefore still see them as communicating as a scientist). The most a scientist can do is to try to communicate to what extent their advocacy is a result of their political values, and their expertise of the subject.

For example, it is quite clear that a volcanologist advocating about a specific traffic policy in Northamptonshire is doing so as a citizen, as their expertise in volcanology has no relation to this policy. However, if the volcanologist was advocating about a specific traffic policy on Montserrat, an actual volcano, then they would have to demonstrate that their predictive

[100] Methods are listed in no particular order and are often interrelated.

mapping of lahars has not been biased to support their politically influenced views about traffic policy. Similarly, if this same volcanologist was trying to use their expertise to add weight to their view about Northamptonshire's traffic policies, it would be called an abuse of position. Scientists can reduce concerns about an abuse of position by using the methods below. This way, scientists can engage in policy advocacy, whilst still being seen as both a scientist and a citizen. Acceptable advocacy for scientists is advocacy that does not impede scientists from legitimately contributing to scientific knowledge. Scientists do not have to do all of these methods – they might not always be possible – but each can help manage tensions in a different way. I shall now explain how each method can help with 'matching mapping'.

Figure 6: Eight methods for scientists to use to help increase the likelihood that audiences perceive the scientist to be communicating in the role that the scientist intended, and guarding against the suspicion of biased science or an abuse of position.

Method 1: Speak out as a group

Interviewees extolled the virtues of speaking out as a group, as the scientist is immediately able to shift the focus away from just being solely on them. Judgements are then made about the group, rather than just one individual. Of course, there still may be a particular individual that audiences fixate on, and may judge the rest of the group based on their judgement of that individual. For example, if the audience harbour a severe dislike for an individual in that group, then the audience may also end up disliking the rest of the group by virtue of association. But forming a group, such as the IPCC, or the American Association for the Advancement of science, or the Royal Society – groups with a *diverse* range of expertise and values – scientists can help demonstrate that it is not as a result of individual bias that they are engaging in communication. Specifically, advocating as a group of scientists with a diverse range of political values can help demonstrate that the advocacy is based on widely shared values, which is likely to be less controversial.

Groups of homogenous political values can also still engage in acceptable advocacy – indeed, it can help with clearly communicating values (see method five). However, these groups are likely to come under scrutiny for producing biased science, and they must clearly demonstrate that this is not the case. Therefore, being transparent about how the group was formed (e.g. around a set of values, or concerns, or common identity) and came to an agreement about what it is the group would communicate – can help the group communicate their values and logic in reaching the position that they have.

Scientists can join other groups that are not just made up of other scientists, but non-scientists too. For example, a local group against air pollution, the Women's Institute, Extinction Rebellion, or Greenpeace. Groups may or may not be advocacy groups, but just as with the disliked individual, a scientist may risk being 'tarred with the same brush' by others as a result of their group membership. This only becomes a source of tension for the scientist if the group are accused of misrepresenting the science, or advocating views not supported by the scientific consensus. The scientist is still free to advocate based on views outside of the scientific consensus, but needs to be careful that in doing so they do not advocate against values that are central to the scientific method (i.e. that they are advocating that science become less rigorous), misrepresenting the science, or that they are seen as creating biased science to support their (and the groups' view).

Method 2: Be aware of how you are seen

As already mentioned, being aware of how others see you is the central tenet of managing contextual factors. Specifically, being aware of how others see the scientists' authority, integrity, and independence. Interviewees identified career progression as a key mechanism for demonstrating these characteristics. The further along a scientist is in their career, the greater amount of evidence exists to demonstrate that they can be trusted to be independent, and conduct their research with integrity. Therefore, when they speak out, they have greater evidence to call upon to show that they do not create biased science. Therefore, this awareness needs to go beyond the scientists' *perceptions* of how they are seen, to establishing an understanding of how they are seen. Crucially, scientists need to have this awareness of how their community sees them in order to understand if their scientific credibility is being questioned as a result of their actions (or inaction).

Method 3: Frame communications well.

Interviewees found that framing, whilst not a form of advocacy, could be seen as a form of advocacy. The scientific community is very sensitive to the communication frames that are used as they feel they can greatly influence the way in which audiences understand the science and how they derive action from this understanding. As such, it is important that the scientist chooses their communication frame by assessing how the scientific community will assess their reasoning (linked to method two). This was particularly the case when communicating uncertainties. Uncertainties can be difficult to translate to non-expert audiences, particularly if they have different perceptions of phrases used to characterise uncertainties. Framing uncertainties as a type of risk can help audiences to understand the uncertainty,[101] but this may not always be possible. Particular frames may trigger different responses from different audiences. For example, framing action on climate change as a justice issue does not work very well for people of the Hindu and Buddhist faith due to its Abrahamic overtones, nor with people with conservative political values due to its resonance with left-wing values (Marshall *et al.,* 2016). Engaging in dialogue (method four), doing background research on the audience (method seven), as well as getting communication training in how to form frames (method eight) will help scientists to identify which frames are best for their audience.

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[101] Climate Outreach have produced a guide for climate scientists communicating uncertainties to non-expert audiences (Corner *et al.*, 2015) and, communicating specific climate risks to specific communities (Messling *et al.*, 2015; Shaw & Corner 2016).

Similarly, the scientific community may be concerned about a communication if it appears to be using a frame in a way so as to engage the emotional reasoning of an audience as this would appear to be going beyond framing uncertainties for cognition into framing uncertainties so as to engage with an emotional motivator for action – possibly a type of stealth advocacy. Sometimes, this sort of emotional framing is used to create a 'short-cut' to a desired outcome – which again, more often than not, is seen as a form of stealth advocacy. However, this relates to the ethics of framing communications to engage with people's emotions, which I have not explored in this thesis. Nevertheless, it is a factor that scientists need to be aware of – that their scientific credibility could be questioned by the scientific community if the community suspects the communicator is choosing frames in order to engage in a form of stealth advocacy.

Method 4: Engage in dialogue

Engaging in dialogue means seeing science communication as a dynamic interaction rather than a one-way message delivery. It also helps to show the human-side of science, and demonstrate the personability of the scientist. Dialogue also helps, as already mentioned, scientists to use many of these methods for matching mapping well. Interviewees gave many examples of how dialogue helps them to identify suitable communication frames, informed the scientist of how they were being interpreted, and build trust with audiences. Of course, dialogue involves listening. Creating opportunities to listen to audiences is therefore needed. Interviewees said this can be part of scientists doing their groundwork before communicating with an audience (method seven) to understand the political conditions they will be speaking in to, and other concerns they may be competing with. This includes being aware of what others in the scientific community are saying. Listening is also crucial to keep actively doing throughout communications to ensure that scientists are being interpreted in the way they intended, to be able to learn more about the audience, and therefore how to tweak communications if needed. This may require the scientist to get training in how to listen and interpret audiences (method eight).

Method 5: State your values

In order to understand how the scientific community may be suspicious of unacceptable advocacy, scientists need to be aware of how they may be perceived as creating biased science or abusing their position. This involves understanding what values the audience think the scientist has that could have, as well as being aware of what values the scientist actually has. Interviewees said that working with a diverse range of people (method one) can help them to identify their own values as meeting others who do not share these values may help reveal them. Stating values was also seen as a way of communicating to the audience the motivations for the scientist engaging in communication, and thus make it easier for the audience to be able to identify biased science made to support these motivations. To a limited extent, interviewees said that stating values and motivations can also help the scientist to demonstrate how they are fulfilling their duty to communicate the science, and also to demonstrate their humanity. By clearly stating values, scientists can show what views they hold, like any citizen, and how they ensure these do not bias their science. The scientific community, by virtue of their expertise in assessing the creation of scientific knowledge, can then analyse the science and stated values and certify that there has been no biased science.

Method 6: Be clear about where your expertise stops

An abuse of position is where scientists sought to use their authority as an expert to speak authoritatively on issues that they are not an expert in. This was seen to be unacceptable advocacy. Defining expertise is important for the scientific community to see scientists doing. To not do so immediately makes the scientific community suspicious that there is a desire for an abuse of position. The scientific authority to speak as an expert on the subject comes from that knowledge having been established by the scientific community, and the scientific credibility that they recognise that scientist as having is limited to the area of expertise that scientist has. Therefore, interviewees said that scientists should be clear with the audience about their 'intellectual wheelhouse', and exercise some humility in doing so, as well as recognising that they may also have knowledge about other disciplines. Whilst expertise is difficult to define, and is a relative phenomenon, scientists can still express the degree to which they consider themselves to be expert in an area.

Interviewees said that if they were asked to provide an answer to a question relating to subjects outside of their area of expertise, and they wished to avoid being seen to be advocating, they can either pass the question on to an expert within that field, or answer based on the consensus science. If they cannot do either, and are being asked to provide their opinion, they are more than likely to be engaging in advocacy (as perceived by the scientific community) and are likely to also be seen as abusing their position (as perceived by the scientific community). Using the consensus views of that subject area would guard against the perception of an abuse of authority. Scientists are still free to advocate on non-consensus views on topics outside of their area of expertise (for example, economics), but should communicate clearly why they are doing so, based on which values, and avoid claiming expertise in that other area. It may be that there is not a consensus, in which case, this should be explained too.

Method 7: Do your homework

Learning what worldviews the audience holds – from both 'desk reviews' and dialogue (method four). Understanding how communications may be interpreted. Learning what the consensus science is in other disciplines, and who are the experts in those areas. Understanding how the policy making process works. Learning about values and which values scientists possess. These were all described by interviewees as groundwork tasks that scientists should do in order to inform their communications and help them to shape how they are perceived. Demonstrating that the scientist has done this groundwork also provides assurances to the scientific community that the scientist is taking care in their communications to ensure they do not abuse their position.

Method 8: Get the communication skills you need

This last method is phrased in this way to emphasise that: 1) communication is a skill, and different types of communication require different skills, and 2) that there is a choice for each scientist about how they communicate. Interviewees were keen to express that not every scientist is, not should need to be, a gifted communicator – but that they all do communicate in some way or another (even if through their silence). Scientists should therefore get the skills that they need in order to communicate what it is they want to communicate, in the way they desire to communicate it. This may look like training courses,[102] or mentorship, or it may just be self-taught and practice honing skills. Either way, scientists expressed a desire to receive training in how to navigate advocacy and other communication roles, and were encouraged that, by the management of contextual factors, that they can, to a limited extent, choose how they communicate and are heard. Being trained in how to listen will also enhance the ability to be aware of how you are seen (method two). This method also applies for enhancing the communication skills for

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[102] For example, the AAAS run training courses in advocacy (https://www.aaas.org/programs/catalyzing-advocacy-in-science-and-engineering) and Climate Outreach provides training to scientists in how to engage non-expert audiences and navigate communication roles (using my advocacy spectrum).

scientists talking to fellow scientists. Better communication skills and practices within the scientific community will increase the community's ability to be confident in recognising if communications are engaging in policy advocacy or not, and in identifying the presence of biased science or if there has been an abuse of position.

5. Summary

In this chapter, I returned to my interview data to show how scientists demonstrate that they are communicating in a way that preserves scientific credibility and independence (i.e. not creating biased science or abusing their position). These actions are important for scientists to use whenever they communicate as they can help to provide assurances to the scientific community that they are not engaging in stealth advocacy. The second part explored how scientists accurately communicate which role they are attempting to communicate in; the methods that they use to manage contextual factors. Here, I outlined the experiences of interviewees when they communicate and how they categorised the different tensions that arose for them and others when they sought to communicate in particular ways. As a result, I gathered examples of different methods that interviewees have used in order to reduce these tensions (both from the scientific community as an audience, and other audiences). that they experience as a result of the influence of contextual factors. These methods also include how scientists can improve their communication skills, increase their awareness of the effects of contextual factors, as well as helping to demonstrate that their scientific credibility and independence has been maintained. By using these methods, scientists can engage in different communication roles across the whole advocacy spectrum with credibility and independence, and help to make sure that the scientific community (as well as possibly the target audience they are communicating with) see them as communicating in the same role. Thus, by using these methods, scientists can engage in acceptable policy advocacy and guard against accusations of stealth advocacy.

7. Conclusion

In this thesis, I have demonstrated how climate scientists can engage in what they view as an what they perceive their community and peers to consider as acceptable policy advocacy by providing theoretical understanding and practical methods for doing so. This has included:

- generating a new theoretical framework for the different types of communication roles for scientists (my advocacy spectrum);
- outlining a new understanding as to why scientists may experience different tensions when operating in these roles (my description of the influence of contextual factors);
- conducting interviews with 47 climate scientists, creating a rich qualitative data set their views about policy advocacy and their methods for managing the influence of contextual factors;
- examining the theoretical arguments for and against scientists engaging in policy advocacy and clearly demonstrating how policy advocacy may theoretically be acceptable for scientists to engage in; and
- developing a set of practical actions that scientists can deploy to help them evidence that their science is not biased and that they are not abusing their position, and to manage the influence of contextual factors.

This thesis has the potential to change the science-policy and science-public discourse on climate change, if more climate scientists now feel more confident about engaging in acceptable policy advocacy.

I have explored the different definitions of advocacy and demonstrated that a variety of advocacy types exist, and that they vary in their acceptability for audiences. When focusing on what is acceptable for the scientific community, this acceptability is based on the concern that science may be biased or that the scientist is abusing their authoritative position. However, not all advocacy results in biased science or an abuse of position. Indeed, advocacy in the defence of science was described by interviewees as a duty that scientists should fulfil. In certain circumstances, to not engage in advocacy would be to not fulfil scientific values, such as accuracy, rigour, or universalism. As their scientific community are the only ones that have the expertise to examine the scientific rigour and the bounds of each other's expertise (they are in the ivory tower), they are the audience that is best able to judge if the science that has been created is biased, or if the scientist is abusing their position by virtue of their expertise. Therefore, if scientists can demonstrate to the wider scientific community that their science has not been biased in light of their advocacy, and that they have not abused their authoritative position, then they can be said to have engaged in acceptable advocacy. This is to say, that it is acceptable to the extent that these concerns have been allayed for the scientific community. Other audiences may still need convincing, but this is related to how they trust the scientific community to regulate what is said in the name of science. The audience, be it the scientific community or non-experts, may still take objection to the *content* of what it is the scientist has advocated, but the act of engaging in advocacy has been a permissible one.

I presented my advocacy spectrum in Chapter Two as a way to conceptualise the different (acceptable) roles that scientists can communicate in. In Chapter Four, I presented this spectrum to interviewees. It proved to be very fruitful, and was strongly supported by my empirical data and could be used to explain the tensions and positions that scientists experienced in real life. This spectrum therefore contributes to the science communication literature in providing a way to conceptualise different communication roles for scientists in practice, including advocacy roles, and provides a method for registering the influence of contextual factors on scientists' communications. The spectrum included the 'non-engagement in policy' role – a role which can be described as being typical 'SciComm' where the climate scientist is seeking to communicate scientific knowledge without any reference to policy (for example, describing the 'greenhouse effect'). The 'policy advice' role is where scientists communicate science to policy makers and help inform policy based on scientific evidence. The two advocacy roles, 'action advocacy' and 'specific policy advocacy', are defined by the extent to which scientists advocate for policy action – from 'do something, anything other than this' through to 'do this specific policy in this specific way with this specific timeline'. Both require the presence of some form of political value (either widely shared or disparate values) which are not part of science's set of values.

Indeed, science does have values. As explored in Chapter Five, the value-free ideal for science is simply not desirable as we (in a modern western democratic society) wish science to have values to govern it in order to help us identify what is 'good' and 'bad' science. However, there are a set of values that we do not wish to have a direct influence in the way science is conducted – political values. It is these values that inform policy advocacy positions. Therefore, to hear scientists discussing political values may give cause for concern if the audience fears that the science may be in danger of having political values directly influence its creation. This is true of both non-expert and expert audiences. Indeed, interviewees expressed a great concern that their colleagues might perceive them as engaging in unacceptable advocacy, which could potentially damage their careers.

Unacceptable advocacy is a legitimate concern, and one that can be raised despite the attempts of climate scientists to avoid engaging in advocacy. The theoretical literature in Chapter 5 described just how undesirable biased science is, but also demonstrated that not *all* advocacy results in biased science. Science is valued because of the type of knowledge it creates – knowledge that is not dependent upon one's political values in order for it to be applicable. I also argued that scientists, by virtue of science's value, have value in society. Their value is because: (a) they contribute to the creation of scientific knowledge, and (b) they are able to understand the scientific knowledge (at least the parts relating to their area of expertise). Advocacy poses a threat to the first by the way of biased science, and to the second by abuse of this position. Abuse of position can happen in a number of ways: stealth advocacy (claiming to just be stating the science when they're actually smuggling in political views), claiming expertise when they do not have it, and using their expertise to give added weight to views unrelated to their expertise. Stealth advocacy is not acceptable, and neither is abusing their authoritative position to lend weight to arguments outside of their area of expertise. However, guarding against abuse of position is dependent on being able to define areas of expertise and stating values. Defining expertise is a difficult thing to do, mainly because it is relative to the presence of others. Stating values, however, includes stating motivations, which may include stating political values. Whilst scientists can hold political values, they must not allow them to influence the way in which they conduct their scientific research.

Contextual factors are a central aspect to mapping communications on the advocacy spectrum. Also in Chapter Two, I make a list of contextual factors and describe how they can influence how an audience interprets communications, which can result in the scientist being interpreted as communicating in a different role to the one they were aiming for on the advocacy spectrum, including unacceptable advocacy. I explained how, when a scientist communicates, it is like firing an arrow at a target. As the arrow flies through the air, contextual factors can shift the course of the arrow, meaning that it lands in a different place on the target board (or misses it entirely). Contextual factors are all about how an audience perceives and interprets a communication, and are related to three components of communication: the voice, the content, and the audience position. The voice relates to how the background of the scientist(s) influences how the audience interprets a message, as well as the influence of whether a scientist is communicating on their own or with others. The content includes the substance of what is being communicated (that is, the actual topic of communication), the communication method, and the framing used to present the information. The audience position encompasses the influence of the audience's worldviews, and the political conditions being experienced alongside the communication. Each of these factors can influence a scientist's communication and mean that the audience perceives them as engaging in, for example, specific policy advocacy, when the scientist was trying to just give policy advice. Even engaging in silence, via the influence of contextual factors, can result in being mapped on the advocacy spectrum (or indeed off it in unacceptable advocacy). Interviewees said that they had experienced the influence of contextual factors on their communications, and that concerns about biased science and abuse of position were reasons why they avoided policy advocacy.

In further conversation with interviewees in Chapter Six, I was able to learn more about their experience in communication, the tensions they experience when communicating in different roles, and how they experienced and managed the influence of contextual factors. In doing so, I derived eight 'methods for matching mapping' which allow scientists to: (1) demonstrate that they are not engaging in unacceptable advocacy (biased science or an abuse of position), and (2) manage the influence of contextual factors to increase the likelihood that the audience interprets the scientist's communication as being the same one that the scientist was intending to communicate in. In presenting these methods for matching mapping, I have given practical guidance for how scientists can engage in acceptable policy advocacy, as well as being interpreted as engaging in a communication role in the way they intended.

Crucially, I have not argued for whether scientists *should* engage in advocacy or not. I, like many of my interviewees, hold that this fundamentally remains the *choice* of the scientist. I think scientists should engage in policy advocacy *if they want to.* There may be separate arguments about what scientists may feel morally bound to do (such as speaking up in defence of science), but I have not explored this in great depth in this thesis. And nevertheless, this would still be a choice made by scientists. Instead, as it is acceptable for citizens to engage in advocacy, and all scientists are citizens, this thesis has explored *how* scientists *qua* scientists can engage in policy advocacy in an acceptable way. In doing so, I have tried to be explicit about separating out objections relating to the *act* of advocacy and objections relating to the *content* of advocacy. This thesis demonstrates the ways by which it is acceptable for climate scientists to engage in the *act* of policy advocacy, but we might still object to them engaging in policy advocacy based on the content of their advocacy (for example, hate speech).

This thesis has also been limited to examining the acceptability of advocacy *as defined by scientists themselves*. As mentioned previously, I chose to focus this thesis on the scientists' perceptions about advocacy. From my pilot interviews and discussions with scientists and non-scientists, the concerns about advocacy seemed to be closely related to perceptions about biased science and abuse of position. Scientists are also the most concerned about losing credibility with their colleagues. I reasoned that due to the complexities of explaining expert knowledge to a non-expert audience, fellow scientists have the best knowledge and expertise to review the science and scope of expertise of a scientist, and thus would be the suitable group to consult; non-experts *trust* the scientific community to police scientists engaging in unacceptable advocacy. Whilst many of the concerns about advocacy may be shared by non-experts, there remains the possibility that a non-expert audience may have different concerns that this thesis has not explored. Indeed, a non-expert audience may have entirely different ideas as to what acceptable advocacy looks like for scientists – or they may not be concerned at all about scientists engaging in advocacy. Similarly, the methods used to demonstrate that there has not been biased science or an abuse of position may be satisfactory for the scientific community and what it is *they* think will be helpful for a non-expert audience, but a non-expert audience may need further assurances that unacceptable advocacy has been engaged in. However, non-experts do not have the expertise to define what counts as credible science. They also lack the expertise to know when an expert is speaking outside of their area of expertise. It is in these two things – biased science and abuse of position – that advocacy poses a threat to the *scientific* credibility and independence of a scientist, and the only audience that can judge this is the *scientific* community. This thesis has not explored the acceptability of advocacy *as perceived by a non-expert audience* – rather, it has explored the perceptions that scientists have about themselves, their community, and others in their community.

1. Future research and recommendations

The scope for future research is very wide indeed. For example, I interviewed climate scientists individually, and only in the context of the UK and USA. Further research could expand this to explore in more detail the communication dynamics of scientific bodies and collectives, and the context of other countries. As mentioned in my introduction, this thesis assumed the role of science within a democratic society. Further research could examine how tensions relating to policy advocacy differ in different societies. In non-democratic contexts, we might expect to find a different role for science in decision making and different concepts about the role of citizens, and thus experience different tensions in science communication. However, I think there are three main areas that would be particularly interesting to research further: expanding to other disciplines, examining the tensions of advocacy for different types of communicators, and understanding in more detail the effect and impact of the communication methods I outline in Chapter Six. First, whilst this thesis has focussed on the communication of climate scientists, given the particular political context of conversations about policy responses to climate change, the findings may apply to other fields too. The advocacy spectrum and communication methods may apply to other sciences that are also concerned with the threat that advocacy presents to credibility and independence. For example, as mentioned in this thesis' introduction, conservation biology has wrestled with the issue of policy advocacy for some time. Similarly, medical scientists are often called upon to comment on policy, particularly when a threat to human health has been identified, as demonstrated in the recent coronavirus outbreak.

Second, further research should look into widening the scope of communicators to others that communicate science, such as science communicators, NGOs, the media, and government bodies. Indeed, as covered in Chapter Five, it is not always easy to define between who counts as a scientific expert and who does not. The tensions may differ for different communicators. Due to their relative distance from the production of scientific knowledge, they may not so acutely feel (if at all) the tensions between engaging in advocacy and having to demonstrate that there has not been an abuse of position or biased science. They may instead face different challenges in engaging in policy advocacy and may have different (or have no) duties towards upholding of scientific credibility and independence.

This may result in different communication roles, different blurred boundaries, and different responses to the influence of contextual factors.

Third, developing the methods in Chapter Six with rich examples and empirical research also constitutes an important area for future research. This would also help to address the limitations in this thesis relating to these principles have been formed solely based on scientist's perception of what they think is needed for navigating the influence of contextual factors. Further research could include exploring the principles that may be derived from audience perception, which may help to identify further principles, and possibly even indicate which principles may be more influential for certain types of communication or audience. This research could explore what concerns (if any) different audiences may have about scientists engaging in policy advocacy, and how they differentiate between what is acceptable and unacceptable forms of advocacy. For example, understanding which particular analogies engage particular audiences best in understanding scientific uncertainties, or which methods work best for communicating values to an audience. Empirical research could be designed so as to ascertain which methods are most effective in matching spectrum mapping between communicator and the audience. For example, to what extent would establishing a common set of political values for a field of research - either in order to define a new research agenda based on common values (like conservation climate change), or find a way of facilitating a statement of belief from climate scientists (like a Hippocratic oath) - help scientists in navigating policy advocacy relating to their field of research. This further research would help to add to the understanding of the effects that different types and methods of communication have on audience perception of science communication roles.

As well as recommending my methods for matching mapping, my research has raised some other issues for consideration. As mentioned in Chapter Six, interviewees expressed a desire for training on communications. They often receive media training as part of their development from their respective institutions, but these often focus more on how to interview well and get key messages across on camera. Some interviewees also expressed a desire to know more about the philosophy of science (for example, the types of knowledge created by science and the role of values in science), and how to engage in reflexive practice to identify their own values and world views. None of my interviewees said that they had received formal training on how to engage the public with climate change – instead, they said it was something that they 'just did'. There are some institutions that will offer training on public engagement (particularly for school work, for example), but in general, there is little in the way of training for climate scientists for public engagement and talking with policy makers. Some organisations such as the American Association for the Advancement of Science (AAAS),[1] the Royal Society,[2] and the Wellcome Trust[3] offer training in science-diplomacy and public engagement. However, none of these training courses relate specifically to communicating climate change. Climate change, as mentioned in the introduction, is a topic which is inherently hard to engage with because of psychological distancing (amongst other things). Climate Outreach[4] have just launched a training programme specifically for climate scientists, training them in methods developed by social science research that best engage audiences with climate change. My advocacy spectrum, contextual factors, and mapping methods are included as part of this training workshop.

Some interviewees also expressed a desire that the public receive more education in the sciences, and that increasing the public's general scientific knowledge (and then specific knowledge about climate change) would make public engagement easier. I would agree that reducing the 'gap' between lay and expert knowledge would tend towards making public engagement easier in the sense that it may reduce the extent to which the science needs to be simplified for public comprehension. There are concepts that would be much easier to communicate if the public had an improved level of scientific literacy. However, contextual factors still play a role in issue engagement that are not necessarily linked to levels of education (such as political views). Therefore, advocacy for public education needs to be careful not to stray into the 'knowledge-gap' conceptualisation of science communication. A specific area for improved public understanding would be in what type of knowledge science creates – that certainties will always exist, and that the value is in the scientific method.

Interviewees expressed a desire to receive more specific training in (lay) public engagement, and I would recommend that this is something that scientists should indeed receive if they want it.[5] However, access to training means reviewing how the role of scientists is perceived. If society values scientists communicating their research, particularly in different ways such

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1 https://www.aaas.org/program/center-science-diplomacy/training
2 https://royalsociety.org/grants-schemes-awards/meet-the-scientists/
3 https://wellcome.ac.uk/what-we-do/our-work/public-engagement-support-researchers
4 https://climateoutreach.org/advice-and-training/

5 Here, I am using 'public engagement' to mean engagement beyond the academy, and thus mean both communications with policy makers and the lay public.

as through public engagement, then this needs to be recognised as part of the role of scientists. As mentioned in Chapter Six, interviewees sometimes felt unsupported in their communications work. Whilst some funding proposals require the scientist to engage in some form of public engagement or result dissemination, interviewees felt like this was often done poorly. Some did receive support from their institutions but felt that a lot of their public engagement was done in their own time and was not formally recognised by their employer, despite the employer encouraging them to do it. By formally recognising that public engagement is part of a scientist's job role (and by 'formally recognising' I mean accounting for public engagement activities in the scientist's time and/or renumeration, and professional development), interviewees felt that it would be something they could dedicate more time to, and greatly improve in. I would echo this and recommend that scientists' public engagement activities are more formally recognised. In doing so they are likely to enhance the public engagement activities that occur.

2. Summary

Scientists have control, albeit to a limited extent, over how it is they communicate and are perceived as communicating. The aim of this thesis was to test if there was a way to engage in acceptable advocacy, and if so, to demonstrate how it can be done in practice, so that climate scientists can make the decision about how to engage in it or not.

I have shown that engaging in policy advocacy is perceived by scientists and their peers to be permissible for scientists so long as they are able to demonstrate that they have not created biased science or abused their position in doing so. I have also provided a new way of conceptualising science-policy interaction, including defining different types of advocacy, and creating a new way of understanding how one operates in these roles. My advocacy spectrum was designed to match the experience and practice of climate scientists which is something that other science-policy models fail to do. I also provide an answer to why scientists sometimes experience tensions that are usually associated with communicating in different roles - that is the influence of what I call 'contextual factors'.

In accompanying my theoretical work with empirical analysis, I have been able to test that my theories really do work in practice, and have been able to enrich the theoretical work with practical examples. In doing so, I have created a rich qualitative data set - 46 hours' worth of interview recordings with most fully transcribed - with climate scientists in the UK and USA describing their thoughts and opinions in great depth on and around the subject of policy advocacy. This has not been done before. From this data, I have also developed practical steps for scientists to adopt for demonstrating that their advocacy is not an abuse of expertise nor as a result of biased science, and to help limit the influence of contextual factors on their communications. This creates a way for climate scientists qua scientists to engage in acceptable policy advocacy.

For the climate change science community, I hope this provides reassurance that there are ways they can speak out and engage in policy advocacy that are acceptable to their scientific community, regardless of career stage or area of expertise, and ways to avoid engaging in policy advocacy. It remains the case that no matter how skilled a scientist is in managing contextual factors, an audience may still see them as engaging in unacceptable advocacy. In the case of climate change science, this is not uncommon as it is such a politically polarised subject. This only emphasises the need to understand what counts as acceptable policy advocacy for climate scientists, and to identify the methods that ensure that the policy advocacy is acceptable. For some audiences, however, the content of the communication has become so objectionable that they do not value climate change science. The methods for matching mapping can still be useful for communicating with these audiences. By building a dialogue, understanding the audience's world view, and framing communications in a way that resonates with the audience, scientists may just be able to delay the knee-jerk dismissal of climate change. Now, more than ever, it is crucial that we take action on climate change and develop policies that will help to sustain habitats for life (of course, assuming that is commonly held value). This will need input from climate scientists, and this thesis has shown that climate scientists qua scientists can engage in policy advocacy and identified methods for doing so. This has the potential to greatly influence our decision-making processes, and to mean that we hear a lot more from scientists on policy action.

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Appendices

List of Interviewees

Below is a list of the people I interviewed for this research project, and to whom I am most grateful for their time, honesty, carefully expressed thoughts, and encouragement:

Prof. Michela Biasutti, Lamont Associate Research Professor, Lamont-Doherty Earth Observatory, Columbia University, USA.

Prof. Ken Caldeira, Senior Scientist at Carnegie Institution for Science, USA**.**

Prof. Jason Chilvers, Professor of Environment and Society, University of East Anglia, UK.

Prof. John R. Christy, Director of the Earth System Science Center, Distinguished Professor of Atmospheric Science, University of Alabama, USA.

Prof. Mat Collins, Joint Met Office Chair in Climate Change, University of Exeter, UK.

Dr. Judith Curry, President of Climate Forecast Applications Network, USA.

Dr. Thomas L. Delworth, Senior Scientist at GFDL/NOAA, Faculty Member in Atmospheric and Oceanic Science at Princeton University, USA.

Prof. Chris Field, Perry L. McCarty Director, Stanford Woods Institute for the Environment, Standard University, USA.

Prof. Dave Frame, Director of the New Zealand Climate Change Research Institute, University of Wellington, NZ.

Dr. Peter Gleick, President Emeritus of the Pacific Institute, USA.

Dr. Stephen M. Griffies, Lecturer in the Princeton University Atmospheric and Oceanic Sciences Program, Princeton, USA.

Dr. Luke Harrington, Postdoctoral Research Assistant, Environmental Change Institute, University of Oxford, UK.

Dr. Zeke Hausfather, Berkeley Earth, USA.

Prof. Isaac Held, Senior Research Scientist at GFDL/NOAA, USA.

Dr. Helene Hewitt, Science Fellow and Manager of the Ocean Modelling Group, Met Office, UK.

Prof. Mark Z. Jacobson, Professor of Civil and Environmental Engineering, Director of Atmosphere/Energy Program, Stanford University, USA.

Dr. Rachel James, Supernumerary Teaching Fellow, St John's College, University of Oxford, UK.

Prof. Philip Jones, Professorial Fellow, Climatic Research Unit, School of Environmental Sciences, University of East Anglia, UK.

Prof. Manoj Joshi, Professor of Climate Dynamics, University of East Anglia, UK.

Dr. Sarah Kapnick, Deputy Division Leader & Research Physical Scientist in Seasonal to Decadal Variability and Predictability Division, GFDL/NOAA, USA.

Dr. Till Kuhlbrodt, Model Configuration Manager for UKESM, National Centre for Atmospheric Science, UK.

Dr. Allegra N. LeGrande, Physical Research Scientist, NASA Goddard Institute for Space Studies, New York, USA.

Dr. Michael Mastrandrea, Director of Near Zero, Senior Research Associate at the Carnegie Institution for Science.

Prof. Denise Mauzerall, Department of Civil and Environmental Engineering and the Woodrow Wilson School of Public and International Affairs, Princeton University, USA.

Prof. Sonali McDermid, Assistant Professor in the Department of Environmental Studies, New York University, USA.

Mr Asher Minns, Executive Director of the Tyndall Centre for Climate Change Research, University of East Anglia, UK.

Dr. Doug McNeall, Climate Scientist and Statistician, Met Office Hadley Centre, UK.

Prof. Michael Oppenheimer, Albert G. Milbank Professor of Geosciences and International Affairs; Director of Centre for Policy Research on Energy and the Environment.

Dr. Friederike E. L. Otto, Acting Director of the Environmental Change Institute, and Associate Professor, Climate Research Programme, University of Oxford, UK.

Prof. Stephen W. Pacala, Frederick D. Petrie Professor in Ecology and Evolutionary Biology, Princeton University, USA.

Dr. Matt Palmer, Lead Scientist: Sea Level, Met Office Hadley Centre, UK.

Prof Amilcare M. Porporato, Department of Civil and Environmental Engineering and Princeton Environmental Institute, Princeton University, USA.

Prof. Corinne Le Quéré, Royal Society Research Professor of Climate Change Science at the University of East Anglia, UK.

Prof. Laure Resplandy, Assistant Professor of Geosciences and the Princeton Environmental Institute, Princeton University, USA.

Dr. Benjamin D. Santer, Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, USA.

Dr. Gavin A. Schmidt, Director, NASA Goddard Institute for Space Studies, New York, USA.

Prof Jason Smerdon, Lamont Research Professor, Lamont-Doherty Earth Observatory, Columbia University, USA.

Prof. David Stevens, Professor of Applied Mathematics, University of East Anglia, UK.

Dr Naomi Vaughan, Senior Lecturer in Climate Change, University of East Anglia, UK.

Prof. Gabriel Vecchi, Professor of Geosciences and at the Princeton Environmental Institute, Princeton University, USA.

Dr. Craig Wallace, Senior Research Associate, School of Environmental Sciences, University of East Anglia, UK.

Prof. Rachel Warren, Professor of Global Change and Environmental Biology, University of East Anglia, UK.

Dr. Michael White, Senior Editor, Climate Sciences - Nature Magazine, USA.

Mr Daniel Williams, Manager of Climate Knowledge Integration, Met Office, UK.

Dr. Phillip Williamson, Honorary Reader and NERC Science Coordinator, School of Environmental Sciences, University of East Anglia, UK.

Two other interviewees wish to remain anonymous.

List of Nodes for Coding

1. **DEFINING ADVOCACY**
    1.1. What Advocacy is
        1.1.1. Framing as Advocacy
    1.2. What Advocacy is not
        1.2.1. Manipulation
        1.2.2. Support
        1.2.3. SciComm
        1.2.4. Advice
        1.2.5. Stealth Advocacy
    1.3. Unclear definition-understanding
    1.4. Advocacy Spectrum
        1.4.1. Areas
            1.4.1.1. Non-engagement
            1.4.1.2. Policy Advice
            1.4.1.3. Action Advocacy
            1.4.1.4. Specific Policy Advocacy
        1.4.2. Boundaries
        1.4.3. Mapping on Spectrum
            1.4.3.1. Factors effecting mapping
        1.4.4. Feedback
            1.4.4.1. Positives
            1.4.4.2. Criticisms
    1.5. Silence as Advocacy

2. **ACCEPTABLE ADVOCACY**
    2.1. Real Examples
        2.1.1. Jim Hansen
            2.1.1.1. Good
            2.1.1.2. Bad
            2.1.1.3. Mixed
        2.1.2. Real Time Attribution Science
            2.1.2.1. Good
            2.1.2.2. Bad
            2.1.2.3. Mixed
    2.2. Theoretical Examples
        2.2.1. Acceptable advocacy
        2.2.2. Unacceptable advocacy
        2.2.3. Uncertain about acceptability
    2.3. Funding
        2.3.1. Advocacy for
        2.3.2. Tensions relating to
    2.4. Identifying Audience
        2.4.1. Acceptable for Policy Makers
        2.4.2. Acceptable for General Public
        2.4.3. Acceptable for Scientific Community

3. **SCIENTIFIC ATTRIBUTES**
    3.1. Values
        3.1.1. Individual

3.1.2. Shared
3.1.3. Conflicting values
3.1.4. Managing values
3.1.5. Communicating Values

3.2. Expertise
3.2.1. Defining-Identifying expertise
3.2.2. Limits of expertise
3.2.3. Boundaries of expertise
3.2.4. Abuse of expertise
3.2.5. Relationship with other characteristics

3.3. Consensus
3.3.1. Roles of consensus
3.3.2. Tensions of consensus
3.3.3. Pros/cons of consensus
3.3.4. Strength of consensus
3.3.5. Type of consensus

3.4. Authority
3.4.1. Defining-Identifying authority
3.4.2. Limits to authority
3.4.3. Threats to authority
3.4.4. Abuse of authority

3.5. Integrity
3.5.1. Defining-Identifying integrity
3.5.2. Importance-Role of Integrity
3.5.3. Type of integrity
3.5.4. Threats to integrity

3.6. Credibility
3.6.1. Defining-Identifying credibility
3.6.2. Importance-Role of credibility
3.6.3. Type of credibility
3.6.4. Threats to credibility

3.7. Humility
3.7.1. Defining-Identifying humility
3.7.2. Importance-Role of humility
3.7.3. Tensions of humility

3.8. Diversity
3.8.1. Defining-Identifying diversity
3.8.2. Importance-Role of diversity
3.8.3. Tensions of diversity

3.9. Interdisciplinarity
3.9.1. Defining interdisciplinarity
3.9.2. Importance of interdisciplinarity
3.9.3. Relationship to other characteristics

4. RIGHTS & DUTIES

4.1. Role-Duty of Science
4.1.1. In a democracy
4.1.1.1. 'Honest Broker'
4.1.1.2. 'Policy Adviser'
4.1.1.3. 'Pure Scientist'
4.1.1.4. 'Science Arbiter'

4.2. Role-Duty of Scientists
4.2.1. In a democracy
4.2.2. In scientific community
4.3. Role-Duty of Citizens
4.3.1. In a democracy
4.4. Freedom of Speech
4.4.1. Right to
4.4.2. Limitation of

5. ETHICS OF COMMUNICATION
5.1. Communication Frames
5.1.1. Choosing frames
5.1.2. Framing Uncertainties
5.1.3. Framing risk
5.2. Ethical Obligations
5.2.1. 'Sounding the alarm'
5.2.2. Being a reliable source
5.2.3. Correcting false statements
5.2.4. On being correctly understood
5.3. Communication Styles
5.3.1. Activism
5.3.2. Mediums of communication
5.4. Audience
5.4.1. Audience interaction
5.4.2. Audience identification
5.4.3. Audience influence
5.4.4. Responsibility for reaction
5.4.5. Forming dialogue
5.5. Motivations

6. PRACTICAL METHODS
6.1. Speaker
6.1.1. Expertise
6.1.1.1. Identifying and staying within area of expertise
6.1.1.2. Passing on to other experts
6.1.1.3. Acknowledging limits
6.1.1.4. Acknowledging transfer
6.1.2. Forming Consensus
6.1.2.1. For group agreement
6.1.2.2. For speaking as a group
6.1.2.3. With diversity
6.1.3. Motivations
6.1.3.1. How to recognise them
6.1.3.2. How to analyse them
6.2. Message
6.2.1. Recognising influences
6.2.2. Stating Values
6.2.2.1. Practical methods
6.2.2.2. Being reflexive
6.2.2.3. Being honest
6.2.2.4. Being personable

- 6.2.3. Forming content
- 6.2.4. Communicating uncertainties
- 6.2.5. SciComm
  - 6.2.5.1. Good practice examples
- 6.3. Delivery
  - 6.3.1. Communication Medium
- 6.4. Audience
  - 6.4.1. Identifying the audience
- 6.5. Achieving Dialogue
  - 6.5.1. Forming relationships
  - 6.5.2. Cultivating trust
  - 6.5.3. Listening well
- 6.6. Groundwork
  - 6.6.1. Science Education for non-scientists
  - 6.6.2. Training for Scientists
    - 6.6.2.1. Philosophy of Science
    - 6.6.2.2. Handling Journalists
    - 6.6.2.3. Handling Sceptics
    - 6.6.2.4. Reflexive practice
    - 6.6.2.5. In how to speak to non-experts

7. TENSIONS IN COMMUNICATING

- 7.1. Communicating Uncertainties
- 7.2. Maintaining Trust. Integrity, Credibility
- 7.3. Complexity
- 7.4. Unknowns
- 7.5. Value-shoulds
- 7.6. Perception of Risk
- 7.7. Politically polarised problem
- 7.8. Competing Issues
- 7.9. Can't separate citizen from scientist

8. OTHER KEY WORDS OR THINGS

- 8.1. Views on Objectivity
- 8.2. Motivations or Rewards
- 8.3. Boundary Groups
- 8.4. In defence of Science
- 8.5. Career progress differences
- 8.6. Civil servants vs HE
- 8.7. Non-related Advocacy
- 8.8. Reasons for non-engagement
- 8.9. Personality traits
- 8.10. IPCC
- 8.11. Applied Science
- 8.12. Dynamics of groups vs individuals
- 8.13. Publications & Peer Review
- 8.14. Country Differences