Sea change or still water?

A triadic analysis of ideal roles, the relevance of science and experience, and quality assurance in the public climate debate

Peter Busch Nicolaisen

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Preface

Partly driven by a genuine interest in the climate question, and partly animated by an urge to feed a hungry ego bordering on the insatiable, I enrolled as a PhD student almost three and a half years ago.

While my wish to prove that I belong among the intellectual elite undoubtedly has been a significant impetus spurring me in this direction, it cannot be regarded as a sufficient condition. Before conceiving of the research idea that turned into this dissertation, I was planning to apply for a PhD grant with a proposal to examine the impact of science on certain areas of policy. In my master's thesis, I had investigated the spillover of the discourse present in the IPCC reports on the climate rhetoric of the two largest political parties in Denmark and how it translated into their policy proposals. The tentative PhD project was an attempt to build on the latter component of the master's thesis, employing the idea in other policy fields such as the health area, and I suspected that such a proposal would be in high demand from an assessment committee.

However enticing the thought of becoming a PhD was, I did not feel profoundly engaged with the topic and ended up aborting the application. It struck me that my motivation hinged on the climate element, and I therefore guided my brainstorm to blow in this direction. After a fruitless couple of weeks, I was on the verge of giving up on the ambition of becoming a PhD student, but then suddenly, one Sunday evening I had a revelation while watching a game of football. I got my girlfriend to fetch a piece of paper, and within a few minutes, I gave birth to the idea that has been realised here.

My initial excitement has been enduring, and unlike many other PhD students, I have never doubted the relevance of my project. I think that the sense of doing meaningful research has helped me through the tough moments, and quitting has never been an option although my course as a PhD has had its fair share of cobblestone sectors. The hardship I have faced as a PhD student, not least my father nearly dying three times during the past two and a half years, made a timely finish unattainable. While it was disappointing not to hand in on time, I am nevertheless very satisfied with the product you are about to consume. However, as much as I would like to take full credit for this dissertation, it would be very far from the truth.

Usually, PhD students thank their partners at the end of texts like these, but in my case, it would be unjust not to first mention my girlfriend, Trine Nygaard Johansen. Ever since she succeeded in noting down my erratic talk when the idea dawned on me that Sunday evening, she has been heavily involved with the project. She has operated as a research assistant in most of my

focus groups, transcribed interviews, proof-read all my papers, helped find references, and engaged in countless hours of conversations in English to ease my feeling of having subpar verbal proficiency, just to name a few of the tasks she has carried on her broad shoulders. There is no doubt that Trine is the undisputed MVP of my support team.

My supervisor Mads P. Sørensen also deserves to be acknowledged for guiding me to the finish line. He onboarded when I had eight months left of my contract and the project was in a dire state. Our biggest argument occurred at the first meeting when I suggested that he could function as a lead out man delivering me to the final sprint in an optimal position. He objected to my proposal but bought into the cycling metaphor by offering to act as a *directeur sportif* instead, yelling commands and cheering from behind. Fortunately, he has kept the yelling at a minimum, and I have really enjoyed his informal approach to supervision. Our scheduled meetings have been productive, but I have benefitted even more from the many improvised sessions of supervision in either of our offices, at the stairs, or in the hallways. I have grown greatly by feeling his confidence in me, and the encouragement he has provided me with has fuelled my ambitions to produce high-quality research. The effort of the only constant in my supervision line-up, co-supervisor Tine Ravn, also merits praise. She has always delivered meticulous feedback, and her ability to be highly critical and thoughtful at the same time is admirable. Every time I have reached out, she has been very willing to help.

Among my other colleagues at the Danish Centre for Studies in Research and Research Policy, there is a host of people to whom I owe a debt of thanks to. Although his influence on my research has been modest, Emil Bargmann Madsen is the one towards whom I feel most gratitude. He is probably the person I know who has the most well-calibrated moral compass. I appreciate that he has sided with me when I have met injustice and listened in times of adversity. In all honesty, I have needed him more than vice versa, and he is probably my friend more than I am his. Andreas Kjær Stage has also shown a great amount of care for my well-being and has surpassed the expectations of an ordinary colleague in this regard. For instance, I remember when he called me during one of the lockdowns solely to check if I was doing okay. It was very warming to experience that my welfare sincerely mattered to him.

Turning to the academic aspect, Serge Pascal Johannes Maria Horbach, a professor in the making by my best estimate, has been a treasured sparring partner for me. My papers have been strengthened noticeably from being exposed to his sharp eye. I have also gained a lot from the exchanges with my fellow PUS colleagues, Simon Fuglsang and Lucilla Losi, both of whom have been enthusiastic critics of my work. Duncan Thomas, Jens Peter Andersen, and Lise Degn have also provided valuable input along the way.

On a practical level, the service from the corps of student assistants at the centre has been immense. Mads Kruse and Mia Woer have been particularly involved. The former has been a reliable aid in preparing and conducting a handful of focus groups, while the latter impressively maintained both her sanity and good spirits despite transcribing the lion's share of focus groups and in record time as well. I am thankful that the centre director, Carter Bloch, agreed to assign so many student assistant hours to my project, and I am also grateful that he decided to let me keep my office after I exceeded the official deadline for handing in the dissertation. The mix of a vast amount of expense claims and a distracted nature seemingly constitutes a secretary's nightmare, but I remain impressed with how our centre secretary, Jane Frølund Irming, has handled this poisonous combination as she has continually kept her cool and afforded me the same welcoming treatment that she has given my more orderly colleagues. On a side note, I would like to applaud Ebbe Krogh Graversen for the way he led the RTO project on which we cooperated. His leadership at eye-level was inspiring, and if I ever become a project manager, he will be my role model.

A considerable amount of recognition should also go towards the personnel at the Department of Communication and Media Research at the University of Zürich, who massively contributed to my pleasant and rewarding stay abroad. Professor Mike Schäfer was more generous with his time than I had any right to expect, and his refined feedback provoked hours of reflection. My officemates in Switzerland, Niels Mede and Daniela Mahl, did everything to help me settle in. I value their hospitality and the interest they have shown in my research.

My best friend, Kasper Lyngholm Larsen, should also be saluted for the time he has spent going over the considerable quantity of text I have sent him during my time as a PhD. His editing has improved the readability of my work, and I have usually accepted his suggestions wholeheartedly. The services of the language editors at the Department of Political Science have also been highly useful with respect to the linguistic fine-tuning of my work.

Finally, I want to pay homage to the focus group participants who dedicated several hours of their lives to discuss climate science communication, thereby paving the way for this dissertation. All the people in my network who helped me in the recruitment phase also deserve appreciation.

Peter Busch Nicolaisen
Aarhus

Chapter 1: Introduction

The first time I came to reflect on the role of journalists was during my first semester as a student at the Danish School of Media and Journalism. During the introductory course, we were presented with four different conceptions of the role of journalism in a democracy. These ideal types drew on canine imagery (Bro, 2006, pp. 68–70). Accordingly, journalists could act as watchdogs barking when discovering problematic conduct from those in power, hunting dogs biting on to wrongdoers until a resolution prevailed, rescue dogs trying to engage citizens in the solution of societal problems, or herding dogs facilitating public deliberation just for the sake of it. As the remaining curriculum of the initial semester revolved around learning the practical basics of the craft such as researching and interviewing, the awareness of roles quickly faded and did not resurface subsequently.

I spent almost half of my four years of journalistic education as an intern, a mandatory requirement bespeaking the school's learning-by-doing approach. The first year I worked at Aarhus University's internal newspaper. Tasked with interviewing scientists across the entire spectrum, I had to comprehend complex physiological research on venous pumps one day and talk to a psychologist about his most recent study on pathological gambling the next. Often, my lack of prior knowledge on the subjects I covered deprived me of critical questions. Moreover, during this period, I noticed the pronounced difference in scientists' attitudes towards public communication. While some took obvious joy in discussing their research, others were difficult to schedule appointments with and acted disengaged during interviews. It thus seemed that some scientists preferred to keep their outreach activities at a minimum to concentrate on doing research and teaching instead. This impression was reinforced in subsequent freelance projects as I sometimes came across researchers who would not contribute to journalism out of sheer principle. However, I also encountered examples of the opposite: scientists transgressing their area of expertise during interviews to comment on subjects they had not studied.

During the last six months of my internship, I was employed by the Danish Agriculture & Food Council, and one of my primary responsibilities was to browse the daily newspapers to see if they wrote anything pertinent to the agricultural sector. While scrutinising the diurnal media output, the climate reporting of one journalist caught my attention, and soon my scanning of that outlet was more targeted at his byline than at the presence of stories relevant

to the council. Hitherto, I had had slight interest in the climate issue. In high school, I was taught about the greenhouse effect and had watched 'An inconvenient truth' (Gore, 2007), but it had not really caught on, and my involvement with the subject was average at best. The incisive climate coverage of the experienced journalist in question nevertheless ignited something in me. It radiated from his stories that he was deeply worried about the future climate, and article by article, this concern was transferred to me. A large part of his persuasiveness hailed from the fact that he clearly knew what he was writing about. He was on top of the science that featured in his stories, not overwhelmed by it as I had been as an aspiring science journalist.

I was not sure which kind of dog he was, and, in some cases, he might have deviated from the neutral reporting style that had been highlighted as the golden standard at the school. Nevertheless, his work had a profound impact on me. Suddenly, I felt that I ought to follow the climate debate closely due to the weight of the problem posed by an increase in the global average temperature. I had developed an inclination to judge people that spoke about their detachment with the subject, and I felt guilty and less qualified as a voter if I temporarily failed to keep myself updated. At some point, I started doubting whether the expectations that I held for others and myself were warranted. Likewise, considerations emerged about whether different rules applied to climate journalists compared to their colleagues working other beats. Based on my experience with both hesitant and extremely media-eager scientists, I wondered which type of communicative behaviour would be appropriate from climate scientists. Was it okay for a climate scientist to take on the role as a stray dog trying to escape the public eye? Ultimately, these experience-based ruminations gave way to the research idea that eventually turned into this dissertation. I imagined that I could convene climate scientists, climate journalists, and citizens in a kind of tripartite negotiation of their respective rights and responsibilities.

My first move as a PhD student was to expose the perplexity about the appropriate roles of climate scientists, climate journalists, and citizens to the scientific literature. This manoeuvre exacerbated it. When I inquired into the extant scholarship related to the three roles, I got the impression that these fields were abundant with unresolved questions. For instance, something as basic as the need for journalistic coverage of science was debated. The advent of social media as forums for dissemination and discussion of science, so-called Science Communication 2.0, was seen as a threat to science journalism as it provided citizens with a platform to create their own science coverage and communicate directly with the scientists, bypassing the media while doing so (Bucchi, 2017). However, the idea of knowledge-based journalism seemed to offer

journalists an opportunity to retain their relevance in relation to the deliberation of science in general (Donsbach, 2014; Patterson, 2013) and climate change in particular (M. C. Nisbet & Fahy, 2015). By becoming more science savvy, journalists can arm themselves to interrogate the processes and products of climate science more autonomously (M. C. Nisbet & Fahy, 2015, p. 228) and accordingly create a unique selling proposition for climate journalism.

The role of citizens in the societal discussion of scientific topics also happened to be a moving target. While the picture of the public was once that of apathetic bystanders, focus has more recently been on the participatory potential of citizens (Bauer et al., 2007; M. S. Schäfer, 2009). In the mould of this thinking, the concept of scientific citizenship suggests that members of modern knowledge societies should be faced with certain entitlements and obligations vis-à-vis the public conversation on science-related subjects: a right to be included in such discussions and a duty to obtain the requisite scientific competence to meaningfully participate in them (Mejlgaard & Stares, 2010, p. 548). However, due to the omnipresence of science-based issues on the public agenda, citizens are faced with a potentially endless list of subjects to engage with, and some sort of discrimination is, therefore, required (Elam & Bertilsson, 2003, p. 247). In this regard, climate change has been proposed as an evident candidate for citizens to embrace their scientific citizenship, as the regulatory regimes enacted to reduce CO_2-emissions will profoundly impact the lives of people worldwide (Blue, 2017).

Scientific citizenship is one way of addressing the alleged need to minimise the distance between science and society by moving the latter closer to the former. However, scientists have also been urged to draw closer to society by furthering their public engagement activities (Shugarta & Racaniello, 2015). This call has not least been levelled at climate scientists who are argued to bear a special responsibility for discussing their research publicly (Anderegg, 2010; Hansen, 2007; Lubchenco, 1998; Oreskes, 2020). The question of how to properly enact this obligation is nevertheless a contested one, and scientific advocacy is at the forefront of this dispute. One faction of scholars disapproves normative communication from climate scientists because they suspect that a prescriptive approach will undermine climate science's mandate as a provider of facts (Lackey, 2007; Oppenheimer, 2011), whereas others contend that climatologists should be allowed to use their knowledge proactively to create the biggest possible impact in society (Ellis & Trachtenberg, 2014; Schmidt, 2015).

Many aspects of the research connected to the roles of climate scientists, climate journalists, and citizens are subsumed by the notion of post-normal science communication (Brüggemann et al., 2020). This theory expects the three actors to inhabit new roles as a response to the post-normal circumstances (uncertainty, high stakes, disputed values, and urgency) surrounding

climatology. It is presumed that the role set of climate scientists and climate journalists will overlap as both will act as advocates and interpreters of scientific facts, while citizens are predicted to undertake a more active role in climate science communication.

What emerged on the backdrop of inspecting the concerned literature was an image of three roles purportedly in flux. This merited an investigation of the ideal role perceptions of the three actors to examine whether this trend is manifested here. A prerequisite for a reconstitution of the roles in what I in the following refer to as 'the triangle of climate science communication' would thus be that the change is reflected in the actors' self-understanding. However, if the modification of the role was opposed by other significant actors in the climate communication ecosystem, it would be difficult to bring to fruition. It therefore appears reasonable to not only consider the three actors' perceptions of their own role but also explore their outlook on the roles of the other two actors. Based on this insight, the dissertation seeks to shed light on the following research question:

> *How do climate journalists, climate scientists, and citizens perceive the ideal roles of themselves and one another in climate science communication?*

Two of the papers in this dissertation are dedicated to furthering the understanding of this research question. In Article 1 (Busch Nicolaisen, 2022b), I review the extant empirical literatures on the ideal roles of climate scientists, climate journalists, and citizens to confront the theoretical assumption about changing role prescriptions with how the actors have actually been found to conceive of the three roles across time and space. Article 2 (Busch Nicolaisen, 2022c) is also propelled by an intent to empirically probe the speculation about a recasting of the roles in climate science communication. Whereas Article 1 strives to create an overview of the entire relevant literature, Article 2 zooms in on the Danish context to examine the ideal role perceptions of climate scientists, climate journalists, and citizens in a particular setting, using focus group methodology.

From the beginning of the PhD project, it was my intention to produce three articles during the period. The content of the third article was long unresolved, although I was inclined towards writing a methodological paper based on my experiences with employing a research design comprising a mix of heterogeneous and homogeneous groups in the focus group study. While conducting the focus groups, it nevertheless dawned on me that knowledge seemed to be a recurrent theme in the conversations. This hunch was sustained as I began analysing the material. It was apparent that a considerable

part of the focus group data revolved around negotiating the relevance of scientific and experiential knowledge in the public deliberation on climate change.

Amid the analysis phase, I realised that the knowledge-related aspects of my data could feed into the longstanding argument within science studies about the incorporation of lay input in discussions of scientific topics (Collins & Evans, 2002; Funtowicz & Ravetz, 1993; Wynne, 1992). Recently, a plea to increase the receptivity to non-scientific voices has been directed specifically at climate science (Dudman & de Wit, 2021), further promoting the need to examine how central actors in climate science communication assess the applicability of scientific and experiential knowledge.

This dialectical process between data and theory encouraged the second research question of the dissertation:

> *How do climate scientists, climate journalists, and citizens negotiate the relevance of scientific and experiential knowledge in the public climate debate?*

Another thread running through most focus groups was the maintenance of a healthy public climate debate featuring a minimum of misinformation. This theme paired well with the scholarly discussion on journalists' contested position as gatekeepers, induced by the rise of the internet and social media and the ensuing enablement of an unmediated public sphere (Bogaerts & Carpentier, 2012; Vos, 2020). The evolution of the media landscape has been pointed out as particularly relevant to science journalism (Bucchi & Trench, 2014, p. 9). On the one hand, the technological development has granted citizens the opportunity to independently seek out information (Dunwoody, 2014, p. 27), but on the other, it has been deemed a potential threat to the quality of the knowledge dispersed (Brumfiel, 2009, p. 275; Bucchi, 2017; Bucchi & Trench, 2014, p. 9).

The third research question of the dissertation is directed at this puzzle and asks:

> *Who should ensure the quality of the knowledge claims proposed in the public discussion of climate-related subjects according to the three actors?*

Article 3 (Busch Nicolaisen, 2022a) investigates the latter two research questions by applying a different analytical lens to the focus group data than Article 2. It provides empirical testament to how scientific and experiential knowledge are weighed in connection to a specific subject, the climate, while also exploring the continued relevance of journalistic gatekeeping in the Science Communication 2.0 era.

The common denominator of the three articles is the interest in the interaction between climate scientists, climate journalists, and citizens. Further, they share a normative framing. Article 1 and Article 2 are preoccupied with how the actors should ideally behave, whereas Article 3 enquires into the appropriate application of different forms of knowledge and the preferred actor to ensure the quality of the knowledge claims put forth in the public conversation of climate-related issues. Table 1 displays how the three papers of the dissertation are related to each other in terms of their subject matter and methodology.

Table 1: Overview of studies by theme and approach

Theme	**Role perceptions**	**Knowledge**	
Paper	Article 1: Role Perceptions in Climate Science Communication (Published in *Environmental Communication*)	Article 2: A State of Emergency or Business as Usual in Climate Science Communication? A Three-Dimensional Perspective on the Role Perceptions of Climate Scientists, Climate Journalists, and Citizens (Published in *Science Communication*)	Article 3: Orchestrating the Climate Choir: The Boundaries of Scientific Expertise, the Relevance of Experiential Knowledge, and Tackling Misinformation
Approach	Literature review	Focus groups	

The three articles form the empirical basis of this PhD. They constitute chapters 4, 5, and 6, respectively. The research of this dissertation draws upon theories stemming from the sociology of scientific knowledge, science communication, and journalism studies. Chapter 2 introduces the somewhat eclectic theoretical framework that has guided my work, while Chapter 3 situates the dissertation in the interpretive methodological tradition and details the methods applied in the collection and analysis of data. Whereas chapters 4, 5, and 6 contain discussions of the findings from the individual studies, Chapter 7 discusses the results from the three articles in conjunction. In Chapter 8, the dissertation is concluded by recapitulating the most important findings, summing up the overall contribution, and sketching out directions for future research in this area.

Chapter 2: Theory

This chapter will start by introducing the two most central theoretical themes of the dissertation: ideal roles and knowledge. It will proceed to consider the diverse set of theories from the sociology of scientific knowledge, science communication, and journalism studies that has informed the research agenda pursued in this dissertation, namely post-normal science, post-normal science communication, Studies of Expertise and Experience (the Third Wave of Science Studies), Science Communication 2.0, knowledge-based journalism, and scientific citizenship. The aim is not to outline the individual theories in their totality, but rather to give an overall outline of each and a justification of their relevance in relation to the study of climate science communication. In the final section, I will provide a synthesis of how the insights of the various theories were combined into the theoretical framework that underlies the research of this dissertation.

Ideal roles

The role concept can be approached from a range of angles as it lends itself to studies of how roles are enacted, how they are expected to be carried out, or how the enactment and the expectation align (Biddle, 1979). In the climate science communication literature, there are examples of the first two types of inquiry. The enactment aspect has been examined by content analyses of the journalistic coverage of climate change (M. T. Boykoff, 2008; Dotson et al., 2012; Evans, 2016) as well as by explorations of how climate scientists and citizens communicate on social media (Arlt et al., 2018; Lörcher & Taddicken, 2017; Metcalfe, 2020; Walter et al., 2019). Further, a range of studies have inspected how climate journalists and climate scientists make sense of their own roles (Brüggemann & Engesser, 2014; Getson et al., 2020; Gibson et al., 2016; Hiles & Hinnant, 2014; Sharman & Howarth, 2017; Tøsse, 2013). Turning to the general literature on the journalistic profession, Mellado's work on the link between journalists' role performance and their role conceptions is a specimen of research of the third type (Hellmueller & Mellado, 2015; Mellado & van Dalen, 2014).

In this dissertation, the focus is exclusively on the perceptual level as the guiding theoretical notion of Article 1 and Article 2 is ideal roles. In line with Giddens' definition of a social position, I understand a role as:

> a social identity that carries with it a certain range (however diffusely specified) of prerogatives and obligations that an actor who is accorded that identity (or is an 'incumbent' of that position) may activate or carry out. (Giddens, 1979, p. 117)

Together, these prerogatives and obligations represent the role prescriptions connected to a certain position. As this dissertation attends to the ideal roles of climate scientists, climate journalists, and citizens, the aim is not to determine the current delineation of the prerogatives and obligations connected to each role but rather what the actors' think they should be. The idealistic approach serves to enable an abstraction from the present practice of climate science communication and allows the dissertation to tap into the three actors' injunctive norms, i.e., what should be done, rather than their descriptive norms, i.e., what is being done (Cialdini et al., 1990; Kallgren et al., 2000; Lapinski & Rimal, 2005, p. 130; Reno et al., 1993). As this dissertation examines a potential alteration of the three roles, it will be suitable to study the injunctive norms as these might reveal ideals that will materialise in later behaviour (L. G. E. Smith et al., 2015). In general, inquiries into role expectations would be irrelevant if they had no bearing on role enactment. However, 'the idea that expectations generate behavior' is 'endemic to most versions of role theory' (Biddle, 1986, p. 79). This mechanism can work in two ways as actors may either feel pressured to conform to the expectations of their surroundings or simply internalise them (J. Jackson, 1998, p. 50). Along the same lines, Ajzen's theory of planned behaviour proposes that beliefs about the reaction of significant others, i.e., members of peer groups, is one of the pivotal background factors driving behaviour (Ajzen, 1991, 2005).

A cornerstone in Giddens' thinking about role prescriptions is their malleable nature. Giddens thus distances his interpretation of the role concept from the notion of a role as a fixed entity (Giddens, 1984, p. 84), which he associates with functionalism (Parsons, 1967) and symbolic interactionism (Goffman, 1959). In agreement with his structuration theory,[1] Giddens emphasises the mutually constituting relationship between agents and roles. Agents are not just formed by the roles they inhabit as the practice of agents can potentially serve to reproduce new role prescriptions (Giddens, 1979, pp. 117–118). The belief that role prescriptions can change over time is integral to the research of this dissertation as it rests on the suspicion that the expectations towards

[1]Giddens' structuration theory is most extensively outlined in *The Constitution of Society* (Giddens, 1984) and concerns the formation of social practices. It proposes that social practices are not the product of the forces of either structures or agency but that they are instead generated by a continuous interplay between the two determinants.

climate scientists, climate journalists, and citizens are undergoing transformation.

Aside from its emphasis on plasticity, Giddens' role concept also accentuates the likelihood of contestation over the meaning of a given role. He problematises the presumption that roles are formed by a 'unity of normative expectations' and that 'a consensus in a social system about what those expectations are' exists (Giddens, 1979, p. 116). However, as noted by Jackson, it is critical that role occupants in counter-positions like physicians and patients 'share the behavioural expectations associated with their positions in society' (J. Jackson, 1998, p. 50). Combining Giddens' awareness of the conflict potential associated with the negotiation of role prescriptions and Jackson's stress on the need for aligned expectations for 'social interaction to run smoothly' (J. Jackson, 1998, p. 50) and applying these insights to climate science communication underscores the pertinence of investigating the mutual expectations of climate scientists, climate journalists, and citizens. Perhaps less obvious than in Jackson's patient–doctor example, these three actors can also be argued to be situated in counter-positions in relation to the public discussion of climate-related issues.

According to Giddens, the role concept can only be applied sensibly under circumstances where 'the normative rights and obligations associated with a specific identity are relatively clearly formulated' (Giddens, 1984, p. 86). While this is undoubtedly the case for climate scientists and climate journalists, the role of citizens in climate science communication appears vaguer. However, the idea of a scientific citizenship provides the contour of what the citizen role could entail by proposing a package of rights and responsibilities reserved for members of modern knowledge societies (Mejlgaard & Stares, 2010, pp. 547–548). By engaging with this borderline case, the present dissertation therefore serves to explore the boundaries of the appropriate use of the role concept.

Knowledge

A neighbouring agenda to the one on ideal roles in climate science communication regards knowledge. It pertains to the relevance of different sorts of knowledge, scientific and experiential, in the public climate debate as well as how the quality of the knowledge claims introduced here should be ensured. These two lines of inquiry criss-cross as the ideal communicative behaviour of climate scientists and citizens likely depend on how their contributory potential is evaluated, while the quality assurance aspect is tied to the role of climate journalists. These knowledge-related questions are investigated by Article 3. In this section, I will define these rather elusive constructs and position them

within current scholarly debates in the fields of public understanding of science and science communication.

I will not attempt to give a thorough examination of the vast literature on epistemology as this is not needed to understand the more practice-oriented utilisation of the knowledge concept employed in this dissertation. Instead, I will concentrate on a narrow selection of elements from the epistemological literature that are relevant for my purpose. Zagzebski's introduction to the anatomy of knowledge is helpful in this regard. She discriminates between two meanings of knowledge: knowledge by acquaintance and propositional knowledge (Zagzebski, 2017, p. 92). Knowledge by acquaintance pertains to the subject's familiarity with elements of reality, e.g., Climate Scientist A knows Climate Scientist B because they have collaborated on a project. Propositional knowledge on the other hand relates to the true propositions one can make about the world, e.g., Climate Scientist A knows that the global average temperature has increased during the last century. It is the second connotation of knowledge that is of interest to this dissertation as propositional knowledge in contrast to knowledge by acquaintance is easily conveyed from one person to another (Zagzebski, 2017, p. 92) and therefore applicable in a communicative context. When a scientific study on the status of the Antarctic ice sheet suggests a certain level of melting, it is thus an example of propositional knowledge.

The conventional understanding of propositional knowledge posits that it is embodied by justified and true beliefs (Bolisani & Bratianu, 2018, p. 3; N. Lemos, 2007, p. 9; Zagzebski, 2017, p. 100). Specifically, the justified true belief formula suggests that a person can be said to have knowledge of something when he or she believes it, has justification for the belief, and the belief is true (Bolisani & Bratianu, 2018, pp. 3–4). This definition of knowledge has been opposed in the epistemological literature on the grounds that it does not account for instances where 'the truth is reached by chance', so-called Gettier cases (Gettier, 1963; Zagzebski, 2017, p. 100). However, such objections operate on a more theoretical level than what is relevant for this dissertation, and the standard definition of knowledge is workable for the objective targeted here. This concept of knowledge is useful for the research of this dissertation because it can comprise both scientific and experiential knowledge. Under this paradigm, science-based and experience-based knowledge can be seen as separate types of knowledge with diverging ways of justifying truth propositions.

Shapin calls science 'our culture's most highly valued form of knowledge' (Shapin, 1995, p. 292). Nevertheless, it has been deemed difficult verging on infeasible to provide a one-size-fits-all definition of science (Chalmers, 2013, pp. 227–228). Ziman furnishes a persuasive rendering of this 'peculiar institution' and the knowledge it produces (Ziman, 2000, p. 1). Ziman endorses a

middle ground between the glorification of science found in certain traditions within the philosophy of science and the hypercritical approach towards scientific knowledge associated with the sociology of scientific knowledge. Hence, he is opposing 'the legend' of science where the activities of scientists are perceived to successfully generate the 'complete true story of the world' (Kitcher, 1995, p. 3), and yet, he refuses to equate scientific knowledge with other forms of knowledge (Ziman, 2000, pp. 1–5). Ziman acknowledges that scientific knowledge, like other knowledge types, is the product of human minds situated in certain cultures and that it, by way of the human ingredient, may be affected by 'folly, incompetence, self-interest, moral myopia bureaucracy, anarchy and so on'; however, he also stresses that the 'distinctive institutional characteristics of science' marks out scientific knowledge as a special branch of knowledge (Ziman, 2000, pp. 5–6). The peer-review process whereby the quality of scientific knowledge is guaranteed is one of the most prominent of the institutional traits connected to science (Petts & Brooks, 2006, pp. 1046–1047), although the efficacy of this procedure has been questioned (Schwartz & Zamboanga, 2009; R. Smith, 2006).

As implied by the concept of the knowledge society, scientific and technical knowledge are claimed to have 'penetrated all spheres' of advanced societies (Stehr, 2003, p. 647). Moreover, Stehr argues that risk assessment is a case in point regarding the 'scientization' of modern societies (Stehr, 2018, p. 314). Climate change is perhaps the most pressing example of a modern risk with a strong scientific constituent (Brossard & Lewenstein, 2009, p. 11). According to Weber, 'the slow and gradual modification of average climate conditions is difficult to detect and track accurately based on personal experience' (Weber, 2010, p. 332), and the climate challenge is therefore a good fit for the statistical language of science (Weber, 2010, p. 334). A similar point is made by Moser and Dilling who contend that:

> the lack of direct experience makes climate change – at least for now – fundamentally a problem that requires signalling, illustrating, and explaining from those who have expert knowledge to those who don't (Moser & Dilling, 2011, p. 163).

Without explicitly referencing Beck, Weber – along with Moser and Dilling – classify climate change among the risks that the former would characterise as 'second-hand non-experiences'. Beck considers this family of risks as being 'by nature beyond perception' (Beck, 1992, p. 72) and thus only possible to explore by scientific means (Sørensen & Christiansen, 2012, p. 84). Accordingly, scientific knowledge has been instrumental in defining climate change and continues to serve as a focal point in the public climate debate (Blue, 2017, pp. 89–90; Dudman & de Wit, 2021, pp. 2–4; Sarewitz, 2011, p. 479). Indeed, the

centrality of science to the societal deliberation of climate change has been so thoroughly manifested that non-scientific input has purportedly been marginalised. The climate science–society interface has hence been claimed to be 'haunted by older "deficit" models of science communication, with an underlying assumption that the public is somehow lacking in knowledge' (Pearce et al., 2015, p. 619) (Cook & Overpeck, 2019). A construct originally conceived of by Wynne (Wynne, 1993, p. 335), the deficit model connotes a style of science communication where scientific knowledge is perceived as superior and is transmitted to the public in a unidirectional fashion (Brossard & Lewenstein, 2009, pp. 12–13; Gross, 1994, pp. 5–6; Pearce et al., 2015, p. 619).

Due to the widespread recognition of the deficit models' futility in engaging the public with climate science, Cook and Overpeck insist that it is time to overthrow it and pursue a more egalitarian mode of climate science communication (Cook & Overpeck, 2019). A similar call is made by Dudman and de Wit who propose that the climate scientific community should tone down 'the speaking agenda' and increasingly embrace 'the listening agenda' (Dudman & de Wit, 2021). They suggest that climate communication has hitherto been excessively preoccupied with scientific representations of the climate challenge, resulting in a negligence of potentially important non-scientific input:

> *Listening* thus seeks to create new spaces for reciprocity that previously did not exist. If climate change communication is to truly escape the deficit model, it must itself explore new avenues for dialogue that is receptive rather than instrumental; it must listen to more than science for knowledge worth communicating, and challenge its institutional collaborators to reciprocate the openness they seek to cultivate in public audiences (Dudman & de Wit, 2021, p. 6).

Dudman and de Wit's plea for increased mutuality in climate science communication is in tune with what Trench terms 'the grand narrative in public communication of science and technology' since the late 1990s, namely the transition from deficit to dialogue (Trench, 2008, p. 120). The appeal for more dialogical science communication largely receives its impetus from a pair of dizygotic twin assertions: that science is not always right and that the public is able to contribute more useful input than has traditionally been assumed. Wynne is among the leading proponents of these contentions as his widely recognised case study on Cumbrian sheep farmers serve to display both the limitations to scientific knowledge as well as the valuable stock of 'local knowledge' possessed by non-scientists (Wynne, 1992, 1996, pp. 62–67). The case study details how a group of government-appointed scientists ignored non-scientific forms of knowledge and gave misleading advice to hill sheep farmers in the Lake District of Northern England following the Chernobyl crisis. What unites Wynne's criticism of how the Cumbrian sheep farmers were treated following

the Chernobyl fallout and Dudman and de Wit and Wynne's objection to modern climate science communication is the emphasis on the need to listen to voices outside science. This implies a reconsideration of the relevance of experiential knowledge for discussions with a strong scientific element. Experiential knowledge can be seen as 'knowledge based in the lives and histories of real communities, such as local farming or agricultural practices' (Brossard & Lewenstein, 2009, p. 15) or as expertise derived from 'everyday observation' when engaging in specific social practices (Irwin et al., 1999, pp. 1312, 1320).

A more dialogical regime in the public discussion of climate science cannot be instituted by force. The idea of a tyranny of dialogue is not particularly alluring after all. A new order in climate science communication can thus only come about by being backed by central actors in the link between climate science and society. By examining how climate scientists, climate journalists, and citizens perceive the role of scientific and experiential knowledge in the public climate debate, Article 3 inspects the foundation for a reconstruction of the traditional knowledge hierarchies. If, for example, citizens do not recognise their own potential to contribute experiential input to the societal debate of climate-related issues or the journalists do not see them as suited sources, or the climate scientists are not receptive to the thought of including non-scientists in the conversation, the appeal for increased reciprocity seems like a distant fantasy. Focusing on the role of scientific and experiential knowledge in conjunction opens the possibility of observing the interrelation between the actors' appreciation of the two knowledge types. It can thereby help to reveal whether a critical view towards science and a positive evaluation of lay input go hand in hand as one might guess based on the work of Wynne.

The appropriate way of ensuring the quality of the knowledge claims put forth in the public climate debate is one of the main themes of Article 3. Addressing knowledge management in organisations, Peters et al. define a knowledge claim as a contention that concerns the way things are or will be and can, therefore, take the form of either a description, explanation, prediction, or evaluation (K. Peters et al., 2010, p. 244). When stated publicly, such claims can be subjected to what they term 'knowledge claim evaluation', the process by which 'articulated hunches, beliefs, proposals, and plans' are either rejected or become 'accepted knowledge' (K. Peters et al., 2010, p. 244). When applying the concept of knowledge claim evaluation in the context of the public discussion of climate change, it becomes clear that it intersects with the notion of gatekeeping (i.e., the selection of newsworthy information deserving public diffusion), a task traditionally associated with the journalistic profession (Janowitz, 1975; Vos, 2016). When traditional media were still undisputed as the prime vehicles of public discourse, journalists could, therefore,

be seen to act as the key knowledge claim evaluators. In their capacity as gatekeepers, journalists serve to validate the factual claims of their sources (Gamson, 1999, pp. 23–24). However, according to Bucchi and Trench, the emergence of social media (this development will be discussed further in the section on Science Communication 2.0 below) has lessened journalists' 'centrality as filters and guarantees of the quality of information' featuring in the public debate on scientific issues (Bucchi & Trench, 2014, p. 9) (Bucchi, 2013, p. 905; Bucchi & Trench, 2014, p. 9). This is a consequence of the fact that the new media environment has paved the way for citizens to curate and disseminate information independently (O'Neill & Boykoff, 2010, pp. 241–242; Vos, 2020, p. 90). However, Trench depicts the online public sphere on science as a 'noisy bazaar of traders bidding for attention' (Trench, 2007, p. 136), and in keeping with this, Dunwoody maintains that the identification of 'good information requires effort on the part of the individual searcher' (Dunwoody, 2014, p. 27). As part of an argument for the continued relevance of science journalism, she contends that 'the typical individual rarely expends' the required resources to seek out valid information (Dunwoody, 2014, p. 27). Further, Schäfer highlights the body of facts connected to climate change as especially difficult to manoeuvre due to the intricacy of the subject (M. Schäfer, 2011, p. 3). This dissertation therefore aspires to elucidate how the three actors prefer to delegate the responsibility for certifying the knowledge advanced in the public climate debate in a time when this chore does not self-evidently lie with the journalists.

Post-normal science

Roughly a decade before online platforms provided the set-up for further public participation in science-laden discussions, Funtowicz and Ravetz noted that developments within science merited that non-scientific perspectives were increasingly included when deliberating certain scientific topics. Hence, in the early 1990s, they proposed the concept of 'post-normal science' as a new way of doing science that matched the emerging challenges of 'global environmental and other complex political and technical issues' (Funtowicz & Ravetz, 1990, p. 20). They define post-normal science in contrast to Kuhn's 'normal science' (Kuhn, 1962), which entails 'routine puzzle solving' and steady advances (Funtowicz & Ravetz, 1993, p. 740). According to them, these new risks are characterised by four attributes:

> in what we call 'post-normal science', we can think of it as one where facts are uncertain, values in dispute, stakes high and decisions urgent (Funtowicz & Ravetz, 1993, p. 744).

Funtowicz and Ravetz argued that science had achieved a hegemonic position in modern societies based on its success in explaining and controlling natural phenomena (Funtowicz & Ravetz, 1993, p. 741). However, they asserted that the picture of science as a value-neutral enterprise manufacturing certain knowledge was waning (Ravetz, 1999, p. 648) and that it was getting progressively obvious that the traditional way of knowledge production was unable to handle the peculiar essence of post-normal issues. In their view, a new conception of science was warranted:

> The old dichotomies of facts and values, and of knowledge and ignorance, are being transcended. Natural systems are recognized as dynamic and complex, those involving interaction with humanity are 'emergent', including properties of reflection and contradiction. The science appropriate to this new condition will be based on the assumptions of unpredictability, incomplete control, and a plurality of legitimate perspectives (Funtowicz & Ravetz, 1993, p. 739).

Hence, a core argument of Funtowicz and Ravetz' is that science is not self-sufficient to handle post-normal problems as it cannot singlehandedly resolve the uncertainty and value questions ingrained in these challenges. As a remedy to the inadequacy of science in tackling post-normal issues, Funtowicz and Ravetz recommend the introduction of an extended peer community comprising non-scientific actors (Funtowicz & Ravetz, 1993, pp. 740–741; Ravetz, 1999, p. 651). By providing 'extended facts' extracted from their own experiential horizon, the extended peer community is not simply meant to establish a 'democratic element in the life of science' (Funtowicz & Ravetz, 1993, p. 741). Instead, its primary purpose is to provide 'a parallel enrichment of the cognitive basis of post-normal science' (Funtowicz & Ravetz, 1990, p. 22):

> The extension of the peer community is then not merely an ethical or political act; it can positively enrich processes of scientific investigation. Knowledge of local conditions may determine which data are strong and relevant, and can also help to define policy problems. Such local, personal knowledge does not come naturally to the subject-specialism experts whose training and employment predispose them to adopt abstract, generalized conceptions of genuineness of problems and relevance of information. Those whose lives and livelihood depend on the solution of the problems will have a keen awareness of how the general principles are realized in their 'back yards' (Funtowicz & Ravetz, 1993, p. 753).

With the endorsement of an extended peer community, the thinking of Funtowicz and Ravetz aligns with a significant cluster of empirical research from the sociology of scientific knowledge highlighting the value of experiential input to discussions of scientific matters (Epstein, 1995; Irwin et al., 1999; Wynne, 1992, 1996). Although more than 30 years has passed since the term post-normal science was coined, it remains a continuous reference point for

scholarship on the science–society nexus (Brossard et al., 2019; Brüggemann et al., 2020; Martin et al., 2020). However, the concept has also received its fair share of criticism along the way. One line of objection pertains to its descriptive validity (Turnpenny et al., 2011; Weingart, 1997). Turnpenny et al. provide a forceful articulation of this point:

> However, in haste to acknowledge the political, there is a danger of setting up a dichotomy between times when issues were tame and science was normal, and now, when issues are wicked and a post-normal approach is required [...] Did such a change ever really happen; has science ever been normal, or is it more that the political conflicts have now moved into a different, more public, arena? (Turnpenny et al., 2011, p. 301).

Another strand of scepticism towards the theory concerns the fuzzy nature of the idea of an extended peer community (Collins & Evans, 2002, p. 282; Turnpenny et al., 2011, p. 300; Yearley, 2000):

> Though people are said to bring "extended facts" of these societal problems, it is unclear how their factuality is attested to and into what forum such considerations are brought. They say neither whom the peer community should be extended to include, nor what the criteria by which these new peers should make their assessments (Yearley, 2000, p. 110).

The application of post-normal science in this dissertation is largely aimed at interrogating these alleged soft spots of the theory. While Article 1 and Article 2 primarily draw on Brüggemann et al.'s amendment (Brüggemann et al., 2020) (discussed subsequently) to post-normal science, the findings of these papers still reflect on the work of Funtowicz and Ravetz as they, by varying means, examine the influence of post-normality on the ideal roles of climate scientists, climate journalists, and citizens. Article 3 likewise investigates the footprint of post-normal thinking but with a focus on how the role of disparate kinds of knowledge in the public climate deliberation is perceived by the three actors. In doing so, Article 3 also grapples with the critique regarding the vague conceptualisation of the extended peer community as it explores how the three actors think lay perspectives should feature in the public climate debate. Overall, the three articles therefore help to appraise the explanatory power of post-normal science by analysing the degree to which post-normal tendencies are imbedded in the actors' perceptions of ideal roles and the relevance of different knowledge types. Further, Article 3 provides cognisance of the actors' view on the mandate of a potential extended peer community.

Climate science communication appears a highly suited arena for the study of post-normal science's bearing on reality as climate science is generally regarded as a prototypical example of a post-normal field (Bray & Storch, 1999; Carvalho, 2009, p. 487; Funtowicz & Ravetz, 1990, p. 20; Krauss et al.,

2012; Saloranta, 2001). The projection of the future development of the climate is thus highly uncertain as the IPCC estimates for global surface temperature change by the year 2100 range from slightly less than +1.5°C to almost +5°C compared to the pre-industrial period (IPCC, 2022a, p. 16). Further, climate change is riddled with disagreement potential (Hulme, 2009), concerns 'increasingly severe, interconnected and often irreversible impacts' on 'ecosystems, biodiversity, and human systems' (IPCC, 2022a, p. 5), and requires acute societal transformations (United Nations Environment Programme, 2022, p. 15). Hence, all four criteria (uncertainty, disputed values, high stakes, and urgency) of a post-normal issue are 'easily fulfilled' (Krauss et al., 2012, p. 123).

Post-normal science communication

In the slipstream of Funtowicz and Ravetz' post-normal science framework, Brüggemann et al. recently advanced the concept of post-normal science communication (Brüggemann et al., 2020). Whereas post-normal science was marketed as a new method for doing science (Funtowicz & Ravetz, 1990), post-normal science communication's primary objective is to apply the insights of Funtowicz and Ravetz to predict a new role configuration for scientists and journalists in the public discussion of post-normal issues. A major contribution of Brüggemann et al. is therefore to theorise about how post-normal circumstances might impact science journalism as the original theory of post-normal science did not ponder the effect of post-normality on the media coverage of such subjects.

The principal claim of Brüggemann et al. is that the cocktail of post-normal situations, a changing media landscape, and polarising societies will invoke the emergence of a new catalogue of norms among scientists and journalists that will lead them to embrace a range of non-traditional roles (Brüggemann et al., 2020, p. 10). Due to the politicisation and urgency associated with post-normal topics like climate change, Brüggemann et al. expect the prevailing objectivity norm in science and journalism to be sacrificed at the altar of post-normality as scientists and journalists increasingly act as advocates (Brüggemann et al., 2020, pp. 10–11). Further, to amend the confusion about what constitutes valid knowledge in debates on post-normal subjects and to mitigate the pronounced polarisation of these, post-normal science communication anticipates that scientists and journalists will increasingly function as interpreters of scientific facts and dialogue brokers (Brüggemann et al., 2020, pp. 11–12). While the role of citizens is not a chief concern of post-normal science communication, Brüggemann et al. foresee the realisation of the ex-

tended peer community and herald participation as an emerging norm in science communication (Brüggemann et al., 2020, p. 12). Table 2 illustrates the new setting of roles in science communication as it is envisioned by Brüggemann et al.

Table 2: The role configuration in post-normal science communication as proposed by Brüggemann et al. 2020

Actor type	Role in post-normal science communication
Scientists	Advocates Interpreters of scientific facts Dialogue brokers
Journalists	Advocates Interpreters of scientific facts Dialogue brokers
Citizens	Extended peer community

Post-normal science communication is a central concept in this dissertation as both Article 1 and Article 2 strive to probe the empirical resonance of the predictions proclaimed by the theory. By extensively scrutinising the literature on the ideal roles of climate scientists, climate journalists, and citizens, Article 1 observes whether the new norms proposed by Brüggemann et al. can be traced in the current corpus of research on the subject, while Article 2 explores if novel role perceptions have materialised in the Danish context of climate science communication.

Studies of Expertise and Experience (the Third Wave of Science Studies)

In the wake of the growing scholarly attention to the value of lay input in discussions of scientific matters, including Funtowicz and Ravetz' idea about the extended peer community, Collins and Evans reckoned that the time was ripe to develop 'a normative theory of expertise' (Collins & Evans, 2002, p. 237). They envisioned that this endeavour would be the basis of a new research agenda, 'Studies of Expertise and Experience' (Collins & Evans, 2002, p. 236). This programme would come with a clear mission statement:

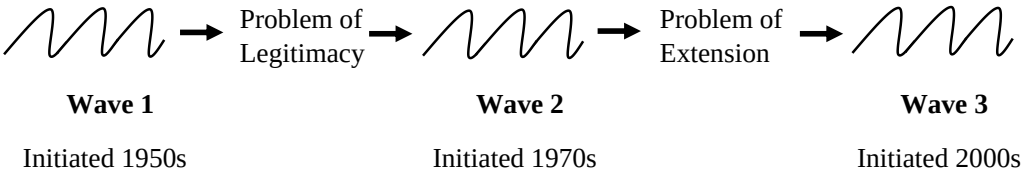
> Our problem [...] is to find a clear rationale for the expansion of expertise. But a satisfying justification for expansion has to show, in a natural way, where the limits are. Perhaps this is not today's practical problem, but with no clear limits to the widening of the base of decision-making it might be tomorrow's (Collins & Evans, 2002, p. 237).

They argue that Studies of Expertise and Experience should be the main feature of a Third Wave of Science Studies that will serve to ameliorate the shortages of its predecessor (see Figure 1 for overview of waves). In a seminal discussion paper from 2002, Collins and Evans thus identify two previous waves of science studies, each of which have deficiencies from their perspective (Collins & Evans, 2002, pp. 239–240). Per Collins and Evans, the first wave unfolded during the 1950s and 1960s and was marked by social science's failure to question the legitimacy of science (Collins & Evans, 2002, p. 239). The uncritical attitude towards science was remedied by the second wave, the social constructivist tradition of science studies that formed in the 1970s and still thrived when they wrote the discussion paper (Collins & Evans, 2002, p. 239). However, according to Collins and Evans, the resolution of one bind spawned another as the second wave of science studies introduced the so-called Problem of Extension in replacement of the Problem of Legitimacy associated with the first (Collins & Evans, 2002, p. 237). The Problem of Extension has a normative character and concerns the appropriate extent of participation in technical decision-making (Collins & Evans, 2002, p. 237). As apparent from the above quote, the Third Wave of Science Studies is intended to engage with this question. The mission of Collins and Evans is nevertheless not merely diagnostic. Departing from the claim that 'expertise is real' (Collins & Evans, 2002, p. 237), they proceed to prescribe a cure for the social studies of science's current ailment as they aim to '[…] hammer a piton into the ice wall of relativism with enough delicacy not to shatter the whole edifice' (Collins & Evans, 2002, p. 240).

Collins and Evans' proposition for a rectification of the wrongs of the previous waves is thus to inhabit something akin to a middle position between them. Pairing the first wave's separation of science and democracy with the second wave's disapproval of the self-evident legitimacy of everything stamped 'science', the third wave strives to fuse the most valuable lessons of its antecedents (Collins & Evans, 2002, p. 249). The result is a contingent appreciation of expertise where one should be neither qualified nor disqualified from delivering input based on one's credentials. Putting expertise at the forefront of such evaluations, Collins and Evans acknowledge the existence of 'pockets of expertise' in the wider public, while they concur that scientists do not per se have 'special authority in virtue of their scientific qualifications' regarding specialisms outside their own (Collins & Evans, 2002, pp. 250, 259–260). A fundamental element in Collins and Evans' reasoning is that one's potential for supplying expertise is very subject dependent (Collins & Evans, 2002, pp. 244, 265–266). This point rests on the discrimination between different categories of science, public domain, and the esoteric that engender variable opportunities for public involvement (Collins & Evans, 2002, p. 242). In

public domain sciences, such as computer science and engineering, experience-based expertise is highly relevant (Collins & Evans, 2002, p. 266), whereas only a slim set of scientists can deliver useful input with respect to esoteric subjects like gravitational wave physics (Collins & Evans, 2002, p. 242). By proposing a fine-meshed approach to the assessment of valid contributions to scientific decision-making, Collins and Evans posit to alleviate the confusion brought about by the supposedly crude outlook on legitimate public participation entrenched in Funtowicz and Ravetz' notion of the extended peer community (Collins & Evans, 2002, p. 282).

Figure 1: Illustration of the three waves of science studies and the problems entailed by Wave 1 and Wave 2.



The Third Wave of Science Studies was intended to target the constitution of legitimate expertise in 'technical decision-making' (Collins & Evans, 2002, pp. 235–236), but in this dissertation, Collins and Evans' assertions are projected onto the public deliberation of climate science, where they feed into the discussion of the role of scientific and experiential knowledge in Article 3. Although Collins and Evans did not have the public discussion on scientific issues in mind when formulating their theory, I will argue that the parallel between delivering input to decision-making processes and societal debates is sufficiently alike to warrant a meaningful transfer of their view on expertise. However, Collins and Evans would possibly maintain that the need to separate democratic rights and expertise lessens as the distance to decision-making increases. The primary justification for including Collins and Evans' third wave thinking in Article 3 is to challenge and nuance Funtowicz and Ravetz' vision of the extended peer community in connection to the case of climate science communication. In addition, climate science seems a particularly pertinent discipline to confront with Collins and Evans' theory, at least in the broad interpretation of climatology used in this dissertation, as it comprises sub-disciplines of both the esoteric and the public domain sort. Applying Collins and Evans' ideas in a study on how climate scientists, climate journalists, and citizens perceive the relevance of different types of knowledge therefore offers the possibility of determining whether the context sensitivity urged by the two

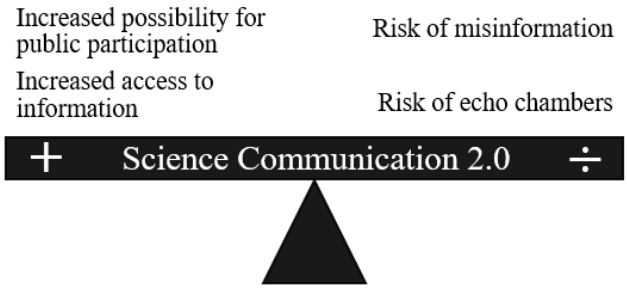
authors is present among central actors in climate science communication. Finally, the distinct normativity of Collins and Evans corresponds with the normative approach employed in Article 3 and in the dissertation as a whole.

Science Communication 2.0

Science Communication 2.0 is a descriptive concept denoting the overhaul the infrastructure of science communication has undergone since the internet became widespread in the late 1990s (Bucchi, 2013, 2017). Through blogs, scientists and citizens have been granted the possibility of providing unfiltered renderings of scientific issues, while the emergence of social media, and especially Twitter, have licensed direct interaction between scholars and society at large (Walter et al., 2019, pp. 698–699). Science Communication 2.0 signifies a break with the epoch where legacy media were the dominant venues for the public ventilation of scientific topics (Fahy & Nisbet, 2011, p. 782), while science journalism is described as 'an increasingly imperilled occupation' (Dunwoody, 2014, p. 27) and an intermediary in risk of 'being bypassed in both directions' (Trench, 2007, p. 134). According to Bucchi, this development has the characteristics of a double-edged sword as it, on the one hand, improves the conditions for increased public participation in deliberations of science, while on the other, it risks 'pushing into the public discussion rushed conclusions and even fraudulent content' (Bucchi, 2017, p. 891).

A body of research with a slant towards Twitter-oriented studies has investigated the deliberation of climate change on social media (Pearce et al., 2019, p. 10). Although these new circumstances are projected to have ramifications for science communication in general (M. S. Schäfer, 2012, p. 528), the global span of the climate challenge and the need for multi-stakeholder involvement has been claimed to make social media especially suited to facilitate the public discussion of this subject (Fownes et al., 2018, p. 1). However, while social media holds the promise of decreasing the distance between climate scientists and the public and enabling more dialogical climate science communication (Metcalfe, 2020; O'Neill & Boykoff, 2010, p. 237), these largely unregulated channels are also argued to pose a challenge to the quality of the knowledge entering the public information flow (Bucchi, 2017, p. 890; Treen et al., 2020, p. 12; van Dalen, 2020, pp. 364–365) and found to stimulate the formation of echo chambers on either side of the climate argument (Metcalfe, 2020; Williams et al., 2015, p. 135). It therefore appears an open question whether the introduction of social media will strengthen or hamper the deliberative quality of the public climate debate. The seeming trade-off is illustrated by Figure 2.

Figure 2: Illustration of the opportunities and threats associated with Science Communication 2.0



Science Communication 2.0 is a cross-cutting theme in all three articles of this dissertation. The disruption of established hierarchies of communication and the erosion of power of traditional gatekeepers (Pearce et al., 2019, p. 1) brought about by the advent of social media thus provides food for thought in relation to both the roles in climate science communication studied in Paper 1 and Paper 2 as well as how the quality of the knowledge fed into the public climate debate should be assured, a theme covered in Article 3.

Knowledge-based journalism

As a response to the increased marginalisation of legacy media in the public sphere of present-day society, it has been proposed that journalism should carve out a new identity for itself by becoming 'the new knowledge profession' (Donsbach, 2014). To achieve this, journalists will have to embark on knowledge-based journalism (Patterson, 2013). According to Donsbach, improved subject competence is a prerequisite for journalists to perform knowledge-based journalism. He argues that the ability to ask critical questions and effectively locate the most qualified experts hinges on their success in acquiring 'deeper knowledge and understanding of the subjects they are covering' (Donsbach, 2014, p. 668).

Donsbach perceives knowledge-based journalism as a medicine against the ills inflicted by professional journalism's reduced significance in the current media landscape, namely 'people's less validated and less joined cognitions' (Donsbach, 2014, p. 664). He thus contends that the successful implementation of knowledge-based journalism will allow journalists to continue to fulfil their core societal functions by 'sorting out the relevant parts of reality, checking assertions about these, and relating them to other parts of reality in the present and past' and providing a 'commonly accepted platform for social discourse credited with trust' (Donsbach, 2014, pp. 673–674)

Knowledge-based journalism has been argued to be especially necessary in 'politicized science debates' such as the one on climate change (M. C. Nisbet & Fahy, 2015, 2017). In the view of Nisbet and Fahy, the services of experienced beat journalists can help mitigate the consequences of the polarisation permeating the public discussion of subjects like climate change (M. C. Nisbet & Fahy, 2015, pp. 224–225).

> even with the best intentions of expert bloggers, fact-checkers and nonprofit journalists, if society is going to successfully navigate politically contested science issues, we need big budget commercial ventures that prioritize in-depth coverage. Indeed, given the complexity of these issues, our society requires ongoing, dedicated sources of context-focused journalistic coverage produced by news outlets and professionals who neither cater to nor depend on meeting the expectations of a particular ideological audience or network of philanthropic donors (M. C. Nisbet & Fahy, 2015, pp. 226–227).

Given Fahy and Nisbet's rationale, climate science communication comes across as a likely context to find support for knowledge-based journalism. Article 1 and Article 2 set out to probe this by examining whether scientists, journalists, and citizens subscribe to this redefinition of the role of journalists in relation to climate journalism. They thereby contribute to the scholarly discussion regarding the realisability of knowledge-based journalism as a new professional ideal (van Witsen & Takahashi, 2018).

Scientific citizenship

The notion of scientific citizenship is founded on the idea that the ubiquitous presence of science on the public agenda begs a reconceptualisation of citizenship tailored to modern knowledge societies (Horst, 2007, p. 151; Irwin, 2001). Scientific citizenship thus stresses the importance of scientific knowledge in contemporary societies (Mejlgaard & Stares, 2010, p. 547). It presupposes that in:

> an increasingly complex world, where science and technologies extensively shape the everyday lives of the public and affect social practices, citizens are in need of particular competences, knowledge, and skills to navigate effectively and define their own role within the system (Mejlgaard & Stares, 2010, p. 547).

According to Mejlgaard and Stares, a scientific citizenship can be conceived of as a set of rights and responsibilities in line with conventional conceptions of citizenship. Hence, they concur that the invocation of a scientific citizenship would afford citizens with the right to be informed about developments within science as well as the obligation to participate in the societal debate on science-related issues. However, building on Horst (Horst, 2007), they argue scientific

competence to be a requisite for 'effective human agency in modern societies' and the fruition of a 'full' scientific citizenship (Mejlgaard & Stares, 2010, pp. 547–548). This conceptualisation of scientific citizenship therefore also seems to present citizens with a duty to engage with the information that the scientific community is obligated to provide about its activities as legitimate participation hinges on scientific competence. Such a notion of the citizen draws on a deliberative heritage (Mejlgaard & Stares, 2012, p. 661) and can thus be criticised for placing excessively high demands on the public as stressed by Arnason:

> From an individualist liberal viewpoint, the citizens should not be bothered with demands for collective deliberation on public policy. They should be able to enjoy the privacy of their personal life and have freedom from politics (Árnason, 2013, p. 935).

Elam and Bertilsson articulate another reservation as they point to the slightly ironic element in the justification of the need to make the public into scientific citizens:

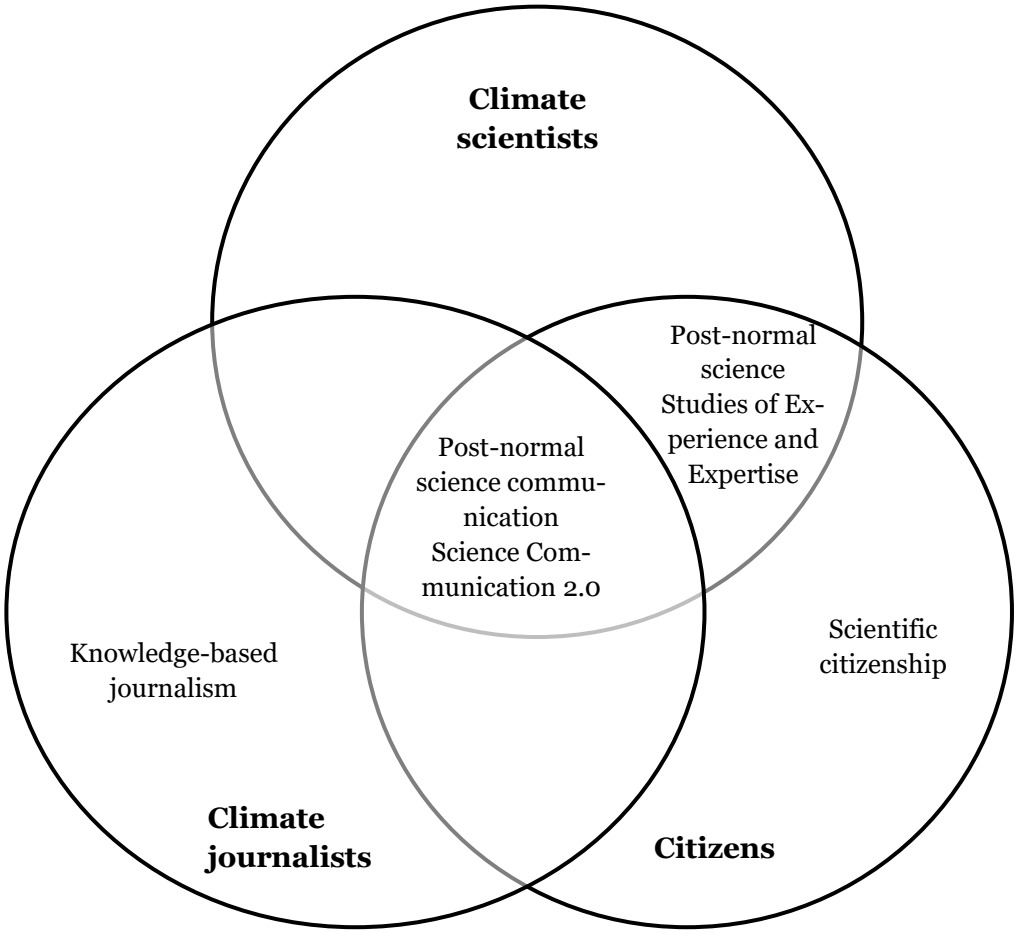
> because science and technology are becoming so pervasive in everyday life, there is potentially no end to the list of science-based new combinations for responsible citizens to engage with. A precondition for active citizen engagement in one area of science and technology must in the end be disengagement, passivity and indifference in another (Elam & Bertilsson, 2003, p. 247).

The circumstance that prompted the idea of a scientific citizenship is thus also restricting its proliferation according to Elam and Bertilsson. Their argument is forceful. It seems sensible that citizens must exhibit selectivity regarding their attentiveness when exposed to a near infinite number of science-laden issues. However, climate change seems like a most-likely subject for citizens to enforce their scientific citizenship given its massive saliency on the agenda of contemporary societies. Article 1 and Article 2 therefore set out to explore whether the image of a scientific citizenship strikes a chord with the three actors in relation to climate science communication. This endeavour could turn out to either provide some much-needed empirical grounding of the concept or severely question its applicability.

Synthesis

In this chapter, I have tried to situate the dissertation in a varied theoretical terrain by presenting the main concepts that have directed my work. This synthesis serves to present the primary concepts of the dissertation alongside each other and highlight their interrelation. Figure 3 illustrates how the various concepts are linked to the three actors.

Figure 3: Venn diagram displaying the dissertation's theoretical framework with emphasis on how the different concepts relate to the three actors investigated



When reviewing the theories that have stimulated this dissertation, it becomes apparent that an undercurrent of change is almost ubiquitous. Regarding the role aspect, Giddens' role concept frames roles as amenable, while the concepts of post-normal science communication, knowledge-based journalism, scientific citizenship, and Science Communication 2.0 all provide suggestions to how one or more of the roles in climate science communication could develop. As illustrated by Figure 3, post-normal science communication and Science Communication 2.0 concern the roles of all three actors. In fact, the former is woven into the latter as Brüggemann et al. contend that 'a drastically changing media environment' is one of the preconditions for the emergence of post-normal science communication (Brüggemann et al., 2020, p. 2). Brüggemann et al's projection of a more active role for the public in the public discussion of post-normal issues is hence facilitated by 'digital public spheres' (Brüggemann et al., 2020, p. 12). Further, the need for scientists and journalists to act as interpreters of scientific facts is also partly owed to the introduction of social media in scientific debates, as they – along with the increased

polarisation of modern societies – are perceived to catalyse the spread of diverging knowledge claims in relation to post-normal science issues (Brüggemann et al., 2020, p. 12).

To become interpreters of scientific facts, science journalists need to attain a high degree of scientific proficiency according to Brüggemann et al. (Brüggemann et al., 2020, p. 12). This part of post-normal science communication is, therefore, linked to knowledge-based journalism. Additionally, knowledge-based journalism is connected to Science Communication 2.0 as the demand for greater scientific competence on the part of science journalists is often justified as a response to the shifting media setting. Knowledge-based journalism can be justified from a societal viewpoint as Donsbach argues that a well-functioning society requires a 'shared reality' founded on 'a reservoir of common knowledge, experiences, and values' (Donsbach, 2014, p. 665). This line of reasoning resonates with Brüggemann et al's rationale for the fact-interpreter role of science journalists. Knowledge-based journalism can also be legitimised from another perspective as a means of safeguarding the continued relevance of science journalism against the competition from non-professionals such as bloggers and citizen journalists on the science news market – a more profession-centric take on the threat posed by Science Communication 2.0 (Donsbach, 2014, pp. 662–663; van Witsen & Takahashi, 2018, p. 717).

Regarding the role of citizens, a similar chord runs through post-normal science communication and scientific citizenship as both ideas build on a vision of citizens as active participants in the societal discussion of science-based topics. The concepts nevertheless differ in the attention they allocate to the role of citizens as it is the alpha and omega of scientific citizenship but only a minor concern of post-normal science communication. Yet, Brüggemann et al. adopt the view that the public will act as an extended peer community – Funtowicz and Ravetz' brainchild – into their framework for understanding future science communication practices under post-normal circumstances (Brüggemann et al., 2020, p. 12). The calls for the implementation of scientific citizenship and the extended peer community both stem from a realisation that it is about time to invite citizens to participate further in debates on matters rooted in science. In either case, the underlying logic consists of arguments that such a development would further both democracy and scientific inquiry (Funtowicz & Ravetz, 1993, pp. 739, 741, 753; Mejlgaard & Stares, 2012, pp. 660–661). However, the proponents of scientific citizenship seem to foreground the democratic component, whereas Funtowicz and Ravetz italicise the benefit for science. According to them:

> an extension of peer communities, with the corresponding extension of facts, is necessary for the effectiveness of science in meeting the new challenges of global environmental problems (Funtowicz & Ravetz, 1993, pp. 754–755).

A wind of change also blows across the dissertation's knowledge-related track. Dudman and de Wit's promotion of the listening agenda in climate science communication is in tune with the rallying cry for increased dialogue between science and society often heard in the public understanding of science literature as well as Funtowicz and Ravetz' conceptualisation of an extended peer community. The effectuation of a more reciprocal approach to climate science communication would necessitate a reconsideration of the role of scientific and experiential knowledge in the public climate debate. This is where Collins and Evans' normative theory of expertise enters the picture as it encourages a more conditional view on the relevance of public input to scientific discussions. The relationship between the theories of Funtowicz and Ravetz and Collins and Evans is nevertheless not one of opposition as the latter pair likewise recognises the contributory potential of the public but with more reservations than the former. Both theories can, therefore, be seen to propose a break with the traditional deficit-styled way of conducting climate science communication (Cook & Overpeck, 2019, p. 7; Pearce et al., 2015, p. 619), with Funtowicz and Ravetz as the radical option and Collins and Evans as a more moderate alternative.

Speaking of the aspiration to further public participation in climate science communication, the arrival of social media can be regarded a blessing as it significantly improves citizens' possibility to join the societal climate discussion. However, the increased participation facilitated by Science Communication 2.0 may come at the expense of the quality of the knowledge claims circulated as the new communication platforms are loosely governed and do not entail the same quality assuring devices offered by traditional media outlets (Bucchi, 2013, p. 906). In relation to post-normal science and Studies of Expertise and Experience, Science Communication 2.0 can be seen to support the realisation of Funtowicz and Ravetz' ideal of extending the peer community, while the development simultaneously raises quality-related questions that echo Collins and Evans' apprehension towards the unlimited extension of expertise.

Chapter 3: Research design and methodology

This chapter will present the reflections that have underpinned the selection and application of methods. It will start by introducing the overarching research design and the methodological considerations guiding it. This will be followed by two sections pertaining to the two methods applied: the literature review and focus groups. These will describe the methods in detail, explain why they were chosen, and how they were used. They will also discuss the strengths and weaknesses of the methodical choices made in connection to each.

Overall research design

At its very core, this dissertation seeks to generate knowledge about how climate scientists, climate journalists, and citizens think the ideal science–media–public interface should look regarding climate science communication. It therefore strives to see the world from the studied actors' perspectives. This research interest runs across the three articles. As evinced by Table 3, Article 1 and Article 2 set out to grasp how the actors make sense of the three roles by means of a literature review and focus groups, respectively. Article 3 is also preoccupied with the actors' process of meaning ascription, but the emphasis here is on how they perceive different types of knowledge and knowledge claim assessment in the public climate debate. Like Article 2, Article 3 builds on focus group data, and together, they comprise a case study of climate science communication in Denmark. Another common trait of the research questions is their explorative nature. While theory has been instrumental in formulating the research questions, it has not led to the formation of hypotheses. The role of theory has rather been to provide the explorative endeavour with a direction.

Table 3: Research questions underlying the three articles

Study	Research question(s)	Method
Article 1	Which ideal role perceptions are prevalent among climate scientists, climate journalists, and citizens, and to what degree are these role perceptions compatible?	Literature review
Article 2	How do climate scientists, journalists, and citizens perceive their own and one another's roles in climate science communication, and where do the actors' role perceptions overlap or contrast?	Focus groups
Article 3	How do climate scientists, climate journalists, and citizens negotiate the role of scientific and experiential knowledge in the public discussion of climate-related issues? Who should ensure the quality of the knowledge claims proposed in the public discussion of climate-related subjects according to the three actors?	Focus groups

Methodology

This section will outline the methodological standpoint of the dissertation and place it within the interpretivist research tradition.

Drawing on the interpretive heritage

With the exploration of human meaning-making as its chief aim, this dissertation begs an interpretive methodology. Interpretivism is distinguished by having individual and collective meaning-making as its focal point (Angen, 2000, p. 383; Garrick, 1999, p. 150; Schwandt, 2000, p. 191). As Schwartz-Shea and Yanow put it:

> The sine qua non of interpretive research—the sensibility that is its hallmark and which makes it distinctive in comparison with other research approaches—is its focus on meaning-making: it seeks knowledge about how human beings, scholars included, make individual and collective sense of their particular worlds (Schwartz-Shea & Yanow, 2012, p. 46).

A key element in the interpretive quest to delve into meaning-making is the insistence on the criticality of context (Taylor, 1971, p. 33). The study of meaning is thus the study of meaning in a certain setting. Accordingly, interpretivism contends that the meaning of given phenomena is organised in webs and will not have the same significance if extracted from these and imported to new circumstances (J. K. Smith, 1992, p. 102). The discovery of universal laws is thus not the aim of interpretivist inquiry (Rabinow & Sullivan, 1979, p. 13; Willis, 2007, p. 99). In fact, the epistemological positioning of interpre-

tivism rules out the possibility of producing objective knowledge as the presence of a singular truth about reality is rejected, either because it does not exist (Bevir & Blakely, 2018, p. 20; Willis, 2007, p. 95) or because it is beyond the human remit to acquire it (Rabinow & Sullivan, 1979, p. 6; Taylor, 1971, pp. 37–38). Smith associates interpretivism with the latter viewpoint:

> None of this should be taken to mean that interpretivists are antirealists, that is, that they hold that nothing exists outside of us or of our minds. Rather, they are nonrealists in the sense that they agree that reality is out there, but that our descriptions of it are not and never can be. As such, our world or our reality is always something we make, not something we discover or find (J. K. Smith, 1992, p. 101).

Regardless of the diversity of ontological stances within the interpretivist tradition, researchers of this school share an aspiration to provide accounts of 'the contingency and holistic complexity of the meanings and cultures comprising social reality' (Bevir & Blakely, 2018, p. 9). With this dissertation, I inscribe myself in this doctrine of research. This allegiance is reflected in the conceptualisation of the main subjects of study: roles and knowledge (see Chapter 2 for elaboration of these concepts). Accordingly, Giddens' notion of roles embraces the contingency associated with the definition of a given role (Giddens, 1979, pp. 117–118) in contrast with, for example, a Parsonian view on roles as static objects (Parsons, 1967). An interpretivist undercurrent also runs thorough the ideation of the different knowledge types investigated. By drawing on Zimans' idea of scientific knowledge (Ziman, 2000), I recognise its constructed nature, whereas experiential knowledge is deemed to be the product of certain social practices (Brossard & Lewenstein, 2009, p. 15; Irwin et al., 1999, pp. 1312, 1320).

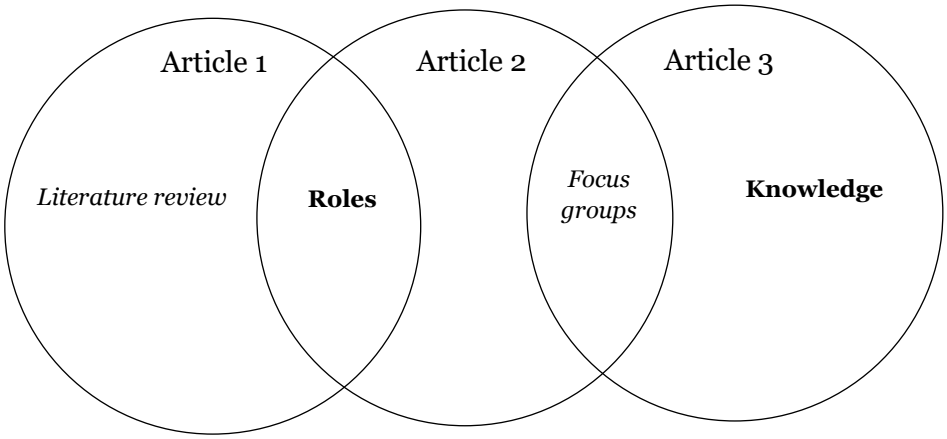
As another manifestation of the interpretivist affiliation, contextualism has been a lodestar for the work of this dissertation throughout the research process. In planning the retrieval of studies for the literature review, the aim was to capture research from as many countries and points in time as possible based on a presupposition that the meaning of the ideal roles of the three actors could fluctuate across contexts. Moreover, the appreciation of context affected the analysis and reporting of the data in Article 1. The analysis was oriented towards discerning geographical and temporal patterns, while the results of the reviewed studies were disseminated with a specification of the context from which they stemmed. Regarding the design of the focus group study, contextual matters were likewise top of mind as I tried to create an assortment of discussion contexts through the employment of homogeneous and heterogeneous groups (elaborated later in this chapter). Additionally, when conveying the results from the focus group study, Article 2 and Article 3 explicate the

influence of contextual factors on two levels: 1) by outlining the group-specific circumstances under which the participants' quotes have been uttered, and 2) by discussing how the Danish setting might have a bearing on how roles, knowledge types, and knowledge assessment are understood.

Naturally, this stress on contextuality has implications for the purported universality of the knowledge generated by this dissertation. Rather than transcendent knowledge which claims to be true anywhere, anytime (Abbott, 2004, pp. 50–51), the knowledge arising from this dissertation is reflexive about its own situatedness within the limits of time and space and its consequent conditionality. The goal is therefore to deliver 'sufficiently contextualized' interpretations (Schwartz-Shea & Yanow, 2012, p. 47) rather than generalisable findings. Relatedly, the dissertation also rests on an assumption that the social cosmos is volatile, and as such, it does not claim an extensive predictive power. Per Taylor, prediction is indeed a misguided goal for social science (Taylor, 1971, pp. 61, 71). However, this is not to say that the aim is to present purely idiosyncratic insights with no value outside the setting in which they were conceived. On the contrary, in line with Lincoln and Guba's notion of transferability (Lincoln & Guba, 1988), the interpretations of this dissertation should be sufficiently thick to enable other researchers to judge their applicability in other situations.

In the following sections, I will go into detail about the course of action followed in the literature review and the focus group study that have given rise to the three articles of this dissertation. Figure 4 illustrates how the articles are related in terms of the methods used and the research topics investigated.

Figure 4: Illustration of the methods (in italics) and research topics (in bold) of the dissertation's articles



The literature review

The first article of the dissertation is a literature review examining the extant research on the ideal role perceptions of climate scientists, climate journalists, and citizens. This section aims to first explain the reasoning behind conducting a literature review before outlining how the study was conducted. It will be concluded with a discussion of the chosen approach.

Motivation

The idea that the roles of climate scientists, climate journalists, and citizens in climate science communication might be facing a reconstitution has been a leitmotif of the present PhD project. A natural first step was thus to establish an overview of the existing literature to see if such a change was already taking place. In this process, review studies are a convenient way to quickly map out the prevailing research terrain. However, it soon became clear that the current literature was short on germane meta-analyses as well as on work that incorporated the perspectives of all three actors. These lacunas engendered the possibility of turning the mandatory familiarisation with the field into a genuine contribution to the self-same literature. Consequently, the literature review of this dissertation was triggered by an intention to synthesise three disconnected literatures and inspire a new research agenda. Torraco argues that review studies are typically conducted either to reappraise mature topics or to provide holistic conceptualisations of emerging ones (Torraco, 2005, p. 357), and the literature review of this dissertation is clearly propelled by the latter aspiration. Further, it seemed suitable to employ a narrative approach to the review as its mission is explorative rather than hypothesis-testing and because the examined literature would be topically diverse. Narrative reviews are geared to handle such conditions according to Baumeister and Leary (Baumeister & Leary, 1997, p. 312). The output of the narrative review would be a thematic analysis of the prevailing literature on the three roles. Thematic analysis is essentially preoccupied with the identification of patterns within data (Braun & Clarke, 2006, p. 79). By generating this kind of insight, the literature review serves an additional function in the context of this project: informing the design of the subsequent focus group study where the themes identified in the current scholarship on the subject could provide input to the development of the moderator guide.

Execution

The literature review was intended to investigate peer-reviewed, empirical studies on how climate scientists, climate journalists, and citizens perceived

their own ideal roles and those of each other in climate science communication. This meant that only studies incorporating a normative perspective on the respective roles were worthy of inclusion. The goal of the review was to perform a thematic analysis of the included studies to extract specific role perceptions from them.

A five-string search tactic

The data collection was planned with the anticipation that the universe of studies with the required focus would be rather limited as the literature on climate science communication is relatively young (M. S. Schäfer & Painter, 2020, p. 4) and includes several branches of research irrelevant to the study of role perceptions, such as the large cluster of content analyses of the media coverage of climate change in different countries. Based on the assumption that the pool of research would be scant, it seemed reasonable to strive to retrieve all relevant studies. Hence, the literature review was aiming at capturing pertinent studies of all methodical types across time and geographical contexts. In this regard, it should be noted that the openness to allow quantitative research in the sample does not contradict the overall interpretivist orientation of the dissertation. Although interpretivism is commonly associated with qualitative methods, Bevir and Blakely argue that a wide range of methods can help advance meaning-oriented inquiries, granted that they are utilised in a non-positivistic manner (Bevir & Blakely, 2018, p. 7,14). Accordingly, no data format was privileged in the evaluation of the reviewed literature. As an additional requirement, studies had to be written in English, German, Danish, Swedish, or Norwegian to be included in the review. A multi-faceted search strategy was employed as illustrated by Figure 5 below.

The first step was to perform a series of database searches in four major transdisciplinary databases (Scopus, Web of Science, EBSCOhost, and ProQuest). Table 4 provides an overview of the database search. It was far more straightforward to select the keywords used to detect studies featuring climate scientists and climate journalists than citizens. In the first two instances, it was sufficient to make sure to cover the various synonyms used to describe climate scientists and climate journalists. It would be unlikely that any studies focusing on either climate scientists or climate journalists would not mention them in the abstract. Neither of the searches resulted in an insurmountable number of hits, so there was no need to limit the searches further. However, when it came to the search on studies on citizens, a somewhat contradictory situation prevailed. Here, it was difficult to construct an exhaustive list of possible search terms synonymous with citizens, and a simple coupling of terms like ‘citizen’ and ‘climate change’ caused so many hits that it could

not realistically be managed within reasonable time. The solution was to perform two different searches: one that paired the search words 'citizen', 'public', and 'lay' with climate change while also emphasising the role perspective by using the terms 'role responsibility' and 'role perception'; and another where the theoretical concepts 'scientific citizenship' and 'public engagement' were paired with 'climate change' and 'climate science', respectively.

Table 4: Overview of databases and search strings used in the literature search

Databases used	Search words for articles with climate scientists	Search words for articles with climate journalists	Search words for articles with citizens
Scopus (title, abstract, tags, and keywords) Web of Science (title, abstract, tags, and keywords) EBSCOhost (abstract) ProQuest (abstract)	["climatologist*" OR "climate scientist*" OR "climate researcher*"]	["journali*" OR "reporter*"] AND ["climate change" OR "global warming"]	[("role responsibility" OR "role perception") AND ("citizen" OR "public" OR "lay") AND ("climate change" OR "global warming")] OR ["scientific citizenship" AND ("climate change" OR "global warming")] OR ["public engagement" AND "climate science"]

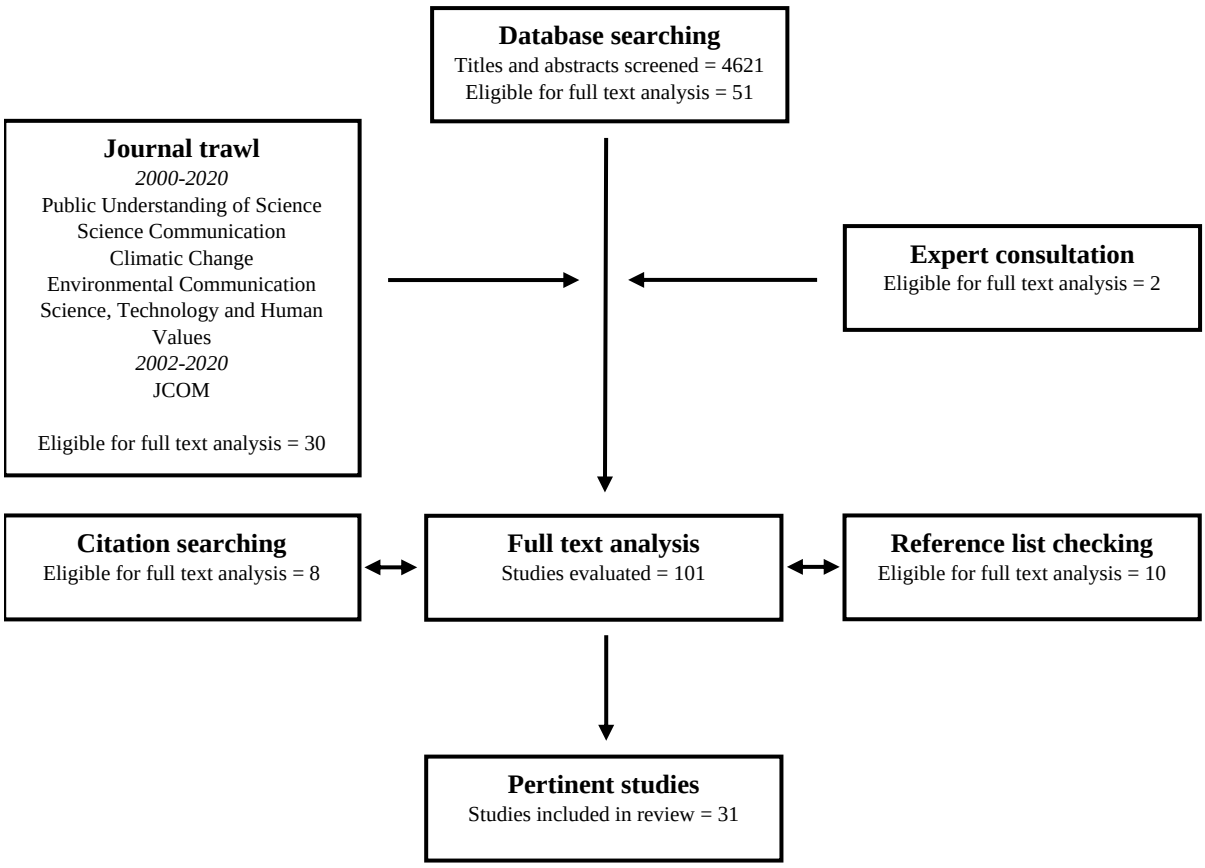
Note: The searches were performed on 1 November 2020.

Studies using alternative wording would be omitted from the database searches, and the next step was therefore to perform a journal trawl. Six journals with a high likelihood to feature relevant studies were selected for examination. Two were dedicated to science communication journals (Science Communication and JCOM), two were more generally interested in the science–society interface (Public Understanding of Science and Science Technology and Human Values), and the remaining two were specialised climate journals (Environmental Communication and Climatic Change). Only editions from 2000 onwards were taken into consideration due to time concerns and the low probability of finding relevant material before that since the research agenda on climate science communication was rather inconspicuous back then. In the case of JCOM, the trawl began with the inaugural edition from 2002. The title of each paper published in each of the six journals in the 20-year period was screened, and in case of any doubt, the abstract was also read.

As it was challenging to locate relevant studies on the role perceptions of citizens in climate science communication through the database search and journal trawl, an alternative measure was applied, namely consulting with ten

Danish experts from a range of fields including science communication, environmental sociology, political science, and environmental pedagogy to benefit from their overview of the literature. The experts were all characterised by having published climate-related research with a citizen perspective. This effort yielded an additional two candidate studies.

Figure 5: Flow chart illustrating the review process



Note: The studies are only counted the first time they are detected. For example, if a study has already been found in a database search, it will not be counted again if it also appears in a reference list check. The bidirectional arrows indicate that citation searching and reference list checking have been performed on all studies eligible for full text analysis and that the studies found by these means have fed studies back into the full text analysis pool.

To mitigate any blind spots held by the previous methods, reference list checking and citation searching were executed. The reference list checking was done by screening the references of each candidate study. This was a way of minimising the risk that potentially relevant studies published prior to 2000 or in lesser-known journals would be missed. Citation searching was carried out in Web of Science, Scopus, and ProQuest (EBSCOhost does not offer this feature). The point of the citation searching was to find out if studies with rele-

vant titles that had gone under the radar so far were citing the already identified papers. As with reference list checking, citation searching was used as a means of lowering the possibility that relevant studies from alternative journals escaped the review. Reference list checking and citation searching were performed iteratively. Accordingly, if a relevant study was discovered by reference list checking, the reference list of this study would be screened along with the titles of the studies citing it. The procedure came to an end when all reference lists and citations had been investigated, and no new potentially relevant studies appeared.

Two stages of coding

Together, the database searches, journal trawl, expert consultation, reference list checking, and citation searching identified 101 potentially relevant studies. The full texts of these studies were then analysed. Seventy studies were excluded in this process, basing the empirical foundation of the review on 31 studies. These studies were then hand-coded with the aim of locating data of any sort with a normative character from climate scientists, journalists, or citizens covering how they perceived the expectations connected to their own role or the role of the other two actors. The coding was split into two phases. In the first phase, the studies were exposed to an open coding to detect normative content on role perceptions, while the second phase comprised of a focused coding where a headline was attached to each coded element to categorise them thematically. By the end of the focused coding, it was possible to draw out the themes that were prevalent when the actors reflected on their own role as well as the recurring themes in either of the two other actors' deliberations of the role.

Discussion

The ambition of the review was to approach the retrieval of studies in a systematic way. Each of the methods employed has shortcomings, but taken together, they constitute a very reliable defence against the omission of potentially relevant studies. If the databases covered all relevant journals and an exhaustive list of search words was developed, database searching would have been sufficient on its own. However, as neither of these conditions was likely to be fulfilled, database searches had to be supplemented by other ways of locating studies.

A hypothetical scenario serves to illustrate the circumstances that would allow a relevant study to evade detection with the chosen selection of retrieval techniques. None of the search words should feature in the title, abstract, or keywords, or it should have been published in a journal not covered by any of

the four databases. It should not have been published in any of the journals trawled. Further, none of the studies discovered by the other techniques should refer to it, and it should not cite any of them. As is illustrated by this pretend situation, it seems improbable that relevant studies would be missed using this approach. However, because the database searches were less effective at retrieving studies on the role perceptions of citizens due to the difficulty of finding the most appropriate search words, the danger of missing out of on relevant studies was more imminent here. To compensate for this potential weakness in the procedure, an additional measure – the expert consultation – was undertaken to locate studies on citizens. Accordingly, for a pertinent study on the ideal role of citizens to slip away, it would also require that none of the field experts approached should have knowledge about its existence.

Accuracy over quantity

While the meticulous approach to data collection helped secure that the type of studies sought was found with a relatively high amount of certainty, the modest number of studies in the final sample raises questions about the decisions taken prior to the initiation of the search process. A main reason behind the limited number of studies in the sample is the decision to focus narrowly on climate rather than on environment more broadly. This choice was guided by the prioritisation of precision over volume. Consequently, in the evaluation of the studies, those that covered either environmental science or environmental journalism generally and without any specific mentions of the climate were discarded.

The exclusion of grey literature

Another way to increase the empirical basis of the review would have been to look beyond the peer-reviewed literature by also including grey literature. However, this expansion of the realm of data would have made it hard to guarantee the systematicity of the data collection as most of the methods utilised would not be applicable to the grey literature. Reference list checking and citation searching would, for example, have no use in relation to the grey literature. Further, the inclusion of other sources of data would also pose a problem in terms of commensurability. For instance, how would a quote in a newspaper article compare to a quote in an academic paper? The decision to concentrate exclusively on the peer-reviewed literature ensures a more level playing field where the analysed data have been produced according to the same standards of quality.

The big picture

Overall, the chosen approach with a strict focus on climate-related studies and the peer-reviewed literature generated a sufficient sample of studies to achieve what was targeted at the outset, namely to understand how the role perceptions of climate scientists, climate journalists, and citizens had been described in the existing literature and specifically the patterns prevalent across time and space. The limited amount of data was a finding in itself, and the small number of studies on the role of citizens was essentially more a problem for the literature than for the review given the comprehensive literature search.

The focus group study

Motivation

The project was born with the intention to do a focus group study with climate scientists, climate journalists, and citizens centred on their expectations for themselves and each other. When writing up the project application, I had noticed that the studies pertaining to ideal roles in climate science communication typically only concentrated on one type of actor at a time, see (H. P. Peters & Heinrichs, 2005) for an example of an exception to this rule. I found it peculiar that more extensive scholarly attention had not been devoted to the relational aspect of roles in climate science communication as roles are not assigned meaning in a vacuum but are rather mutually constituted properties (Biddle, 1979, p. 221; Giddens, 1979, p. 116). Since the start of the project, the aim was to redeem this apparent shortcoming of the current literature by providing a more comprehensive approach to the study of roles in climate science communication than had hitherto been accomplished.

The triangular perspective could potentially have been pursued with a range of methods, for instance, by way of a survey study asking climate scientists, climate journalists, and citizens about their ideal role perceptions or via individual interviews with representatives of each actor type. What then made focus groups the preferred method for investigating the topic? A decisive aspect in choosing this method was the socially constructed nature of the subject and the stress on context induced by the dissertation's interpretivist approach. Hence, what it implies to be a climate journalist, for example, depends on how that role is ascribed meaning in a particular setting at a certain time. A strength of the focus group method is precisely its ability to improve our appreciations of socially constructed phenomena because it can embrace the complexity involved in the negotiation of such issues (Cyr, 2019, pp. 19–20) and 'throw light on the normative understandings that groups draw upon to reach their collective judgements' (Bloor et al., 2001, p. 4). In a similar vein,

Barbour describes focus groups as a 'privileged vantage point from which to observe the processes through which ideas, meanings and discourses are formulated, contested, debated and modified' (R. Barbour, 2018, p. 34). It is hence through their ability to capture the production of shared conceptions of reality that focus groups hold an advantage over one-on-one interviews, which only offer 'an indirect basis for assessing them' (Soss, 2006, p. 139). Focus groups therefore seemed the most suitable tool for exploring the formation of common conceptions of the roles of climate scientists, climate journalists, and citizens in climate science communication. Moreover, the review had revealed that focus group studies were underrepresented in the research pertaining to the roles of climate scientists and climate journalists. An additional reason to choose the focus group approach was consequently to contribute an alternative type of data to these literatures.

As is evident from the above, the focus groups were primarily motivated by the research agenda of Article 2, as the scope of Article 3 was not conceived beforehand. The attention to how different kinds of knowledge should feature in the public debate and questions of quality assurance first arose during the data collection as it became apparent that the discussion of these matters deserved a separate inquiry.

Execution

According to plan, the focus groups should have been held in the spring of 2021, but the study was postponed until autumn because of the restrictions on gatherings due to COVID-19 that were in effect in Denmark until the summer of 2021.

To structure the preparation of the focus groups, I wrote a research protocol (see Appendix A) detailing the research design. The initial idea was to conduct twelve focus groups: three homogeneous groups with each actor type and three heterogeneous groups with a mix of climate scientists, climate journalists, and citizens. However, during the data collection, I decided to conduct one more homogeneous group with each actor type. This decision was made in the aftermath of a homogeneous focus group with citizens where two participants dominated and somewhat derailed the discussion. Out of concern that two successful focus groups with citizens would be insufficient, I chose to arrange an additional group with citizens. To create a balanced foundation of data, two extra homogeneous groups – one each with the other two actor types – were also organised. The number of groups therefore grew from twelve to fifteen. This deviation from the original plan is congruent with the accentuation of flexibility within interpretivism. Yanow and Schwartz-Shea hence argue that flexible research designs are 'a mark of competence in interpretivist

research' (Schwartz-Shea & Yanow, 2012, p. 77). They also convincingly explain why this is the case:

> Due to the researcher's ongoing and evolving learning while in the field, as well as his or her limited control over settings and the persons in them, or over materials in an archive, interpretive research is, and has to be, much more flexible than other forms of research (Schwartz-Shea & Yanow, 2012, p. 55).

Interestingly, during the analysis phase, it turned out that the focus group I had almost disregarded due to the dominant participants contained a substantial amount of useable data. The frustration of losing control over the group had made me underestimate the value of the session.

The setup with homogeneous and heterogeneous focus groups was predicated on the intent to facilitate both inter-group and intra-group negotiation of the topics at hand and thereby generate a multifarious set of data. As the interaction between the participants is a crucial part of the focus group method, it seemed interesting to create different discussion environments to observe how it affected the proceedings. The role of the homogeneous groups was to explicate the collective norms existing in each segment. Collective norms can be understood as a collective social entity's code of conduct (Lapinski & Rimal, 2005, p. 129). According to Lapinski and Rimal, proper assessment of collective norms requires data collection at the social level as they cannot be measured by aggregating individuals' beliefs (Lapinski & Rimal, 2005, p. 130). The purpose of the mixed groups was to capitalise on their heterogeneity to 'uncover and explore assumptions that would otherwise be taken for granted among peers' (Morgan, 1997, p. 63). Hence, the heterogeneous groups could help to defamiliarise accepted truths among either climate scientists, climate journalists, or citizens and force the actors to justify these.

Deciding on selection criteria and sampling for diversity

A central task in the groundwork of the focus groups was the selection and recruitment of participants. This work required a consideration of how each of the three categories of participants should be defined. I decided to define a climate scientist as a researcher employed at a university who studies either the physical basis of climate change or how the challenge can be mitigated or adapted to. The emphasis on these aspects of climate science complies with the domains of the three working groups of the IPCC (IPCC, 2014). A climate journalist was defined as someone who has produced a significant amount of in-depth climate journalism for media outlets and also self-identified as a climate journalist. However, it was not a prerequisite that they were solely dedicated to the climate beat. The term 'citizen' denoted an individual over the age of 18 with voting rights in Denmark.

To create a dynamic and diverse discussion environment where a wide span of perspectives was represented, a maximum variation sampling strategy was chosen (Flyvbjerg, 2006, p. 230). A list of significant parameters on which the participants had to vary was developed for each type of actor. The sample of climate scientists had to vary on institutional affiliation, position (postdoc, assistant professor, associate professor, and professor), and research field, while the participating climate journalists had to represent different media outlets and platforms (print media, television, and radio) and possess varying levels of experience (0–5 years, 5–10 years, and >10 years). Regarding the sample of citizens, it had to incorporate people from different age groups (18–29, 30–39, 40–49, 50–59, and >60) and a nuanced representation of educational and occupational backgrounds as well as attitudes towards climate change. A general guiding star of the sampling was to aim for gender balance in all three segments of participants.

Recruitment

The recruitment of the three types of participants followed separate trajectories. However, a common trait in the recruitment of climate scientists and climate journalists was that it was initiated by establishing an overview of each population. For the climate scientists, this was done by way of examining the websites of the Danish universities working on climate science to identify potential participants. The publication list of each researcher was then scrutinised to see if the individual could be deemed a climate scientist. This effort provided a shortlist of possible participants from different universities with varying positions and research interests. The climate journalists were pinpointed with the aid of the chairmen of the Danish Science Journalists (Danske Videnskabsjournalister) and the Association of Energy and Environmental Journalists (Foreningen af Energi- og Miljøjournalister), who were contacted to provide an outline of the collection of Danish journalists covering the climate beat. This move was inspired by the advice of MacDougall and Fudge, who recommend that key contacts within a certain group are used to connect with the wider community as these can turn out to be champions of the research (MacDougall & Fudge, 2001, p. 122). As a result of these inquiries, a shortlist of relevant journalists was constructed.

The participants from the citizen segment were recruited via two channels: Facebook groups and the network of the researcher. Facebook groups were used to trace citizens with strong attitudes towards the climate and people with certain professional backgrounds. Specifically, the group 'Klimarealisterne' (The Climate Realists) was employed to locate citizens with a contrarian climate attitude, while their climate concerned counterparts were found

by way of groups like 'Klimabevægelsen' (The Climate Movement), 'Bedsteforældrenes Klimaaktion' (The Grandparents' Climate Action), and 'Bæredygtig Livsstil' (Sustainable Lifestyle). Neutral citizens with specific occupations were sought out through groups targeting professions such as primary school teachers, high school teachers, and entrepreneurs. The network of the researcher was also employed to locate citizens with varying educational and occupational backgrounds and a neutral sentiment towards the climate. Here, the guiding principle was that the potential participant had to be at least twice removed from the researcher. It was thus a requirement that the potential participant and the researcher had not had any prior encounters.

Potential participants from all three segments were first contacted by phone by the researcher, who initiated the conversation by presenting himself and introducing the study. Regarding the climate scientists and climate journalists, the call also served two additional purposes. It was used to confirm their status as scholars primarily occupied with climate-related research and reporters covering climate-related subjects, respectively. Further, the scientists and journalists were asked if they knew of colleagues who could be relevant to contact. This was a way of making sure that climate scientists who were not detected by browsing the university websites and climate journalists who were not members of the two associations would not be omitted. In the case of the climate journalists, the co-nomination was a necessity as the number of climate journalists on the original shortlist was insufficient to cover three homogeneous and three heterogeneous focus groups. All potential participants who agreed to partake in the study were promised to receive an invitation (see Appendix A, Appendix VII), an information letter (see Appendix A, Appendix VIII), and an informed consent form (see Appendix A, Appendix IX) via email.

The ethical aspect

Providing an adequate amount of information to participants is an essential element in conducting ethically defensible research with humans (Halkier, 2016, p. 67). The invitation, the information letter, and the informed consent form had the shared purpose of fulfilling this obligation by making the participants aware of what their involvement in the study entailed and how the data would be treated afterwards. As noted by Tolich, focus group participants can only be guaranteed external confidentiality, i.e., that the researcher will not reveal their identity to outsiders (Tolich, 2009). It is beyond the researcher's control to safeguard that the participants do not disclose information about each other to external parties. However, the informed consent form asked the participants to agree to maintain confidentiality, and this point was also stressed in the introduction to each focus group. It was a necessity that the

participants had signed the informed consent form before the start of the focus group.

To ascertain that the study design and the procedures for data handling and storage met all ethical standards, an ethical approval from the Research Ethics Committee at Aarhus University was sought during the summer of 2021 by submitting a protocol describing the research design and the information material intended for the participants. The committee can only grant ethical approval before the data collection has been initiated. Unfortunately, the committee could not endorse the study right away as the approach to anonymisation in the information material to the participants was deemed unclear. The participants had been promised anonymisation, but the committee was worried that this high degree of identity protection was unattainable. To further complicate the situation, the information material had already been sent to the participants attending the first couple of focus groups at this point. The solution was to rewrite the problematical passage in the information material to clarify that the identity of the participants would be pseudonymised rather than anonymised. A revised version of the information material was sent to the participants who had received the first edition. After this effort to ameliorate the deficiency, the committee decided to award the study with an ethical approval (approval number 2021-81, see Appendix XI).

Venue and accommodation

The focus groups were held at two locations: Aarhus University's campus in Aarhus and Metropol, a conference centre in Copenhagen. These venues were preferred as they had the requisite meeting room capacity and were easily reached via public transport in keeping with Bloor et al.'s remark that the accessibility of the venue is a contributing factor to successful recruitment (Bloor et al., 2001, p. 56). As a symbol of appreciation, the participants were compensated for their time with a box of chocolates worth DKK 100 at the end of the session. Further, they were served food and coffee during the focus groups, and their travel expenses were covered by Aarhus University.

Small groups with large diversity

As participant interaction is a defining element of the focus group method, the composition of the groups is a key concern in designing this type of study (Morgan, 1997, p. 55). The main decisions to make in this regard relate to the number of participants and how they should be combined.

In terms of group size, focus groups typically vary between six and ten participants, and according to Morgan, the participants' supposed interest in the subject should be used to decide where to position them on that continuum

(Morgan, 1997, p. 72). The telephone calls initiating the recruitment revealed that the participants were generally enthusiastic about the subject, and several participants stated that they had strong opinions in this regard. This knowledge helped me settle for six as the optimal number of participants, while five participants would be preferred to seven. However, in focus group studies, the researcher is heavily dependent on the reliability of the participants and the risk of late cancellations, and even no-shows are typical. It is thus conventional wisdom within focus group literature that slight over-recruitment might be needed (Cyr, 2019, p. 47; Stewart & Shamdasani, 2014, p. 64). Therefore, in some instances, more than six participants were invited to the focus groups to create a buffer. The warnings of the literature turned out to be warranted as there were quite a few late cancellations and one case of a no-show across the fifteen focus groups. This occurred although advised measures to promote attendance (Bloor et al., 2001, p. 33) were applied, with all participants receiving reminder emails around a week prior to the conduction of the focus groups and a text message the day before. The relatively low conversion rate from accepted invitation to turnout meant that a third of the focus groups consisted of four participants.

Regarding the constellation of participants in the different groups, the idea was to reflect as much diversity as possible within each group to create a dynamic discussion environment. The ideal was therefore to feature a high degree of variance in each group on the parameters that had guided the sampling. It is sometimes argued that caution should be exhibited in composing focus groups with large socio-demographic differences as this might impede group interaction (Cyr, 2019, p. 45); however, internal dissimilarities are also considered to enrich the data as the participants approach the subject from different angles (R. Barbour, 2018, p. 70). Although the aim to achieve diversity guided the configuration of all the groups, it had more significance in the homogeneous groups with citizens as well as in the heterogeneous groups. These groups were more likely to feature participants with markedly dissimilar backgrounds as illustrated by Table 5 below.

The participants in the homogeneous groups with the professionals per default shared certain characteristics like educational level, occupational status, and interest in the subject, while the introduction of participants from the citizen segment escalated the level of diversity since the only variable kept constant here was their nationality. Striving for diversity presented me with the moderating challenge of ensuring that the differences between participants were used to strengthen the discussion. It was therefore key to establish and maintain a safe environment where everybody felt included regardless of their background. Specifically, I made clear from the start of each focus group that all contributions were appreciated and that the goal of the discussion was not

to reach agreement or find a correct answer. During the focus group discussions, I also tried to acknowledge inputs from all participants equally. Securing a levelled discussion did not require much effort in the homogeneous groups with climate scientists and climate journalists. However, with the exception of the previously mentioned homogeneous group with citizens where two participants dominated the conversation in a rather disrespectful manner, it was also possible to achieve balanced discussions in the rest of the homogeneous groups with citizens and in the heterogeneous groups.

Table 5: Overview of focus group composition

	Females	**Males**
Homogeneous groups with climate journalists		
Group 1 (5 participants)	Freelancer, short experience Nationwide media, short experience	Niche media, long experience Niche media, medium experience Nationwide media, long experience
Group 2 (5 participants)	Niche media, long experience	Freelancer, long experience Niche media, medium experience Nationwide media, long experience Niche media, medium experience
Group 3 (5 participants)	Freelancer, long experience Nationwide media, long experience	Freelancer, short experience Niche media, medium experience Nationwide media, long experience
Group 10 (4 participants)	Nationwide media, long experience	Nationwide media, short experience Niche media, short experience Niche media, short experience
Homogeneous groups with climate scientists		
Group 4 (5 participants)	Professor Postdoc	Professor Associate professor Associate professor
Group 5 (5 participants)	Assistant professor	Professor Professor Associate professor Assistant professor
Group 6 (7 participants)	Professor	Professor Professor Professor Associate professor Associate professor Senior scientist
Group 15 (4 participants)	Senior scientist Associate professor	Senior scientist Associate professor

- continues -

Homogeneous groups with citizens		
Group 7 (6 participants)	Pensioner, 60s Product manager, 20s Student, 20s	Construction consultant, 30s High school teacher, 50s Farmer, 40s
Group 8 (4 participants)	Pedagogue, 60s Clerk, 40s	Geological consultant, 60s Carpenter, 30s
Group 9 (4 participants)	Pensioner, 60s	Student, 20s Priest, 60s Chief revenue officer, 50s
Group 14 (6 participants)	Unemployed, 50s Caregiver, 30s Outdoor consultant, 50s Architect, 50s	Engineer, 20s Student, 20s
Heterogeneous groups		
Group 11 (4 participants)	Early retiree, 60s	Professor Professor Journalist from nationwide media, long experience
Group 12 (6 participants)	Professor Student, 20s Primary school teacher, 50s	Journalist from nationwide media, short experience Journalist from niche media, long experience Associate professor
Group 13 (6 participants)	Sustainability consultant, 40s	Journalist from niche media, medium experience Journalist from niche media, long experience Professor Truck driver, 60s Associate professor in biomedicine, 40s

Dry running the moderator guide

In line with Bazeley's recommendation to expose qualitative research designs to a 'dry run' (Bazeley, 2013, p. 55), the moderator guide (described below) was tested through a pilot group. To perform this 'stretching exercise' (Janesick, 2000, p. 386) in preparation for the actual data collection, I composed a focus group consisting of researchers from my home institution, the Danish Centre for Studies in Research and Research Policy at Aarhus University, and people from my network. Ideally, the pilot group had featured a mix of climate scientists, climate journalists, and citizens with no personal relationship to the researcher. However, as climate scientists and climate journalists are scarce resources, it would not be appropriate to use them for testing purposes, and further, it would be difficult to convince a citizen unknown to me to spend time on something that only indirectly contributed to the study. The main purpose of the pilot group was to assess whether the number of questions was suitable and if the exercises worked as intended, and the cast at hand was fully able to

support this function. As the pilot group showed that there was room for additional questions in the moderator guide pertaining to the role of citizens, this theme was supplemented with more content.

The moderator guide: Same themes, different order

Four variations of the same moderator guide (see Appendix A, Appendices I–IV) were used in the study as it was tweaked slightly to fit each type of group constellation. Hence, the only points of distinction between the different versions of the moderator guide were the opening questions and the order of the themes (see Table 6 below). The moderator guide consisted of a mix of open-ended questions and exercises. In case the discussion related to any of the questions stalled, the moderator guide included a list of probes that could be used to reinvigorate the conversation. Each focus group was organised in four parts: an introduction and three sections dedicated to the themes about the role of each actor. During the introduction, the agenda of the study was reiterated and the participants were thanked for contributing and asked to present themselves. In the homogeneous groups, the participants were asked a couple of opening questions designed for each actor type to get the conversation going. For instance, the climate journalists were advised to share their motivation for covering the climate beat, while the citizens were asked to talk about their engagement with the public climate debate.

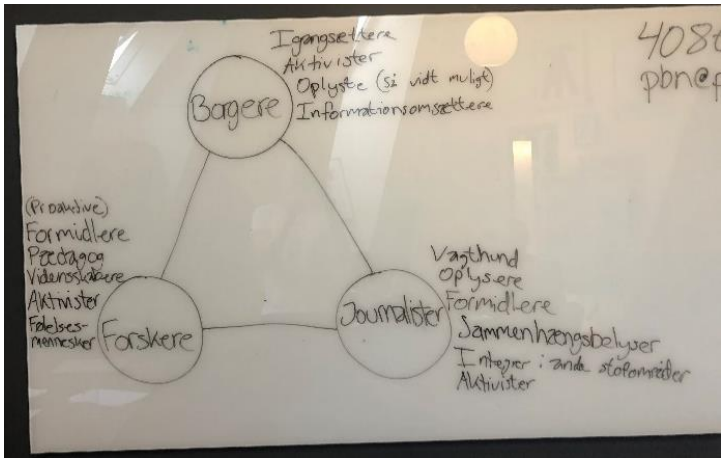
Table 6: Overview of theme order in the four different types of focus groups

Homogeneous groups with climate scientists	*Homogeneous groups with climate journalists*
Theme 1: The role of climate scientists	Theme 1: The role of climate journalists
Theme 2: The role of citizens	Theme 2: The role of citizens
Theme 3: The role of climate journalists	Theme 3: The role of climate scientists
Homogeneous groups with citizens	*Heterogeneous groups*
Theme 1: The role of citizens	Theme 1: The role of climate journalists
Theme 2: The role of climate journalists	Theme 2: The role of citizens
Theme 3: The role of climate scientists	Theme 3: The role of climate scientists

Each focus group was concluded with an outro during which the main elements of the discussions pertaining to the three themes were recapitulated. As part of the summarisation, the participants were presented with a final task, namely to come up with nouns that could be used to describe the ideal roles of the three actors (see Picture 1 below). For instance, climate scientists were often named ‘experts’, while ‘conveyors’ was often used to describe the role of

climate journalists. The expectation was that new perspectives might be elicited due to the juxtaposition of the three roles. In some groups, this hope was realised as fresh views were prompted by discussing the roles in tandem instead of individually.

Picture 1: Illustration of final task where the participants attached labels to each actor type: Scientists (Forskere), Citizens (Borgere), and Journalists (Journalister



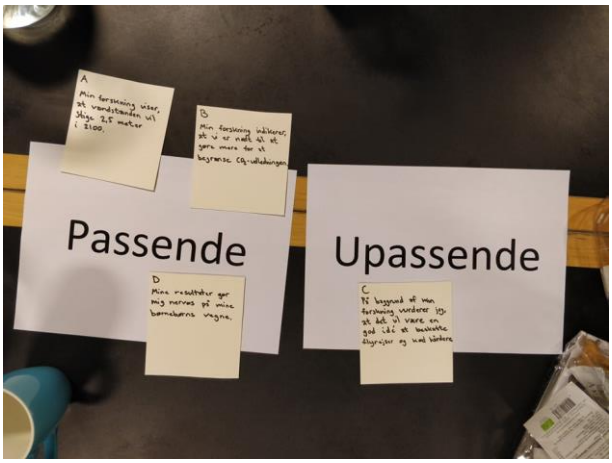
Exercises and stimulus material

Two exercises were included in the moderator guide. In the focus group literature, exercises have been highlighted for their ability to stimulate focus group discussions by activating the participants while ensuring that the group's attention is directed towards the topic under study (Bloor et al., 2001, p. 43; Colucci, 2007, p. 1431).

One exercise was connected to the theme regarding the role of climate scientists where the participants were exposed to a vignette about a fictive climate scientist who has discovered that the water levels might rise further by 2100 than hitherto expected. They were then asked to collectively assess the appropriateness of four different statements that the climate scientist could potentially make in the wake of his research. Option A was a mere description of the result, Option B was a general political recommendation to do more to combat climate change, Option C was a specific political recommendation to increase the tax on flying and meat consumption, and Option D was a declaration of worry on behalf of the grandchildren of the fictitious climate scientist. Picture 2 below shows how the participants in one of the focus groups placed the cards. Option A, Option B, and Option D have been planted in the 'Appropriate' category, while Option C has been rendered 'Inappropriate'. Generally, the participants seemed to enjoy the exercise, but the climate scientists appeared to find it particularly amusing, with some of them expressing their excitement. It also fulfilled the purpose of stimulating the discussion

about the role of climate scientists, especially when the participants disagreed about where a particular card should be placed.

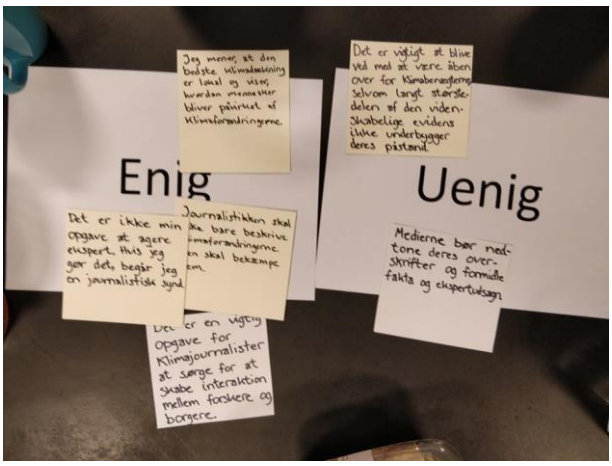
Picture 2: Illustration of exercise connected to the climate scientist theme. 'Passende' translates to appropriate and 'upassende' to inappropriate



The second exercise pertained to the theme about climate journalists and proceeded as follows. In turn, the participants were handed a card with a normative statement from a climate journalist regarding the role of climate journalists. The content of the cards was largely inspired by quotes made by climate journalists in the studies examined in the literature review. For example, one card paraphrased a journalist from a study by Smith (J. Smith, 2005, p. 1479) as it read: 'We journalists are not here to tell people how to behave, we are here to tell them about what is happening'. Each participant was asked to plant their card in either of the categories 'Agree' or 'Disagree' and provide an explanation of the choice, while the other participants were encouraged to comment on the placement. As all participants were provided with a card, the exercise helped to include the entire group in the discussion and to mobilise otherwise reticent participants. Like the scenario-based exercise used in the climate scientist theme, this exercise provoked a lot of group interaction as the participants either differed in whether they agreed or disagreed with a card or supplied alternative arguments for the same position. Picture 3 below is taken just as the participants in one of the focus groups have finished the exercise.

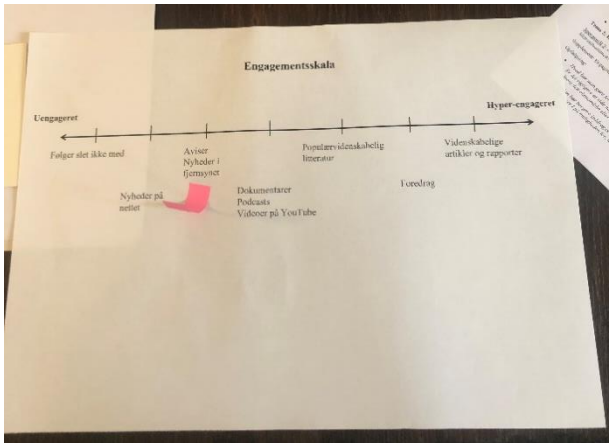
The moderator guide also contained a visual element as pictures were used as prompts to the question: What is good climate journalism? When the discussion of this question seemed to have stalled, the participants were shown three images depicting a graph, a polar bear, and a steak with a cross over it. This was supposed to help the participants reflect on the value of different kinds of climate journalism – be it factual, emotional, or prescriptive.

Picture 3: Illustration of exercise connected to the climate journalist theme. 'Enig' is Danish for agree, while 'uenig' means disagree



After the initial two focus groups, it was clear that the discussion of the role of citizens needed further stimulation. The part concerning citizens' engagement with climate science information seemed particularly in want of impetus as the debate was rather superficial and needed much moderator involvement to be kept alive. Consequently, I developed an engagement scale (see Picture 4 below) that could be used to direct this portion of the discussion. Providing a more concrete anchoring point for the discussion worked according to plan as the deliberation of the subject in the following groups was far livelier and more nuanced.

Picture 4: Engagement scale connected to the citizen theme. The scale ranges from unengaged on the left to hyper-engaged son the right



Transcription

The focus group interviews were audio recorded and subsequently transcribed with the aid of student assistants. I instructed the student assistants to transcribe the focus group discussions along the guidelines proposed by Bloor et

al. (Bloor et al., 2001, pp. 59–62). It was thus emphasised that pauses, overlaps in speech, tone of voice, and other oral expressions such as laughter should be indicated in the transcription. These fine-grained details of the discussions could potentially contain valuable information about the group dynamics and important cues about how to interpret certain utterances. If there was any doubt about the speaker or what was said, I listened to the audio files again. The quotes that have been used in the dissertation have been translated.

Data analysis in three sequences

Using NVivo software, the transcriptions were coded and analysed for Article 2 and Article 3 with a strategy inspired by Auerbach and Silverstein (Auerbach & Silverstein, 2003). First, relevant text was identified in the transcribed focus group discussions, then repeated ideas were recognised among the samples of relevant text, and finally, themes were derived from the repeated ideas. Each analysis was initiated by a within-case analysis of each focus group, where all text relevant to the respective research question was labelled according to its content through a line-by-line coding of each transcript. A range of the coding techniques described by Saldana was used in tagging the relevant text bites, particularly in-vivo coding and descriptive coding (Saldana, 2013, pp. 102–110). In the analytical process connected to both articles, the within-case analysis resulted in a vast number of codes with a concrete character in need of further sorting. A cross-case analysis was then carried out. Here, the diverse sample of excerpts with relevant text from the different groups was compared to recognise repeated ideas present across the different interview contexts. This manoeuvre helped to unearth patterns in the otherwise chaotic assortment of codes related to relevant text and served to guide the analysis towards the subjects that were most frequently touched upon by the participants. During this stage, a number of working displays were developed (see Display 1 below).

Display 1: Overview of focus group data underlying the theme of journalistic positioning.

Positioning (Climate journalists)		
Rejection of advocacy		
Climate scientists	**Climate journalists**	**Citizens**
[…] so, what is good journalism? Is it journalism that also tells people what they should do and what they should not do? *(Moderator)* No. I definitely don't think so. *(Associate professor)* No, no. *(Professor)* Well, like we talked about previously in relation to our role, when it becomes prescriptive, I don't think […] *(Associate professor)* *Group 4* It reminds me of the RT channel and Putin's Russia. There is no point in having journalism that is slanted in a certain direction. *(Professor) Group 6*	[…] I will say that to me, good climate journalism is journalism that lives up to the same criteria that you would use on other subjects. *(Niche media, medium experience)* Agree. *(Freelance, long experience) Group 2* Some people constantly try to undermine the credibility of the classic mainstream media. They say we have an agenda, and that is also why I think that to make campaign journalism […] In a time of fake news, it is incredibly important that we stay as objective as possible […] (*Nationwide media, long experience) Group 1*	[…] But of course, when it is based on research, then there probably are some numbers or some statistics that can show something, but otherwise, I would think that journalism should, to some extent, be neutral so that you as a citizen can engage with it without the journalist imposing a certain view on you. *(Climate sceptic, 20s, student) Group 7* They should not be activists. That was what you seemed to agree on. *(Moderator)* They should not. *(Neutral, 60s, pedagogue)* Journalists? No. Why should they? Because that is another trade. Then they should have become politicians instead. *(Climate sceptic, 60s, geological consultant) Group 8*
Approval of advocacy		
Climate scientists	**Climate journalists**	**Citizens**
[…] Because suddenly, we make campaigns where we tell you 'You could do this to limit your carbon footprint'. That is not an objectively chosen article. Is that okay? (*Nationwide media, long experience)* Yes, I would like to know that! *(Moderator)* I think it is. *(Professor) Group 11* A journalist is allowed to have an opinion if they just signal it clearly. *(Professor) Group 12*	But do you have to push an agenda? *(Nationwide media, long experience)* I tend to think that you have to do that a little bit […] *(Freelance, short experience)* *Group 1* I think you can do it in a lighter and more nuanced way, but I tend to agree (that journalism should not fight climate change). *(Nationwide media, short experience) Group 10*	Can journalists take an activistic stance? This is one who argues in favour of activistic journalism. *(Moderator)* I guess they can if they are transparent about it, like The Guardian. It must be an obvious positioning. *(Climate conscious, 40s, sustainability consultant) Group 13*

As a final measure to organise the data, the repeated ideas targeting a common subject were convened under the same theme. Not all repeated ideas were categorised thematically, as they proved to have little in common with the other repeated ideas. The end-product of the two coding processes was a manageable list of themes that contained the most prevalent repeated ideas. Table 7 and Table 8 below show examples of how the repeated ideas were translated into themes regarding both articles.

Table 7: Example of how repeated ideas were translated into themes during the analytical process of Article 2.

Actor type	**Theme**	**Repeated ideas**
Climate journalists	Positioning	Rejection of advocacy Approval of advocacy Journalism should be action prescriptive Climate journalism must describe state of affairs Activism should be clear
Climate scientists	The style of communication	You should not be politically activistic Scientists must stick to their findings Okay to be nervous on behalf of grandchildren Should not mix feelings and research Activism is okay Appropriate to give general policy recommendations
Citizens	The information-seeking behaviour of citizens	Keeping up to date is a citizen duty No requirements The climate is something special The climate is not something special The education system should equip people Differentiated expectations

Table 8: Example of how repeated ideas were translated into themes during the analytical process of Article 3

Theme	Repeated ideas
Scientific knowledge	Scientists must stick to their own area
	Science is certain
	Is allowed to speak out about more general matters
	Science can be mistaken
Experiential knowledge	Citizens can contribute with experiences
	Experiences are unscientific
	Citizens can deliver ideas to scientists
	Climate science is too technical
	Citizens cannot be experts
Quality assurance	The media has credibility
	The media will not show the real graphs
	Call the bluff
	Scientists should do fact checks
	Misinformation is a problem

Discussion

In this subsection, I will first discuss the implications of situating the focus group study in Denmark. I will then consider the omission of relevant stakeholders. Finally, I will delve into the experiences of employing a research design with a mix of homogeneous and heterogeneous focus groups and my efforts to ensure that my research was conducted in a reflexive and transparent manner.

Studying climate communication in a context of trust and climate concern

In its essence, the focus group study serves as a case study of climate science communication in Denmark. An endemic part of doing case-oriented research is to be reflexive about the significance of the context that the study is conducted within. It is essential to ask the question: What is Denmark a case of? There is a multitude of potentially significant context-dependent features that might have bearing on how the focus group discussions unfolded. Here, I will focus on a selection of characteristics that I consider particularly important in understanding how the context may have affected the course of the focus groups.

A first aspect to take into consideration is the high degree of social trust present in Danish society (Frederiksen & Gundelach, 2022, pp. 441–442; Svendsen & Svendsen, 2015). In this regard, it is especially noteworthy that

the trust-based culture is manifested in the Danes' perceptions of science and the media (Larsen, 2017; Newman et al., 2021, p. 19). When interpreting the results from the focus group study, it is important to be mindful of the fact that Denmark is an example of a country with above average confidence in climate scientists and climate journalists as this might influence how the focus group participants view the ideal roles of these actors and shape their attitude towards scientific knowledge.

Perhaps related to the pronounced trust in science among the Danish population, there is a high degree of recognition of the severity of the climate challenge. Accordingly, the 2019 election was dubbed 'the climate election' as the concern about climate change spilled over to the political scene, where the topic was top of mind for voters across a broad range of the ideological spectrum (Møller Hansen & Stubager, 2021). This means that the Danish climate debate must be regarded as rather harmonious compared to the circumstances in, for instance, the United States where climate change has been found to be a highly divisive topic (Dunlap et al., 2016). The consensual Danish discussion environment might have an impact on how scientific and journalistic advocacy are perceived, as it might seem unwarranted for climate scientists and climate journalists in Denmark to take on a prescriptive agenda when there is already a high level of agreement that anthropogenic climate change poses a threat that must be combatted. Another implication of the widespread awareness of the potential negative effects of greenhouse gas emissions among Danes might be that the citizens who were ostensibly neutral would have been considered climate conscious in another context since the threshold for belonging to this category is relatively high in Denmark.

A third factor to consider when reflecting on the case selection is the Danish tradition of involving citizens in the societal deliberation of scientific issues. In what has later become known as 'the Danish model' of citizen involvement (Goven, 2003; Seifert, 2006), the Danish Board of Technology introduced consensus conferences and public hearings as well as more experimental formats such as scenario workshops and role plays to further public participation in discussions of scientific issues (Andersen & Jaeger, 1999; Mejlgaard & Stares, 2012, p. 486). These measures generally stressed a bidirectional approach to science communication and were meant to foster knowledge exchanges between the scientific community and the rest of society. The Danish culture of involving citizens in science-related matters could potentially have a spill-over effect on how the participants in the focus groups viewed the ideal role of citizens examined by Article 2 and the relevance of experiential knowledge, a focus point of Article 3. It is, for instance, plausible that people in Denmark will tend to visualise a more participatory role for citizens than elsewhere due to the tradition of citizen involvement, which might

also entail that experiential knowledge is held in extraordinarily high esteem in the Danish context. Regarding the perceived relevance of experiential knowledge, it is therefore reasonable to argue that Denmark constitutes a most likely case of a country where this type of input is appreciated (Flyvbjerg, 2006, pp. 229–232).

An emphasis on process rather than outcome

When drawing up the triangle of the concerned actors at the beginning of each focus group, participants often confronted me with comments about the stakeholders that were left out. Questions akin to 'Where are the politicians?', 'What about the businesses?', and 'Have you thought about NGOs?' were frequent. Later in the process, these same requests were raised by reviewers. The responses from the participants and the reviewers demonstrate that climate scientists, climate journalists, and citizens are not shoo-ins as the primary actors in climate science communication, and it therefore seems warranted to provide a thorough justification for the choice to focus on them.

If the purpose had been to examine the outcome of the exchange between science and society, it would have made perfect sense to include one or more of the sought-after stakeholders. For instance, I could have investigated how climate science translates into climate policy or how it affects the sustainability strategies and product development of companies. In that case, the emphasis would have been on the usability of climate science in the mould of Mode 2 science thinking (Gibbons et al., 1994). Extant research has already trodden these interesting avenues of inquiry as scholars in recent decades have been keen on both climate science's link to the political sphere (M. C. Lemos et al., 2012; M. C. Lemos & Morehouse, 2005) and its interplay with the business sector (Linnenluecke et al., 2015; Rothenberg & Levy, 2012).

However, the potential political or corporate consequences of climate science's dealings with its surroundings are beyond the scope of the present dissertation, which instead seeks to understand how the three actors perceive the ideal arrangement of the climate science–society nexus. It is interested in determining the ground rules for the public conversation about climate science: Who should do what? What is relevant knowledge? How is the standard of the discussion maintained? It is thus the process of the dialogue itself that is the focal point of this dissertation. Arguing for the intrinsic value of dialogue, Davies et al. contend that:

> Engagement with science in the context of society allows scientists and publics to explore ideas, to examine current societal issues, to challenge the claims of others, and to develop their own understandings. Thus, whether or not dialogue events inform policy, they may provide an important and effective venue for

adults to voluntarily engage with science in the context of society. (Davies et al., 2009, p. 343)

Along the same lines, Einsiedel classifies dialogue as an independent end of public participation in science and technology (Einsiedel, 2014, pp. 130–131), while Jackson et al. maintain that public dialogue on science-related issues 'locates scientific developments in a wider social context and enables the inclusion of a wider range of relevant expertise with regard to the implications of such developments' (R. Jackson et al., 2005, p. 350).

One could argue that focusing on the processual aspect of dialogue did not rule out considering its outcome, and that both agendas could have been pursued fruitfully by adding another type of stakeholder like politicians or civil servants to the mix. From a feasibility perspective, there is nevertheless no doubt that an expansion of the actor ensemble would be insurmountable, at least with the current research design with homogeneous and heterogeneous groups. To keep a symmetrical design, the inclusion of another actor type would have required the conduction of a further four focus groups. It would also have entailed that an already packed moderator guide should have contained an additional topic, leading to an extension of the focus groups from 90 minutes to almost 120 minutes, severely challenging the attention span of the participants. Hence, the viable way to have included more stakeholders would have been to do without either climate scientists, climate journalists, or citizens.

Harmonious heterogeneity and fiery scepticism

In the focus group literature, there are ample reminders to beware of power dynamics when conducting focus groups (Allen, 2005; Ayrton, 2019). Moreover, interpretivist research has been asserted to come with the ethical imperative of promoting 'an equitable context within which all voices may be heard' (Angen, 2000, p. 388). Regarding the present study, I thought that the issue of power imbalances and the ensuing risk of silencing of certain voices would be most pressing in relation to the heterogeneous groups. The climate scientists and climate journalists in these groups could be seen to hold a position of power compared with the citizens due to their professional engagement with the subject of climate change. This fostered the concern that they would potentially dominate the citizens during the conversation as they might feel that their opinions were more qualified due to their familiarity with the climate topic. Indeed, Conti and O'Neil have demonstrated how the elite status of interviewees can disrupt interview situations if not managed appropriately (Conti & O'Neil, 2007). As the mixing of climate scientists, climate journalists,

and citizens in focus groups is unprecedented, I cannot draw on others' experiences in this regard. Nevertheless, in a study on genetic biobanks, Tutton shows that fruitful focus group discussions are possible when laypeople and experts are mixed, although not without 'its problems and challenges' (Tutton, 2007, p. 178). It is important to underscore that researchers should not strive to avoid disagreements altogether as these could prove to be of great scientific value (Demant, 2014, p. 203), but conflicts resulting from disrespectful behaviour should, of course, not be tolerated.

At the start of the first mixed focus group, I was prepared to play an active role in creating an equal discussion environment. However, it soon turned out that any interference with the group interaction on my part was unnecessary as the participants naturally treated each other respectfully regardless of their backgrounds. The single citizen in the group was very active, and on several occasions, she challenged the viewpoints of the climate scientists and the climate journalists, forcing them to reconsider their statements. A similar pattern emerged in the other two heterogeneous focus groups, which also self-regulated into an egalitarian power structure. The latter of these did, nevertheless, contain some commotion, but this was not due the climate scientist or the climate journalists trying to rise above the citizens. In fact, almost the opposite was the case as the heated debate was instigated by a climate sceptic citizen, who questioned the veracity of climate science and the independence of climate journalism and thereby provoked firm responses from the other participants.

Paving the way for quality with reflexivity and transparency

The issue of quality criteria is a bone of contention in the methodological literature on qualitative research (Miles et al., 2019, p. 304). Indeed, some argue that specific assessment standards cannot be meaningfully applied to interpretive inquiry as the setting of ultimate principles against which to measure quality 'as the warrants one brings to judgements are themselves socially and historically conditioned' (J. K. Smith, 1984; J. K. Smith & Deemer, 2000, p. 882). Respecting this injunction, Schwarz-Shea nevertheless proposes that a revisable core list of criteria grounded in the epistemic community can usefully guide 'the pragmatic work of judging the quality of interpretive research' (Schwartz-Shea, 2006, p. 100). I subscribe to this point, and while there is no definitive test to which I can expose my interpretations, reflexivity and transparency have been guiding principles in my work with this dissertation, particularly regarding the focus group study.

Schwartz-Shea and Yanow define reflexivity as a researcher's considerations of the ways in which his or her own role in the generation of knowledge has affected both the process and the outcome of the research endeavour

(Schwartz-Shea & Yanow, 2012, p. 100). Like ethnographers, moderators of focus groups can be seen as 'the primary vehicles of knowledge production' (Shehata, 2013, p. 211), and reflecting on my role as the arbiter of the conversation was therefore of the highest importance. For instance, my background as a journalist would likely make it easier for me to identify with the climate journalists participating in the groups, which might have an impact on the group dynamic in the heterogeneous groups. Moreover, due to my own concern about the future of the climate, I would be inclined to sympathise with participants with a similar sentiment. To keep these potential sources of distortion in check, I continuously sparred with the research assistants that aided me throughout the research process. After each focus group session, I discussed the course of events with the attendant research assistant to get his or her view on my performance and be made aware of potential blind spots in my moderation. The concern for reflexivity was also ingrained in the planning of the focus groups as they were held over a period of two months to allow sufficient time in between the sessions to digest the impressions from them and learn from each moderator experience. Later, as the interviews were transcribed by student assistants, I got another opportunity to get feedback on my way of steering the conversation, and during the analysis and writing phases, I continued to spar with the primary research assistant. Testing my interpretations on someone who had also witnessed the focus group discussions was very valuable. Member-checking could have been a supplementary way of achieving reflexivity (Schwartz-Shea, 2015, p. 138). It connotes a practice where the researcher sends a draft of the analysis to the people studied to get assurance that he or she 'got it right' from their point of view (Schwartz-Shea & Yanow, 2012, p. 106). Yet, with 76 participants such an operation seemed infeasible regarding the focus group study of this dissertation.

Transparency was another ideal that I navigated towards. According to Schwartz-Shea, transparency concerns one's effort 'to make the linkages among researcher decisions, evidence-generated, and inferences drawn as transparent as they can be' (Schwartz-Shea, 2015, p. 137). In my case, the first step towards transparency was writing the protocol for the focus group study (see Appendix A). Here, I documented my initial conception of how the study should be conducted. During the data collection, I instructed the research assistant present at each focus group session to take pictures of the different exercises to be able to showcase the procedure afterwards. While analysing the data, I used NVivo software to systematise my coding procedure. This made it possible to create working displays that were meant to give me an overview of the data, but at the same time enabled outsiders to follow my train of thought. These measures were all taken to answer the hypothetical question: 'How ex-

actly did you do this research?' (Schwartz-Shea, 2015, p. 138). There are nevertheless also limits to the level of transparency that I can legitimately provide due to the ethical commitment I have towards the participants, which identities I have promised to safeguard. As described by Kvale, the relationship between transparency and identity protection can easily turn into a trade-off (Kvale, 1997, pp. 120–121). To obtain a higher degree of transparency, I could have disclosed more information on for example the climate scientists' home institutions and their specific research fields. Moreover, the transcribed focus group interviews could have been included in the supplementary material. However, if I had taken those actions, I would have violated the contract I made with the participants when they agreed to join the study through the informed consent form.

Chapter 4: Role perceptions in climate science communication

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RESEARCH ARTICLE

Role Perceptions in Climate Science Communication

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ABSTRACT

Climate science communication holds the potential to stimulate a renegotiation of the conventional roles in the science-society interface. As climate science is conducted within a context of uncertainty, disputed values, high-stakes, and urgency it promises to alter the demands placed on scientists, journalists, and citizens in the public discussion of the research. This study reviews the extant literature on the role perceptions among these three actors to examine how they perceive their own and each other's ideal roles. Based on a systematic literature search and a thematic reading, the examination shows that the normative role perceptions of climate scientists and climate journalists are relatively well described, while the ideal role of citizens in the discussion of climate science has received far less scholarly attention. Activism is shown to be a recurring theme in the discussion of the roles of climate scientists and climate journalists. The literature on the role of citizens is preoccupied with what level of scientific competence citizens ought to possess.

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Introduction

Until the latter part of the twentieth century, science communication was primarily a matter of informing the public about the achievements of science (Gibbons, 1999, p. 82). Scientific knowledge was deemed a superior knowledge form (Felt, 1999, p. 10), and scientists' communication with their surroundings was conducted in a unidirectional fashion (Brossard & Lewenstein, 2009, p. 17). This configuration cast the media in a translator role tasked with conveying the scientific discoveries in a language comprehensible to non-specialists, who were primarily considered passive recipients (Bucchi, 1996). In recent decades, this top-down model of science communication has, nevertheless, been widely criticized (Wynne, 1993) and perhaps few scientific disciplines invite an adjustment more than climate science. This topic is argued to be a quintessential example of what Funtowicz and Ravetz term "post-normal science" (Funtowicz & Ravetz, 1993; Krauss et al., 2012) as it fulfills all four defining criteria by featuring uncertainty, disputed values, high-stakes, and urgency. In post-normal situations, Funtowicz and Ravetz contend that the science-society relation must be rethought, as the "scientific argument" must move from "formalized deduction" to "interactive dialogue" (Funtowicz & Ravetz, 1993, p. 740).

Based on Funtowicz and Ravetz' theory, Brüggemann et al. recently launched the concept of post-normal science communication, which provides propositions to how post-normal conditions could influence science communication. Coupled with the opportunity for new kinds of unmediated interaction offered by social media and an increasingly polarized society, post-normal

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situations are argued to lead "to a blurring between and a renegotiation of the professional boundaries of the stakeholders involved in science communication" (Brüggemann et al., 2020, p. 2). Brüggemann et al. expect this development to introduce a new set of role perceptions when scientists and journalists communicate about post-normal science topics like climate change. However, the cli- mate crisis not only has the potential to question the traditional understanding of the responsibility assigned to science and the media; its unique characteristics could also provoke a reconsideration of what is expected of citizens. Climate change thus constitutes a collective action problem (Kim, 2012; Olsen, 1965) as it will require a concerted effort from businesses, policymakers, and publics world- wide to curb the concentration of carbon dioxide in the atmosphere. This makes climate science an obvious candidate for citizens to engage actively in the societal deliberation of the subject. Taking a more participatory stance towards the public debate would resonate with the concept of scientific citizenship, which is based on the idea that the increasing importance of scientific knowledge to modern societies requires a reinterpretation of the conventional notion of citizenship (Horst, 2007, p. 151). It thus suggests that members of modern knowledge societies have certain rights and responsibilities based on this membership regarding the societal discussion of scientific issues (Mejlgaard & Stares, 2010, p. 548).

The scholarship discussed above describes a wave of contemporary transitions that challenge the orthodox conception of what it entails to be a climate scientist, a climate journalist, and a citizen in a modern society. This development invites investigation as it threatens to confuse what the three actors can expect of themselves and each other. It prompts the following research question:

> How do climate scientists, climate journalists, and citizens perceive their own and each other's ideal roles in climate science communication and to what degree are these ideal role perceptions compatible?

This study will answer this question by reviewing empirical studies containing the actors' views of the ideal distribution of responsibility in climate science communication. The existing peer-reviewed literature on the topic will be searched with five different techniques to find the prevalent themes pertaining to each of the three roles (see Figure 2 below). This five-step approach will help in tracing potential temporal and geographical patterns in the actors' role perceptions. It will also serve to highlight how role perceptions have been studied and consequently point out possible methodological limitations.

A framework for studying climate science communication

The following section will elaborate on some of the theoretical currents in the contemporary literature implying that the roles of climate scientists, climate journalists, and citizens might face an adjustment. This will function as the theoretical backdrop informing the subsequent discussion of the results from the examination of the empirical literature on ideal role perceptions. The section will also introduce the triangle of climate science communication, the analytical model underlying this study.

Due to the post-normal circumstances, advocacy is one of the norms Brüggemann et al. expect to gain traction among climate scientists and climate journalists in the future. Hereby, the common interpretation of a core value of both science and journalism, objectivity, would be challenged (Post, 2015, p. 731). According to Brüggemann, climate journalism might move away from the detached reporting employed in "normal journalism" towards a style where the journalist takes a clear stance or even engages in advocacy for specific political purposes (Brüggemann, 2017). Brüggemann et al. proposes a similar development in the communicative approach of scientists as they are supposed to become increasingly political due to the need for urgent decision-making in relation to the climate crisis (Brüggemann et al., 2020, pp. 10–11).

Meanwhile, the possibility that citizens and scientists can communicate directly also threatens to render climate journalists less relevant, at least in the role of gatekeepers. The question then becomes what the journalistic profession can do to regain territory in "the crisis of mediators"

(Bucchi, 2013, p. 905). One way to sustain their relevancy and gird themselves for more independent handling of post-normal issues is for journalists to acquire an in-depth understanding of the processes and methods underlying scientific knowledge production (Brüggemann et al., 2020, p. 12). This will enable them to cover science in a more interpretive way, akin to what Patterson and Donsbach term "knowledge-based journalism" (Donsbach, 2014; Patterson, 2013). Nisbet and Fahy even argue that there is a pronounced societal need for knowledge-based journalism in "politically contentious science-related debates" such as the one about climate change (Nisbet & Fahy, 2015). Attaining a higher degree of expertise, Donsbach asserts that journalists can facilitate the maintenance of a shared reality in a society flooded with competing knowledge claims by finding, valuating, and contextualizing relevant information to create "a reservoir of common knowledge, experiences and values" (Donsbach, 2014, p. 665).

Climate scientists and climate journalists may not be the only actors confronting new responsibilities. As suggested by the concept of scientific citizenship, the increasing importance of scientific knowledge in modern societies raises new questions about how to involve citizens in the societal discussion of science-related topics (Mejlgaard, 2009, p. 483). To fully enforce their scientific citizenship, citizens must be competent and participative (Horst, 2007, p. 151; Mejlgaard & Stares, 2010). Competence implies that citizens require some degree of knowledge of scientific matters "to navigate successfully in the knowledge society" (Mejlgaard & Stares, 2010, p. 545), while they also need to be offered opportunities to participate in decision-making processes and public discussion of scientific issues.

Role perception is a key concept of this paper and is understood in accordance with Giddens' definition of a social role as "the expected behavior of an individual occupying a particular social position" (Giddens, 2001, p. 699). This broad definition applies to both professional roles such as climate scientist and climate journalist and the non-professional role of being a citizen. It is important here to note the difference between role perceptions and role performance as the two concepts are linked, but not to an extent where the former can be seen as simply predisposing the latter (See Mellado for the gap between role perception and role performance (Mellado, 2015; Mellado & van Dalen, 2014)). Normative role perceptions refer to how actors ideally think responsibilities should be delegated between them. To understand this relationship, I propose the triangle of climate science communication as an analytical framework (see Figure 1).[1] Ingrained is a three-dimensional focus where the three actors' reflections on their own ideal role as well as those of the other actors are considered. The normative perspective is intended to facilitate a distancing from the present structure and instead allow an exploration of different Utopias of climate science communication. This approach should provide impetus for critical reflection on the current

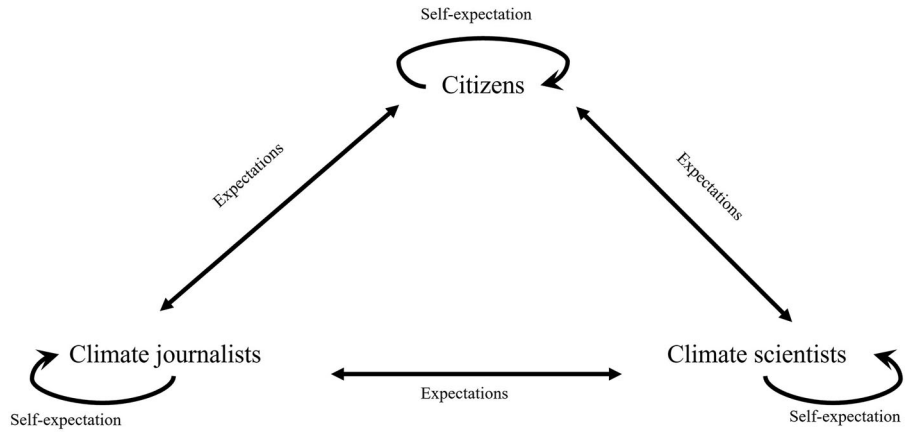

Figure 1. The triangle of climate science communication.

situation in the triangle. Further, by not only investigating how different actors perceive their own role but also how they view the roles of the other actors, potential discrepancies between the actors' self-expectation and the expectations from their interlocutors will come to the fore.

Methods

To identify which role perceptions are prevalent among climate scientists, climate journalists, and citizens and judge their compatibility a review of the contemporary peer-reviewed literature pertaining to this subject was performed. This was done with a structured, narrative approach.

As the intention was to understand how the roles are perceived across time and space, a review of the existing research on the topic was the most suitable approach. Because the study seeks to gain a broad understanding of the role perceptions, a comprehensive search of the peer-reviewed literature was executed. This means that research of all methodological types was considered and that no studies were perceived to be outdated. The feasibility of not having a time limit is a consequence of climate change communication being a young research field only dating back to the 1990s (Schäfer & Painter, 2020, p. 4). Studies were systematically screened and identified as shown in Figure 2. The analysis had a narrative character as the themes occurring in the literature on normative role perceptions in climate science communication were identified. The aim of the thematic reading was to create a categorization of the analyzed studies from which specific role perceptions could be elucidated.

To locate pertinent studies on the role perceptions of climate scientists, climate journalists, and citizens database searches were performed (see Table 1).

As it proved difficult to locate relevant studies with citizens, the publications of six major journals on climate science communication were trawled to find pertinent studies using different terminology (see Figure 2). In the most clear-cut instances, it was sufficient to read the title to rule out an article, while the abstract was scanned in case of doubt.

To trace relevant studies on citizens' role perceptions, I contacted ten Danish scholars from a range of fields including science communication, environmental sociology, political science, and environ- mental pedagogy. By contacting researchers from my home country, I could use my knowledge of relevant institutions and persons in this particular research system. Although some relevant articles were located via the experts, most answered that they did not know of studies eligible for this review. Further, the titles on the reference list of each relevant article were checked. As a final measure, citation searching in Web of Science, Scopus, and ProQuest (EBSCOhost does not offer this feature) was performed to see if hitherto unidentified papers with relevant titles were citing the studies already deemed worthy of full text analysis. By conducting reference list checking and citation searching in tandem, it was possible to track articles published both before and after the studies already qualified for full text analysis. This exercise was performed until the point of saturation was reached.

Table 1. Overview of databases and search strings used in the literature search. The searches were performed on 1 November 2020.

Databases used	Search words for articles with climate scientists	Search words for articles with climate journalists	Search words for articles with citizens
Scopus (title, abstract, tags, and keywords) Web of Science (title, abstract, tags, and keywords) EBSCOhost (abstract) ProQuest (abstract)	["climatologist*" "climate scientist*" "climate researcher*"]	["journali*" OR "reporter*"] AND ["climate change" OR "global warming"]	[("role responsibility" OR "role perception") AND ("citizen" OR "public" OR "lay") AND ("climate change" OR "global warming")] OR ["scientific citizenship" AND ("climate change" OR "global warming")] OR ["public engagement" AND "climate science"]

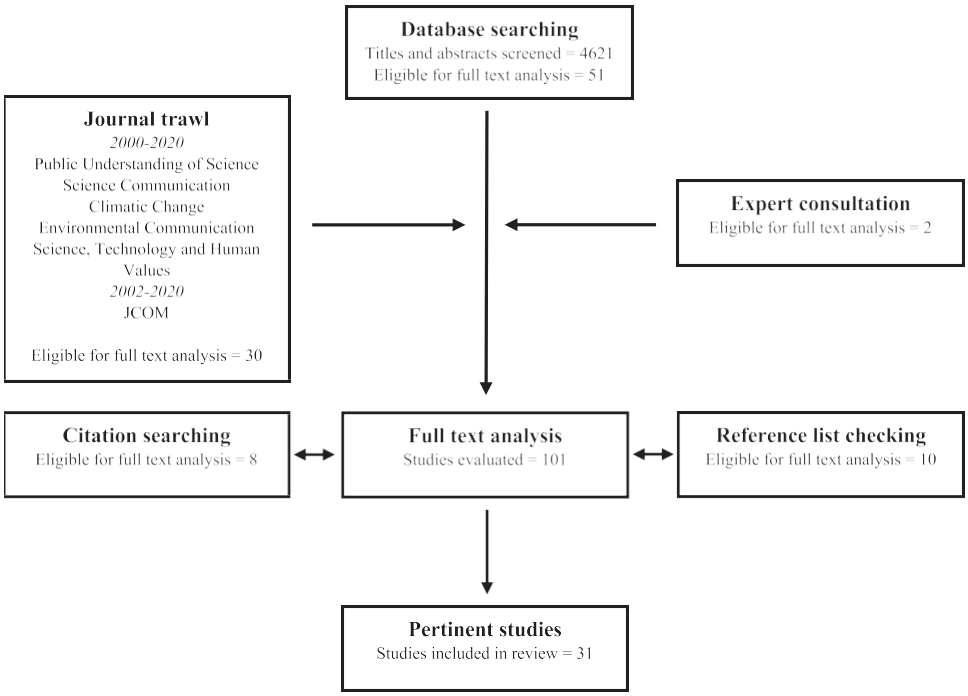

Figure 2. Flowchart illustrating the review process.

The systematic literature search identified 101 candidate references of which 31 were included in the final sample. To be judged relevant, studies had to target climate science communication, investigate either climate scientists, journalists, or citizens, and contain an empirical aspect. Further, only studies that provided insight into what the actors ideally expect of themselves and each other were included. These normative reflections could be expressed both qualitatively (e.g. interview quotes) and quantitatively (e.g. survey answers). It was not a requirement that the studies were focused narrowly on the topic, only that it was touched upon even slightly. Studies with purely descriptive con- tent were excluded. Finally, only studies written in English, German, Danish, Swedish, or Norwegian were taken into consideration (see Table 2) Table 2.

The studies are only counted the first time they are detected. For example, if a study has already been found in a database search, it will not be counted again if it also appears in a reference list check. The bi-directional arrows indicate that citation searching and reference list checking have been performed on all studies eligible for full text analysis and that the studies found by these means have fed studies back into the full text analysis pool.

To elicit themes, the studies were hand-coded to find material of a normative character from climate scientists, journalists or citizens containing information about how they perceived the

Table 2. Overview of number of included studies per actor type and study approach.

	Study approach				
Actor type	Interview	Surve	Focus groups	Observation	Total number of studies*
Scientists	9	9	0	0	15
Journalists	8	2	1	0	11
Citizens	3	3	5	2	10

*Studies employing more than one method will count more than one time in the table. Further, studies featuring more than one actor type will count one time per actor type. This explains the discrepancy between the total number of included studies (31) and the total number of studies in this table.

expectations connected to their own role or the role of the other two actors. The coding process entailed two phases: First, all studies were coded openly to identify normative content on role perceptions; and second, a focused coding of the material was performed, where headlines were added to each normative element to group text segments with the same topic. These headlines ended up constituting the themes used in the analysis. Finally, ideal type role perceptions of the three actors were distilled based on the thematic reading of the literature.

Analysis

Role perceptions among climate scientists

The self-expectation of climate scientists

Generally, the literature is mostly concerned with climate scientists' perceptions of their own role in public communication rather than what they expect of journalists and citizens. Four themes materialize in the studies: *availability*, *activism*, *relevance,* and *credibility*. The former two are very prevalent, whereas relevance and credibility are less represented.

Availability concerns climate scientists' responsibility to communicate publicly. This theme is frequently considered and associated with a high degree of consensus. Across national contexts, climate scientists recognize their responsibility to communicate their research to the public (Getson et al., 2020; Peters & Heinrichs, 2005; Salmon et al., 2017; Sharman & Howarth, 2017; Tøsse, 2013). Climate scientists in Norway, Great Britain, Germany and New Zealand (Peters & Heinrichs, 2005, p. 121; Salmon et al., 2017, p. 59; Sharman & Howarth, 2017, p. 835; Tøsse, 2013, p. 40) all tie this commitment to the public funding of their research, while the high stakes involved in climate science are also found to be a motivating factor (Salmon et al., 2017, p. 59; Sharman & Howarth, 2017, p. 835; Tøsse, 2013, p. 41). Although there seems to be broad agreement on this subject, Entradas et al. present contrary evidence. Their data attests that one in three climate scientists from the American Geophysical Union does not view public communication as their personal obligation. Instead, they place the responsibility with the communication staff at their institution (Entradas et al., 2019 TabS3). While reinforcing the impression that public communication is a "compulsory route" for German climate scientists, Mormont's comparative study of climate scientists from Germany, Belgium and France conducted more than 25 years ago indicated that there is a cultural aspect to the degree of responsibility climate scientists feel towards public communication (Mormont & Dasnoy, 1995). French climate scientists did not view entering the public sphere as an obligation, whereas their Belgian colleagues had an approach similar to the Germans (Mormont & Dasnoy, 1995, p. 52). Bray and Von Storch also found the national context to matter as climate scientists from Germany were significantly more committed to "alerting the general public" than their US counterparts (Bray & von Storch, 1999, p. 450).

Activism relates to how climate scientists think they should position themselves on the advocacy-neutrality spectrum when communicating publicly. Using Pielke's typology of scientific roles (pure scientist, issue advocate, science arbiter, and honest broker) as their theoretical framework (Pielke, 2007), Wilke and Morton found that none of the climatologists in their study could be labeled an issue advocate (Wilke & Morton, 2015b). Instead, the majority was deemed pure scientists, the least advocating of the four ideal types. Another study using the same data also shows that some climate scientists have a strong inclination towards neutrality (Wilke & Morton, 2015a, p. 387). Surveys of climate scientists from the USA and Germany also show a leaning towards a neutral position when entering the public debate (Beebe et al., 2019, p. 41; Peters & Heinrichs, 2005, p. 100). However, the German climate scientists in Peters' study did not dismiss that their role also entailed a responsibility to publicly criticize political decisions (Peters & Heinrichs, 2005, p. 100). The UK-based cli- mate scientists interviewed by Sharman and Howarth were "divided on the extent to which their role should involve engaging in political debate and making policy recommendations" (Sharman & Howarth, 2017, p. 833). This division is also found in interviews with Norwegian climate scientists (Duarte & Eide, 2018, pp. 13–14) and in an American survey exactly half of the climate

scientists supported policy advocacy (Getson et al., 2020, p. 4). Another survey-based study with American climate scientists published last year serves as the only example of unequivocal support of activism (Boykoff & Oonk, 2020, p. 33).

Relevance captures the degree to which climate scientists think they should tailor their communication to the target group. This theme is only dealt with in a Norwegian context where it is argued that climate scientists ought to connect their research to the everyday lives of citizens when featuring in the media (Duarte & Eide, 2018, p. 12).

Credibility refers to how climate scientists think they should handle uncertainty. A small number of studies cover this subject. An American climate scientist interviewed by Boykoff perceived uncertainty to be a significant hindrance for climate scientists to fulfill their role as effective public communicators: "Because all the culture of the university and scientific societies is to hedge everything … we are a little too unwilling to say things as we see [them]" (Boykoff, 2007, p. 483). Both Tøsse and Post find climate scientists to be in favor of informing the public about the uncertainty embedded in their research (Post, 2016, p. 65; Tøsse, 2013, p. 49), although climate scientists have previously been shown to prefer restricting such discussions to scientific journals (Bray & von Storch, 1999, p. 150).

Climate scientists' expectations towards journalists and citizens

The studies featuring climate scientists are mainly introspective. However, a limited amount of research explores climate scientists' expectations of the media and the public. Regarding the role of the media, two themes occur: *authority* and *activism*. The only theme concerning the role of citizens is *competence*.

Authority denotes how climate scientists think journalists should approach climate science in relation to being critical. Peters found that climate scientists acknowledge that journalists should expose scientific uncertainty and handle experts critically when assessing their credibility and during interviews (Peters & Heinrichs, 2005, p. 101, 103). In Boykoff's study on American climate scientists a related aspect of the media's role was discussed as it is argued that the media "don't have to avoid contrarians … but they have to make sure there is a perspective on their relative credibility" (Boykoff, 2007, p. 482). A similar view is found in a Norwegian context (Tøsse, 2013, p. 43). These findings show that climate scientists want the media to scrutinize scientific knowledge claims to be able to flag minority viewpoints.

Activism has also been examined in relation to how climate scientists perceive the role of journalists as the German climate scientists surveyed by Peters "express a central expectation towards journalists, namely to not only present factual issues, but also take on a political role …" (Peters & Heinrichs, 2005, p. 151). Further, they agree that journalists should commit themselves to the protection of the climate (Peters & Heinrichs, 2005, p. 101).

While climate scientists' expectations of journalists rarely have been on the scholarly radar, even less

is known about what they expect of the public. However, Tøsse contributes reflections on the degree of *competence* that climate scientists anticipate from citizens. One of the Norwegian climate scientists thus contends that the current situation "implies that the general public does not take this [climate change] as seriously as they should" and that it is therefore a necessity to increase the level of knowledge in the general public (Tøsse, 2013, p. 41). This corresponds with the general finding that the interviewed cli- mate scientists feared that the public lacked knowledge about climate science (Tøsse, 2013, p. 49).

Role perceptions among journalists

The self-expectation of journalists

Most studies incorporating the perspective of journalists focus on how they perceive their own role in climate science communication. In this part of the literature, *activism* is by far the most dominant theme, although *contribution* and *authority* are also deliberated.

In the literature on journalists' perception of their own role, *activism* is a common theme. It refers to how journalists think they should balance objectivity against advocacy. The general picture emerging from the studies is that journalists think they ought to refrain from being prescriptive in their reporting. This tendency cuts across borders and is found among journalists from the USA, Great Britain and Thailand (Gibson et al., 2016; Hibberd & Nguyen, 2013; Hiles & Hinnant, 2014; Salathong, 2013; J. Smith, 2005). While most studies treat the subject in passing, Hiles and Hinnant provide an in-depth examination of how journalists covering climate change perceive objectivity. Although the interviewed journalists all deem promotion of policies inappropriate, some argue that it is acceptable to advocate more broadly (Hiles & Hinnant, 2014, p. 444). This resembles the kind of advocacy backed by an Indonesian journalist in a study of the coverage of the IPCC's fifth report (Kunelius et al., 2017, p. 275). The German science journalists in Peters' study also largely agreed that the media should commit themselves to protecting the environment (Peters & Heinrichs, 2005, p. 101).

A couple of studies discuss the *authority* that journalists think they should exhibit towards scientific knowledge claims. The American journalists interviewed by Hiles and Hinnant are divided on whether the existence of anthropogenic global warming can be reported as an independent fact or if it must be attributed to a scientific source. Generally, the sample of experienced climate journalists frowned upon stenographic reporting where scientific information is conveyed without considering its reliability (Hiles & Hinnant, 2014, p. 440). One journalist stated that he strived to be a "curator of information" on behalf of his readers (Hiles & Hinnant, 2014, p. 442). Further, the sample of jour- nalists underlined the necessity of remaining open towards the scientists in opposition to the consensus, although their knowledge claims must be critically assessed (Hiles & Hinnant, 2014, pp. 442–43). A similar viewpoint is found among the transnational sample of climate journalists surveyed by Brüggemann and Engesser (Brüggemann & Engesser, 2014, p. 411). Peters casts light on a different aspect of this theme as he found that German science journalists strongly favor edit- ing the journalistic product without interference from climate scientists (Peters & Heinrichs, 2005, p. 103). They also perceived themselves to be entitled to ask critical questions of climate scientists during interviews and to refer to the scientific uncertainty in their coverage (Peters & Heinrichs, 2005, p. 101, 103).

Relevance targets journalists' responsibility to connect their climate coverage to the everyday of their target group. The literature presents an unambiguous take on this question. Studies from New Zealand, Norway, and the United States thus show that journalists acknowledge a responsibility to cover the climate in a way that makes it easy for the readers and viewers to relate to it. It is proposed that journalists should delve into the themes that interest the public the most and provide coverage that affects them by catering to a local audience (Bourk et al., 2017, p. 833; Duarte & Eide, 2018, p. 11; Gibson et al., 2016, p. 425).

Journalists' expectations towards climate scientists and citizens

A handful of studies ask journalists about their view on the role of climate scientists. This research revolves around the themes *availability* and *activism*. None of the analyzed studies discusses how journalists would like citizens to act.

In this context, *availability* designates how accessible journalists expect climate scientists to be in their mutual interactions and in relation to the public climate discussion in general. The American environmental journalists interviewed by Boykoff contended that climate scientists have an obligation to contribute to the societal discussion of climate change (Boykoff, 2007, p. 482, 484), while the German science journalists in Peters also agreed that climate scientists should participate intensively in the public debate (Peters & Heinrichs, 2005, p. 100). In Smith's study from 2005, the British journalists argued that climate scientists should be "a persistent source of ideas, advice and critical feedback relating to climate change storytelling" and that they need to be more available to journalists (J. Smith, 2005, p. 1481). An analogous desire for increased responsiveness of climate

scientists is found among American journalists in a study conducted five years prior (Wilson, 2000, p. 11).

Activism also appears as a theme in connection to how journalists view the role of climate scientists, as Peters' survey also inquired about the ways in which German science journalists perceived political involvement by climate scientists. They largely agreed that climate scientists should criticize political decisions and provide policy proposals (Peters & Heinrichs, 2005, p. 100).

Role perceptions among citizens

The self-expectation of citizens

The few studies that examine how citizens perceive their responsibility in climate science communication all focus on one common theme: *competence*.

Competence concerns how much knowledge citizens think they ought to have in relation to cli- mate science. In a survey with American students, Yang et al. find that they expect themselves to be well-informed about climate change. Their respondents thus rate 73 as the sufficient level of knowledge on a scale where 0 represents "need to know nothing" and 100 signifies "need to know every- thing" (Yang et al., 2014, p. 309). While this is a testament to citizens feeling a sense of responsibility to be knowledgeable about climate science, Norgaard provided contrary evidence in a 15-year-old ethnographic study of a rural Norwegian community. She discovered socially organized denial of climate change to be a strong trait in the local culture (Norgaard, 2006). The community members generally felt overwhelmed by information about the climate with one respondent arguing that it is "better not to know everything" (Norgaard, 2006, p. 386). Further, a couple of studies have investigated the link between competence and participation. Across diverse contexts, citizens perceive a lack of competence to be disqualifying for participating in the public discussion of climate science. In a Danish focus group study, participants found that a lack of knowledge ruled out the possibility of entering the public debate on climate science (Jensen, 2017, p. 447). Participants in an Australian case study on the World Wide Views on global warming expressed similar restraint when asked about an acceptable long term temperature increase with one noting: "I'm not knowledgeable enough to comment on this" (Blue & Medlock, 2014, p. 573).

Expectations towards climate scientists and journalists

The studies based on citizens tend to focus as much on what they expect of the other actors as of themselves. The public's perception of the journalists' role has received more attention than that of climate scientists. Two themes emerged in connection to how the public perceive the role of journalists: *authority* and *relevance*. Turning to the role of climate scientists, *activism* was deliberated.

Authority has to do with how citizens think journalists should engage with scientific knowledge claims and thus constitutes an element of the expertise that journalists are supposed to possess. This theme has been examined in a couple of Scandinavian focus group studies (Jensen, 2017; Ryghaug et al., 2011). In both cases, respondents articulate an expectation that the media should be able to reflect critically on climate science and function as a quality filter. These studies indicate that citizens expect journalists to understand and curate the science they are covering.

Relevance is another component in the expertise citizens expect journalists to have. It pertains to how journalists should take charge of the coverage of climate science and put it into a wider societal perspective by showing how it is connected to the everyday life of citizens. In a focus group study with Swedish citizens, a "call for a more integral and continuous reporting on the environment in general and climate change in particular" was made as participants wanted journalists to be able to link climate change to other topics such as the economy or transportation (Olausson, 2011, p. 293). Salathong presents a similar observation in a focus group study from Thailand where a sample of

students discussed examples of newspaper articles (Salathong, 2013). Here, the participants also preferred media content, which highlighted how climate change is intertwined with economic and social issues (Salathong, 2013, p. 79). Further, the participants expressed a desire for climate coverage that provides practical advice on mitigation actions (Salathong, 2013, p. 79). This current can also be detected in two British studies, which display a demand for "day-to-day practical solutions" in the media (Hibberd & Nguyen, 2013, p. 36) and a call for more media attention to mitigation options "at an everyday level" (N. Smith & Joffe, 2013, p. 27).

Scarce research has been performed on citizens' expectations towards climate scientists. Nonetheless, *activism* is once again in the limelight as Beebe looks into how vocal climate scientists should be about political matters related to their research in the eyes of citizens. In a survey- based study, he found that educated non-experts tend to neither agree nor disagree that climate scientists should blend their public science dissemination with policy recommendations (Beebe et al., 2019, p. 41).

Synthesis

Ideal perceptions of the climate scientists' role

Climate scientists of varying nationalities acknowledge a responsibility to participate in the public debate about their research field, while journalists have also been found to subscribe to the view that climate scientists have an obligation to make themselves available to the public. It is thus evident from the analyzed studies that climate scientists and journalists agree that participation in the pub- lic debate on climate is an integral part of the role of climate scientists (see Figure 3).

The literature also sheds light on climate scientists' reflections on their responsibility to secure

relevance and credibility in their public communication. They expect themselves to be able to connect their communication to the everyday lives of citizens, while the disclosure of scientific uncertainty also seems to be an important priority of climate scientists.

Regarding activism, the extant literature sends mixed signals in terms of climate scientists' attitude towards pairing their research with policy recommendations when addressing the public. However, most studies point towards either division on the question of advocacy or utter rejection. The studies investigating how journalists and citizens perceive the subject indicate that neither

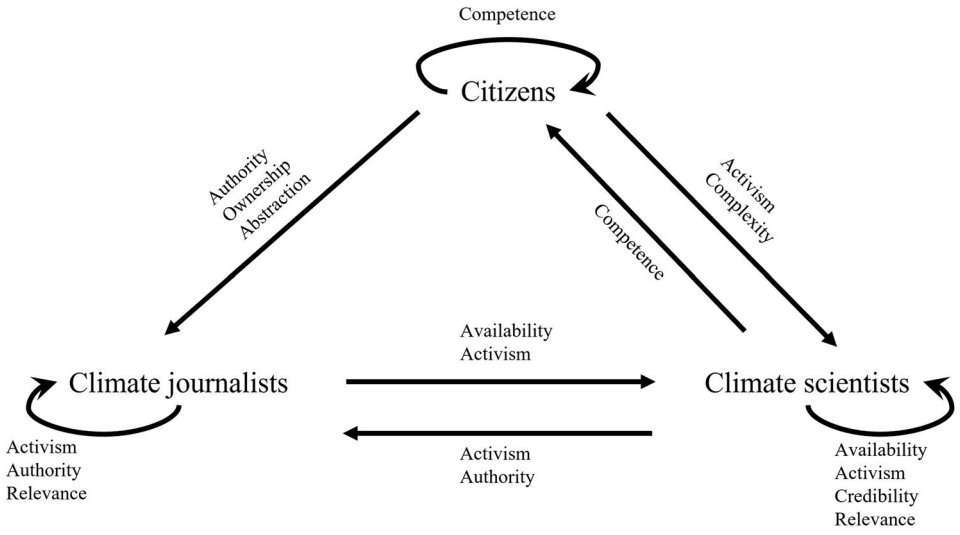

Figure 3. Overview of expectations in the triangle of climate science communication.

group is adamant that science and policy should be kept apart by climate scientists when they communicate in public.

Overall, the literature indicates that climate scientists subscribe to an ideal of being public service providers. This means that they should be readily available to deliver credible and relevant information to the public. Such an ideal of the climate scientists' role resonates with the journalists, who also emphasize the scientists' obligation to participate in the public debate. Climate scientists themselves do not seem to be keen on practicing advocacy, and neither journalists nor citizens encourage them to do so.

Ideal perceptions of the climate journalists' role

Journalists in a variety of countries express a reluctance towards being prescriptive in their climate coverage. Nevertheless, while endorsement of outright political advocacy is nowhere to be found in the literature, some studies show that journalists think they can demonstrate a pro-environmental commitment on a more general level. Very little is known about how climate scientists perceive journalistic advocacy. In a single instance, however, climate scientists have expressed the expectation that journalists take on a political role, where they not only present facts but also make policy recommendations.

In terms of how journalists should handle scientific knowledge claims, the three actors agree that

the media should be able to assess their quality. Journalists have been found to expect themselves to be able to understand climate science on a level allowing them to curate the veracity of different knowledge claims, while there is also evidence that they want to be able to pose critical questions to climate scientists and write their stories without interference from them. Citizens express a simi- lar expectation as they want journalists to be able to distinguish good research from poor. Likewise, climate scientists expect journalists to label marginalized scientific viewpoints as such in their coverage.

Some studies with citizens demonstrate how they expect journalists to make their climate cover- age relevant. This can be done by either zooming in and making it relevant for their everyday decisions or zooming out and putting it into a larger societal context.

In terms of the ideal role of journalists, there is broad consensus among journalists, climate scientists and citizens that they should function as curators of scientific knowledge. They all sup- port that journalists should understand climate science to an extent allowing them to adjudicate between competing knowledge claims. Another perception of the journalistic role materializes in some of the studies interrogating citizens, where journalists are thought of as contextualisers, who should imbed climate information in circumstances relevant to the audience. The ideal that jour- nalists should be advocates has been supported by climate scientists in a single instance more than a decade ago.

Ideal perceptions of the citizens' role

The current literature does not contain much research providing insight into the ideal role of citizens in climate science communication. Nonetheless, information about the degree of competence citizens should possess in relation to climate science can be extracted from studies with citizens themselves as well as a single study with climate scientists. The studies featuring citizens are equivocal as one displays how ignorance about climate change can be deemed desirable due to the emotional strain involved in facing the problem in depth, whereas citizens have also been found to expect themselves to be highly enlightened about climate change. Furthermore, the literature shows that climate scientists share the opinion that the public ought to know more about the climate. As the literature solely focuses on the scientific competence of citizens, they appear to be cast in a role as receivers of scientific information by themselves as well as by climate scientists.

Discussion

The overall impression arising from the analysis is that the actors' expectations are largely aligned. Due to the shortage of studies on the different linkages in the triangle, it is impossible to say whether this apparent harmony is genuine or if clashes would appear with further probing. However, a few expectations seem rather settled. There is consensus among the actors that climate journalists should be scientifically proficient, while climate scientists and climate journalists seem keen on the former's commitment to reach out to the public. These lines of agreement indicate that providing knowledge-based journalism (Patterson, 2013) is now perceived to be an integral part of the media's role in climate change communication by journalists, scientists, and citizens and that the call for additional public engagement by climate scientists (Anderegg, 2010) is integrated in climate scientists' self-understanding as well as in how journalists view the role of climate scientists. The analysis also shows that political activism is currently not ingrained in the identity of climate journalists and climate scientists. This means that Brüggemann et al.'s prognosis about the rise of advocacy in post-normal science fields such as climate change has yet to be realized (Brüggemann et al., 2020, pp. 10–11).

Change, however, may be underway. Contemporary studies thus find climate scientists to be divided on the appropriateness of advocacy (Duarte & Eide, 2018; Getson et al., 2020; Sharman & Howarth, 2017), while American climate scientists have recently been shown to welcome it (Boykoff & Oonk, 2020). With regard to journalists, they accept advocacy formulated in a general fashion not aimed at particular policies (Hiles & Hinnant, 2014; Kunelius et al., 2017). In the case of both climate scientists and climate journalists, it is worth noting that their interlocutors do not seem to want them to refrain from activism. Journalists have been found to approve that climate scientists criticize political decisions (Peters & Heinrichs, 2005, p. 100), and citizens do not take a position in either direction (Beebe et al., 2019, p. 41). This is much in line with Donner's assertion that "public audiences are arguably more comfortable with advocacy by scientists than scientists are with advocacy by scientists" (Donner, 2017, p. 431). Adding further weight to this claim, experimental research has shown that climate scientists can wander far into the domain of advocacy without losing their credibility in the public eye (Kotcher et al., 2017). With regard to journalistic activism, climate scientists in Germany request that journalists take on a political role when covering climate change (Peters & Heinrichs, 2005, p. 151). Although the studies on citizens do not directly address the subject of activism, they have been found to desire solution-oriented media content in line with the tradition of constructive journalism (Aitamurto & Varma, 2018). This demand collides with journalists' reluctance towards being prescriptive as presenting solutions to problems is on the verge of advocacy (Aitamurto & Varma, 2018, p. 698). Journalists therefore seem to face a cross- pressure between remaining neutral and relevant at the same time. In a recent review of the scholar- ship on climate journalism, Schäfer et al. find the tendency to advocate to be more pronounced than in the present review (Schäfer & Painter, 2020, pp. 9–10).

The current literature has a paucity of studies focusing on the role of citizens in climate science communication. While the proper level of scientific competence among citizens has been somewhat examined, citizens' desired degree and mode of participation in the public discussion of climate science is still undetermined. A couple of the reviewed studies indicate that citizens see scientific proficiency as a prerequisite for participation in climate-related debates. They thereby subscribe to the idea underlying the knowledge dimension in Miller's concept of civic science literacy; that a certain degree of familiarity with scientific facts is required to enter the public discussion of science-related issues (Miller, 1983, 1998). It is remarkable that citizens are vouching for this approach, as it has been criticized for repressing lay viewpoints by emphasizing their inferiority to scientific expertise (Bauer, 2015). However, that citizens perceive scientific knowledge to be an entrance ticket to the public climate conversation does not signify how much they think they should participate in it. This question is closely related to what Mejlgaard and Stares brand "preferred participation", although this term has a wider application and is not solely targeting the communicative

aspect of participation (Mejlgaard & Stares, 2013). Interestingly, it has been demonstrated that several European populations have a preference for being disengaged with science (Mejlgaard & Stares, 2013, p. 669). Hence, citizens' desire to be involved in the public discussion on climate science should not be taken for granted. Further empirical investigation is needed to find out whether the public wants to have a relationship with climate scientists and climate journalists that is in line with an information deficit or dialogical approach to science communication (Halkier, 2017, p. 48). The latter approach has gained high esteem in the PUS literature, but as discussed by Árnason it is possible to argue against placing such high deliberative demands on citizens from a liberal point of view as "They should be able to enjoy the privacy of their personal lives and have freedom from politics" (Árnason, 2013, p. 935).

By limiting the study to concentrate on scientists, journalists, and citizens other important actors in the science-society interface like policymakers and businesses are omitted. The rationale behind this delimitation is to focus on the deliberative aspect of climate science communication by investigating the three actors' perceptions of an ideal agora. A compelling argument for the intrinsic value of science-society interaction is provided by Davies in a discussion paper on non-policy- informing science dialogue events. She concurs that "engagement with science in the context of society allows scientists and publics to explore ideas, to examine current societal issues, to challenge the claims of others, and to develop their own understandings" (Davies et al., 2009, p. 343). The potential changes in knowledge, attitude and behavior on the individual level thus constitute a significant outcome in themselves (Davies et al., 2009, p. 344).

This review set out to bring three hitherto disconnected literatures together to gain a more comprehensive understanding of climate science communication. By performing this exercise, the study has shown that the three actors largely agree on what their respective roles should entail. Overall, the notions about how the actors should ideally act proved to be quite stable across time and space as the traditional understandings of the roles are still widespread. The most significant exception to this rule is the newly identified acceptance of advocacy among American climate scientists (Boykoff & Oonk, 2020; Getson et al., 2020). However, when reflecting on the generalisability of the findings presented here, it should be noted that the empirical foundation of this paper has a significant Western slant as most of the reviewed studies originate from either Europe or the US.

Note

1. The study does not include politicians as this would direct the focus more towards policymaking, which along with considerations of citizen science is outside the scope of this review.

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Appendix 1: Overview of studies on climate scientists' role perceptions

Study	Format	Publishing year	Metho	Origin of data	Publication
M. Mormont et al.	Journal	1995	Interview	Belgium, France, and Germany	Media, Culture & Society
D. Bray et al.	Journal	1999	Survey and interviews	Germany, USA and Canada	Bulletin of the American Meteorological Society
H.P. Peters et al.	Book chapter	2005	Survey	Germany	Öffentliche Kommunikation über Klimawandel und Sturmflutrisiken Bedeutungskonstruktion durch Experten, Journalisten und Bürger
M. Boykoff	Journal	2007	Interview	USA	Transactions of the Institute of British Geographers
S. Tøsse	Journal article	2013	Interview	Norway	Science Communication
A. Wilke et al.	Journal article	2015	Interview & survey	USA	Science Communication
A. Wilke et al.	Journal	2015	Interview & survey	USA	Agriculture and Human Values
S. Post	Journal article	2016	Survey	Germany	Public Understanding of Science
A. Sharman et al.	Journal article	2017	Interview	United Kingdom	Public Understanding of Science
R. Salmon et al.	Journal article	2017	Interview	New Zealand	Journal of Environmental Studies and Sciences
J. Beebe et al.	Journal Article	2018	Survey	USA	Environmental Communication
K. Duarte et al.	Journal article	2018	Interview	Norway	Norsk Medietidsskrift
M. Entradas et al.	Journal article	2019	Survey	USA	Climatic Change
J. Getson et al.	Journal article	2020	Survey	USA	Public Understanding of Science
Boykoff et al.	Journal article	2020	Survey	USA	Climatic Change

Overview of studies on climate journalists' role perceptions

Study	Format	Publishing year	Metho	Origin of data	Publication
K. M. Wilson	Journal article	2000	Interview & survey	USA	Public Understanding of Science
J. Smith	Journal article	2005	Seminars (comparable to focus groups)	UK	Risk Analysis
H. P. Peters et al.	Book chapter	2005	Survey	Germany	Öffentliche Kommunikation über Klimawandel und Sturmflutrisiken Bedeutungskonstruktion durch Experten, Journalisten und Bürger
M. Boykoff	Journal article	2007	Interview	USA	Transactions of the Institute of British Geographers
M. Hibberd et al.	Journal article	2013	Interview	UK	International Journal of Media & Cultural Politics
J. Salathong	Journal article	2013	Interview	Thailand	International Journal of Media & Cultural Politics
Brüggemann et al.	Journal Article	2014	Survey	International	Science communication
S. S. Hiles et al.	Journal article	2014	Interview	USA	Science Communication
T. A. Gibson et al.	Journal article	2016	Interview	USA	Journalism
R. Kunelius et al.	Book chapter	2017	Interview	International	Media and Global Climate Knowledge
M. Bourk et al.	Journal article	2017	Interview	New Zealand	Environmental Communication

Overview of studies on citizens' role perceptions

Study	Format	Publishing year	Metho	Origin of data	Publication
K. A. Norgaard	Journal article	2006	Observation Interview	Norway	Sociological Inquiry
U. Olausson	Journal article	2011	Focus groups	Sweden	Environmental Communication
M. Ryghaug et al.	Journal article	2011	Focus groups	Norway	Public Understanding of Science
N. Smith et al.	Journal article	2013	Interviews	UK	Public Understanding of Science
M. Hibberd et al.	Journal article	2013	Focus groups	UK	International Journal of Media & Cultural Politics
J. Salathong	Journal article	2013	Interview Focus groups	Thailand	International Journal of Media & Cultural Politics
G. Blue et al.	Journal article	2014	Survey Observation Interviews	Canada	Science as Culture
Z. J. Yang et al.	Journal article	2014	Survey	USA	Science Communication
K. Bruhn Jensen	Journal article	2017	Focus groups	Denmark	Convergence
J. R. Beebe et al.	Journal article	2019	Survey	USA Ireland	Environmental Communication

Chapter 5: A State of Emergency or Business as Usual in Climate Science Communication? A Three-Dimensional Perspective on the Role Perceptions of Climate Scientists, Climate Journalists, and Citizens

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A State of Emergency or Business as Usual in Climate Science Communication? A Three-Dimensional Perspective on the Role Perceptions of Climate Scientists, Climate Journalists, and Citizens

Peter Busch Nicolaisen[1]

Abstract

Building on post-normal science, Brüggemann et al. (2020) suggest that the uncertain, disputed, high-stakes, and urgent character of the climate challenge facing modern societies may alter the conventional notion of what is expected of scientists, journalists, and citizens in the public discussion of climate science. This article examines this notion via 15 focus groups with climate scientists, climate journalists, and citizens ($N = 76$). The analysis shows that neither of the three actors want climate scientists and climate journalists to act as advocates. However, interestingly, it is seen as legitimate for climate scientists to express emotions connected to their findings.

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Keywords
climate change, environmental communication, environmental journalism, public engagement, scientists' perception of public communication

Introduction

Thirty years ago, Funtowicz and Ravetz heralded the emergence of a new type of science, so-called "post-normal" science (Funtowicz & Ravetz, 1990). According to Funtowicz and Ravetz, this distinguishes itself from Kuhn's concept of "normal science" (Kuhn, 1962) by featuring uncertain facts on topics involving disputed values and high stakes and warranting urgent decision-making (Funtowicz & Ravetz, 1993, p. 744). Scientific topics such as genetically modified food and bovine spongiform encephalopathy disease (BSE) have been highlighted for their post-normal elements. However, it is climate science that has been pointed out as the prototypical case of a post-normal science issue (Bray & Storch, 1999; Krauss et al., 2012), containing all four defining criteria—uncertainty, high stakes, disputed values, and urgency—in large quantities. When dealing with such subjects, Ravetz argues that we "need some new picture of science, on (sic) which goes beyond the simplistic certainties of yesteryear, and which provides guidance through the new perplexities of the uncertainties, value-loadings and commitments that characterise contemporary policy-related science" (Ravetz, 1999, p. 648). In its normal mode, science was thus tasked with "puzzle-solving within an unquestioned paradigm" (Funtowicz & Rafts, 1990, p. 21), whereas the border between facts and values becomes porous under post-normal circumstances. The same applies to the distinction between knowledge and ignorance. This means that the discussion of science must change from being a "formalized deduction" to becoming an "interactive dialogue," where uncertainty is "managed" rather than "banished" and values are explicated (Funtowicz & Ravetz, 1993, p. 740). Hence, the peer community must be extended so it incorporates a broad spectrum of non-academic stakeholders who bring "extended facts" to the table (Ravetz, 1999, p. 651). A central tenet in post-normal science is therefore that the new conditions of science have a bearing on how it should enter the public debate.

Building on this key element in Funtowicz and Ravetz' theory, Brüggemann, Lörcher, and Walter introduce the term "post-normal science communication," which suggests that the traditional role configuration in the science-media interface could be short-circuited in relation to certain topics (Brüggemann et al., 2020). They suspect that scientists and journalists who work on post-normal issues will be driven into new territories as advocates,

Table 1. The Role Configuration in Post-Normal Climate Science Communication as Proposed by Brüggemann et al. (2020).

Actor type	Role in post-normal science communication
Climate scientists	Advocates Interpreters of scientific facts Dialogue brokers
Climate journalists	Advocates Interpreters of scientific facts Dialogue brokers
Citizens	Extended peer community

dialogue brokers, and interpreters of scientific facts. From a normative perspective, it has also been argued that journalists who cover complex and politicized subjects such as climate change must become increasingly scientifically proficient to provide sufficiently autonomous reporting, in line with the idea of knowledge-based journalism (Donsbach, 2014; Nisbet & Fahy, 2015). The threat of becoming obsolete due to the advent of social media and its ability to facilitate unmediated interaction between scientists and citizens might also push journalists in this direction to sustain a claim to relevance. However, it is not only the roles of scientists and journalists that are assumed to be affected by post-normality. The role of citizens is also projected to undergo change, as they are expected to strengthen their participation in the public discussion of climate science by forming an extended peer community. This feeds into the scholarly discussion concerned with citizens "role as legitimate members of the knowledge society" (Mejlgaard, 2009, p. 486) in which they should be afforded rights as well as be faced with duties based on this membership (Mejlgaard & Stares, 2010, p. 548).

The prime ambition of the present study is to examine whether the new ideals for climate scientists, climate journalists, and citizens set forth by Brüggemann et al. are reflected in the role perceptions of these actors when tested empirically. Table 1 serves to illustrate Brüggemann et al.'s proposition of the role prescriptions of scientists, journalists, and citizens in post-normal science communication, which will be compared with the findings from the present study in the analysis.

The modern literature comprises an array of theoretical conceptualizations of the professional roles of scientists and journalists. Regarding the ideal roles of scientists, Pielke has formulated one of the most used typologies, which suggests four ideal researcher types (pure scientist, science arbiter, issue advocate, and honest broker of policy alternatives; Pielke, 2007). In

recent years, ideal roles have also preoccupied journalism scholars, with the work of Hanitzsch being a focal point in that respect (Hanitzsch, 2018; Hanitzsch & Ôrnebring, 2019; Hanitzsch & Vos, 2018). However, turning to the empirical and focusing specifically on climate science communication, the prophecy of a new dawn has not yielded many investigations. While a modest number of studies in the last decade have examined the role perceptions of climate scientists and climate journalists, the role of citizens has been largely neglected (Nicolaisen, 2021). The contemporary literature on the role perception of climate scientists has primarily focused on their views regarding the appropriateness of advocacy. It provides examples of climate scientists being strongly inclined toward political neutrality (Wilke & Morton, 2015a, 2015b), while others find division on the question (Duarte & Eide, 2018; Sharman & Howarth, 2017) as well as clear support for scientific activism (Boykoff & Oonk, 2020; Getson et al., 2021). Advocacy is also a prevalent theme in recent explorations of climate journalists' role perceptions. Across a variety of contexts, climate journalists are found to cling to a classic understanding of their own role as neutral reporters and to disavow prescriptive journalism recommending certain lifestyle choices (Gibson et al., 2016; Hibberd & Nguyen, 2013; Hiles & Hinnant, 2014; Salathong, 2013). The small pool of studies reflecting on the role of citizens produced during the last 10 years has primarily focused on the scientific competence required to participate in the public discussion of climate science (Blue & Medlock, 2014; Jensen, 2017; Tøsse, 2013; Yang et al., 2014).

Generally, the studies on the roles of climate scientists, climate journalists, and citizens are introspective, almost exclusively concentrating on the actors' views of their own roles. The present article contributes with a more comprehensive, although not all-encompassing, approach. It thus does not include all relevant actors in climate science communication, with the most notable exclusion being policymakers. To strike a compromise between span and profundity, the analysis features a three-dimensional perspective. Figure 1 shows how the study takes account of the actors' self-expectations as well as expectations directed at the other actors, in what I term the "triangle of climate science communication." The aim is to address the following research question:

> *Research Question 1*: How do climate scientists, journalists, and citizens perceive their own and one another's roles in climate science communication, and where do the actors' role perceptions overlap or contrast?

This research question sets the study on a mission hitherto unaccomplished by the current literature: to simultaneously explore and compare the role perceptions of the three actors. While studies with a singular focus can capture

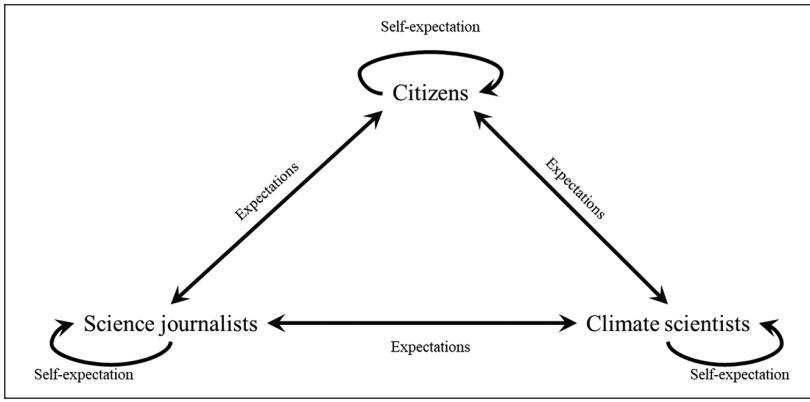

Figure 1. The Triangle of Climate Science Communication.
Source. Adopted from Nicolaisen (2021).

the intricacies of how a specific type of actor makes sense of his role, the more inclusive design employed here will serve to emphasize the systemic aspect of the roles. Because climate science communication does not occur in a vacuum, but rather in a system of co-dependent actors, it is valuable to investigate the correspondence between the expectations the actors hold for themselves and how they are perceived by their interlocutors.

Method

Research Design

The actors' role perceptions were examined by way of a series of focus group interviews. Focus groups are well-suited for exploring the negotiation of socially constructed phenomena such as roles in climate science communication, as the group setting displays how participants collectively make sense of a subject (Bryman, 2004, p. 502; Cyr, 2019, pp. 19–20). Because group dynamics are at the forefront of this method, it is a useful means of plugging into the norms and values shared among participants, which in this instance inform how they perceive the configuration of roles in the public discussion of climate science (Bloor et al., 2001, p. 4; Halkier, 2016, p. 10). The present study benefits from focus groups' capacity to draw on the disparate attitudes and experiences of the participants as a resource in the generation of knowledge as they probe each other's views. This has motivated a research design with both homogeneous and heterogeneous focus groups. The expectation

was that the discussions would likely vary depending on whether the participants were peers or not. A climate scientist would, for instance, be able to probe the argument of a fellow climate scientist from a different angle than would a citizen. Both kinds of challenges are relevant to the research question, and the objective of the research design is therefore to represent both to ensure a richer pool of data.

The study rested on 15 focus groups with Danish climate scientists (N = 26), climate journalists (N = 24), and citizens (N = 26) carried out between September 2021 and November 2021. Twelve homogeneous groups with the three different actor types along with three mixed groups containing representatives of each actor type were created. The size of the focus groups ranged from four to seven participants (See Supplemental Appendix A in the online materials for an overview of focus group composition). Eight focus groups were held at a conference center in Copenhagen, while the remaining seven were conducted at X University. All groups were exposed to the same questions and exercises, although the ordering of the themes varied. The participants were presented with two exercises. One was based on a vignette describing a fictional scenario in which a climate scientist has conducted a study and is about to speak about it in public. The participants were supposed to discuss the appropriateness of four statements (one descriptive, one a general political recommendation, one a specific political recommendation, and one emotional). In another exercise, the participants were in turn told to read aloud normative statements made by climate journalists, whereafter the person holding the card on which the statement was printed was supposed to indicate whether he or she would place it in an "Agree" or "Disagree" category. Next, the other participants were encouraged to discuss where they would have placed the card. The normative statements were inspired by quotes from climate journalists in the academic literature. To stimulate the discussion on the role of citizens, the participants were shown an engagement scale displaying different kinds of information-seeking behavior on a continuum going from disengaged (not doing anything to keep informed) to hyper-engaged (reading academic literature; See Supplemental Appendix B in the online materials for the moderator guide). All focus groups were conducted in Danish. They were audio-recorded and subsequently transcribed with help from student assistants. Each focus group discussion lasted approximately one and a half hours.

I defined a climate scientist as a university researcher who studies either the physical basis of climate change or how the challenge can be mitigated or adapted to. This notion of climate science is in line with how the Intergovernmental Panel on Climate Change (IPCC) defines the areas of responsibility of its three working groups (IPCC, 2014). I defined a climate journalist as someone who has produced a significant amount of in-depth

climate journalism for media outlets, although they did not have to exclusively cover the climate beat. A citizen was defined as an individual over the age of 18 with voting rights in Denmark.

The aim was to feature a diverse representation of each actor type in the study, using a maximum variation strategy (Flyvbjerg, 2006, p. 230). A purposive sampling approach was employed to select the participants, as they had to vary on a range of key characteristics depending on the type of actor in question (Barbour, 2018, p. 69).

The sample of climate scientists consisted of researchers from different Danish universities at different career stages (post.doc., associate professor, and professor) and fields of study (e.g., glaciology, atmospheric chemistry, and climate economics).

The participating climate journalists represented different kinds of media affiliations (nationwide media, niche media, and freelancers) and varying levels of experience (long (10+ years), medium (5–10 years), and short (<5 years)).

The citizen sample encompassed a wide spectrum of the Danish population in terms of age (20–35, 35–50, 50+), educational level, occupation, and climate attitude (climate conscious, neutral, and climate skeptical). Facebook groups were used to locate potential participants with specific educational and occupational backgrounds (e.g., primary school teachers and self-employed) with a neutral attitude, and they were also utilized to trace people with distinct climate attitudes in either direction. Furthermore, the author's network was used to seek out individuals with a relevant profile. Only persons at two or more removes from the researcher were deemed eligible for participation (for elaboration of the recruitment procedure see Supplemental Appendix C in the online materials).

In composing both the homogeneous and the heterogeneous groups, the goal was to achieve a large amount of diversity among the participants. However, as the formation of each focus group required a significant amount of coordination, it was not always feasible to attain the ideal distributions of the various traits.

As part of the recruitment process, each participant was sent an invitation letter, an information letter, and an informed consent form to be signed before the focus group was conducted (These documents can be found in Supplemental Appendix D–F of the online materials). All participants' transport costs were reimbursed, and they were given a small gift in the form of a box of chocolate at the end of the interview. They were not compensated for the time they spent.

Prior to the initiation of the data collection, the study was granted an ethical approval by the Research Ethics Committee at X University (approval number 2021-81).

Analysis Strategy

The focus group transcripts were inductively coded using NVivo software. A combination of within-case and cross-case analysis was employed to both get an in-depth understanding of the content of each focus group and be able to recognize general patterns in the data. To a large extent, the coding process followed the guidelines of Silverstein and Auerbach (Auerbach & Silverstein, 2003, pp. 34–84). The first step was to recognize and name relevant passages in the transcript of each focus group—that is, parts of the text where the participants ascribed meaning to the roles of either climate scientists, climate journalists, or citizens were assigned a code describing the content. By comparing the codes across the focus groups, repeated ideas were recognized. To further condense the data, the repeated ideas were grouped under different themes by identifying the text excerpts which revolved around the same aspect of one of the three roles. The elicitation of themes from the material was somewhat guided by the preconception of the field provided by the work of Brüggemann et al. (2020). To maintain an overview of the different themes, several displays were created (see Supplemental Appendix G in the online materials for examples of displays). In the last phase of the analysis, ideal types were extracted from the data based on the preceding thematic categorization of the material.

Findings

This section will display the main discussion points from the focus groups. It will in turn focus on how the participants perceived the roles of climate scientists, climate journalists, and citizens. The examination of the respective roles will be organized around the two most prominent topics connected to the discussion of each role. By focusing only on two topics regarding each actor, the following section will not fully exhaust the participants' deliberations of the roles. However, this delimitation will serve to strike a balance between displaying the depth and breadth of the focus group data.

The Role of Climate Scientists

The participants' deliberations of the role of climate scientists revolved around several topics. For example, climate journalists and climate scientists in different groups perceived the latter as having a responsibility to help the former in understanding the complexities of the science, acting as teachers. Participants of all kinds also discussed the communication channels that

climate scientists should use. The citizens and climate scientists were most vocal about this question as they stressed that climate scientists should communicate through the established media rather than via social media. However, the subjects receiving most attention across the groups were whether climate scientists ought to disseminate their results and in what way they should communicate them.

The Responsibility to Communicate. There was a high degree of consensus among participants that climate scientists ought to communicate their research to the public. This view was often connected to the recognition that climate scientists receive public funds and therefore owe it to the taxpayers to communicate their findings. The explicit mentioning of public funding was most prevalent among the citizens. In the following passage from one of the homogeneous groups with citizens, a female student in her 20s used this common way of reasoning:

> [. . .] I think that there has been a lot of money thrown into the research they have been sitting and working on, so it would be nice if they would communicate it to the wider public. Well, "obliged" is to put it strongly, but I think they are.[1] (Citizen, Climate skeptic, 20s, student, Group 7)

In many focus groups, the participants discussed whether climate scientists have an especially pronounced communication responsibility compared with scientists in other fields. The special responsibility of climate scientists was acknowledged by all three actor types. A climate journalist maintained that climate scientists in their capacity as citizens with acutely relevant knowledge have a duty to share it, while a climate scientist in another group compared the situation with a seismologist knowing about a future earthquake. The following examples from three separate homogeneous focus groups further testify to how the different types of participants expressed similar views:

> [. . .] what I do now is about green transitioning and in a way, it is irrelevant what I simulate about 2050 if someone just reads it in 100 years. And there I feel that I have a bigger responsibility to ensure that the knowledge I am producing is communicated quickly and widely, because it concerns something which is going to happen soon. (Climate scientist, Associate professor, Group 5)

> Well, scientists always have some kind of responsibility to [communicate] [. . .] I believe I tend to think that climate scientists have a bigger responsibility, because it is a problem which is so overarching for so many people. (Climate journalist, Short experience, niche media, Group 10)

> I just think that when you choose to study something which is so extremely important for, well, our planet, there is nothing more important than the planet. Otherwise, we don't have anywhere to live. So that knowledge must get out in some way. So, I think that if you have chosen to do that, then I also believe you have a responsibility to communicate it in some way. (Citizen, Neutral, 30s, caregiver, Group 14)

However, a handful of climate scientists stressed that they did not perceive themselves as having a special communication responsibility due to the topic of their research. This was expressed in two different instances: It was a near-consensus position in one of the homogeneous groups with climate scientists and a point of contention in a heterogeneous group where a climate scientist and a climate journalist disagreed about the matter. The point made by the climate scientists who opposed an accentuation of their communication responsibilities was not that they should not communicate but rather that all researchers across disciplines have an equal obligation to engage with the public. There were also a few citizens and a single climate journalist who did not expect climate scientists to communicate at all, as they placed that task solely with the journalists. Nonetheless, the general trend was that all three types of actors placed a communication responsibility on climate scientists, which in the view of many participants was heightened due to the severity and acuteness of the climate threat.

The Style of Communication. The appropriate content of climate scientists' communication was another salient subject in the focus groups. There was a strong consensus among all three actor types that climate scientists should refrain from politically prescriptive communication. Representatives from each segment linked this antipathy to a concern that advocacy, that is, policy-prescriptive communication, might damage the credibility of climate scientists, as demonstrated by this conversation between two climate journalists in a homogeneous group:

> I don't think they ought to become too politicizing. You can grow sceptical when it becomes *too* politicizing, I think. (Climate journalist, Short experience, nationwide media)

> Yes. They have a small amount of savings in that account. There is not much to take from. They must be careful not to lose it. (Climate journalist, Long experience, nationwide media, Group 10)

Although a substantial majority of participants discouraged advocacy, there were also a few proponents of scientists combining research and politics in

their communication. These were primarily found among the climate journalists who contended that climate scientists should be allowed to say whatever they want and that it was instead the job of the journalist to disregard it or put it into context. A couple of citizens and climate scientists, as well as a single climate journalist, mentioned that it was legitimate for climate scientists to call for political action in broad terms, such as stating the need to decrease the emission of CO_2 into the atmosphere.

While few participants condoned climate scientists mixing their research with policy, there was great support for blending science and emotions among all three types of actors. This was often linked to the idea that climate scientists are also humans and are therefore entitled to show their feelings. Furthermore, many participants agreed that the expression of emotions connected to the research made the latter seem more relevant. One of the citizens from a heterogeneous group, a male student in his 20s, actually perceived climate scientists as having more leeway for emotional communication than researchers in other fields:

> It is worldwide and it is something that will affect us all at some point in the future. So, in this regard it could be good for us to open our eyes, so you realize the severity in what the scientists are saying. But otherwise, I don't normally think that you should connect your feelings to your research to such a degree. (Citizen, Neutral, 20s, student, Group 14)

The approval of climate scientists articulating feelings like worry or anxiety was not unanimous, however. Some participants, primarily climate scientists and citizens, feared that the scientists would risk their authority by becoming emotional and that it would detract attention from what should be the primary focus of their communication, namely their research. The following excerpt is from one of the heterogeneous groups with citizens and shows how a participant holding the minority opinion that feelings and science should be separated was challenged by another, who espoused the majority viewpoint:

> The question is then whether scientists can show emotions and appear as humans too and that . . . (Moderator)
>
> (Interrupting) That, that you can't avoid. Of course, they can. They are also human beings. It is just stupid to mix it with their research. (Climate skeptic, 60s, geological consultant)
>
> That is where I don't think it is [stupid]. Imagine if dry numbers and graphs and, and, and all kinds could meet *reality*. (Neutral, 30s, carpenter)

> But that is *reality*. (Climate skeptic, 60s, geological consultant)
>
> Nooo! (Neutral, 30s, carpenter)
>
> But it is. (Climate skeptic, 60s, geological consultant)
>
> Yeah, it is. We can agree on that [said sarcastically]. (Neutral, 30s, carpenter)
>
> Or else we are far out there. (Climate skeptic, 60s, geological consultant, Group 8)

In the above example, the participants' divergent appreciations of what constitutes reality—the quantifiable or human passions—translates into different conceptions of how climate scientists should communicate their research. The geological consultant thus preferred that climate scientists stick to a clinical reporting of their results, deeming any further reflections irrelevant, while the carpenter, as well as most participants across the groups, thought that it was valuable to know how scientists feel about their research.

The Role of Climate Journalists

Many different subjects related to the role of climate journalists triggered discussion across the groups. There was, for example, a wide-ranging consensus that climate journalists should not strive to provide a local angle in their coverage to increase its relevance, as most participants feared that this would distort the proportions of the climate challenge. How journalistic outlets should handle climate skeptics was another issue that stimulated much conversation. Across the three segments, a majority argued that people who question anthropogenic climate change should be given modest media attention or ignored altogether, and they granted journalists the right to act as filters. Nonetheless, the topics eliciting the most reactions from the participants pertained to how journalists should position themselves on the advocacy-neutrality spectrum in their coverage and how they should handle scientific knowledge.

Positioning. One of the most extensively debated matters in the focus groups was how climate journalists should position themselves in their climate coverage—whether they should be neutral observers or advocates guiding their audience in a particular direction. Across the three actor types, the dominant assessment was that climate journalists should be descriptive rather than prescriptive. This viewpoint was neatly captured by one of the citizens in a homogeneous group, a male priest in his 60s:

> I am always worried when journalists start preaching. They better leave that to others. (Citizen, Neutral, 60s, priest, Group 9)

The opposition to advocacy journalism was particularly pronounced among the climate journalists themselves. In one of the homogeneous groups with climate journalists, the participants agreed that climate journalism should live up to the same standards that apply to any other subject. Echoing the reservations regarding scientific advocacy, some of the climate journalists were concerned that taking a more activistic stance would jeopardize the credibility of their journalism.

Although most participants rejected advocacy journalism, climate scientists in four different groups backed journalists' right to produce this kind of reporting on the condition that it remained grounded in science. Among the few citizens who approved of an activistic approach to climate journalism, a female pensioner in her 60s from a homogeneous group was particularly adamant that it was a moral question:

> [. . .] everyone must take responsibility in their own way, and I think that the journalists also ought to take responsibility as humans, as citizens, as fathers, who are affected by the climate crisis like we all are, whether we like it or not and whether we know it or not, right? [. . .] the journalists should not all be activists, but they must consider [. . .] what will I do with the knowledge and ethics I have in my profession? How can I contribute? (Citizen, Climate conscious, 60s, pensioner, Group 7)

In one of the heterogeneous groups, a male climate journalist from a niche media outlet used a similar line of argumentation, pointing to the wide-ranging consequences of climate change in his defense of journalistic advocacy:

> It (journalism) fights all injustice in society. It fights the little man's cause. It fights waiting lists in the hospitals. It fights nepotism [. . .] I actually think that it is okay to say that you as a journalist should fight climate change, because there is so many . . . there is such a big impact from it. (Climate journalist, Medium experience, niche media, Group 13)

The other climate journalist in the group did not comment on the question, but one of the citizens agreed that advocacy is acceptable if it is clearly stated. Nonetheless, the mainstream opinion in the focus groups was that journalists should not integrate political messages into their climate reporting.

Handling of Scientific Knowledge. Journalists' proper engagement with scientific knowledge was also heavily discussed in the focus groups. The most common opinion within the three segments of participants was that journalists

should not function as experts, although they were generally expected to be highly knowledgeable. Some participants, especially citizens, thought that journalists' scientific insight was meant to equip them to make comprehensible the complexities of climate science, while others, particularly climate scientists, saw it as a resource that should enable them to critically reflect on the science. However, in most focus groups there was widespread agreement that climate journalists should defer to scientific experts instead of making independent interpretations of climate science. This does not mean that all information ought to come with a scientific reference—several participants, mainly climate journalists, thought that it was unnecessary to begin with "Adam and Eve" in each story and that it was unproblematic for them to state established scientific truth claims. When approaching the frontier of climate science, however, they felt they should be more cautious. In one of the heterogeneous focus groups there was a rare instance where a citizen challenged the viewpoint that climate journalists should not have scientific expertise:

> [. . .] like with any other subject the journalist should be critical towards, what can you say, the essence or data and so on. (Citizen, Climate skeptic, 30s, biomedical scientist)
>
> [. . .] A journalist is not able to evaluate climate science on a scientific level. That is why we have a scientific system in modern science. [. . .] (Climate journalist, Experienced, freelance)
>
> I very much agree. You cannot expect a journalist to go down into the same details as the scientist and analyse the data and say: "You misread this measurement." What we need to do is to trust peer reviews. [. . .] You can't assume that the journalist can act as a peer in that regard. (Climate journalist, Medium experience, niche media)
>
> You shouldn't expect that? (Moderator)
>
> No, no. It is the same whether it is climate or health or . . . (Climate journalist, Medium experience, niche media)
>
> (Interrupting) Can I ask something? Are you then journalists? (Citizen, Climate skeptic, 30s, biomedical scientist)
>
> Yes, of course. (Climate journalist, Experienced, freelance)
>
> It is what . . . Journalism is to convey with a critical sense, and that critical sense you must find in other sources. [. . .] If someone must criticize a study, it must be another expert in the field. (Climate journalist, Medium experience, niche media, Group 13)

The citizen in the above example was not alone, however; a few participants across the groups, mainly climate journalists, considered it permissible for climate journalists to venture into the domain of expertise. An experienced climate journalist from a heterogeneous group was among the exponents of this viewpoint:

> I would say I would dare to step into the expert role and be so self-assertive that I will actually say that you can do that as a journalist. (Experienced, niche media, Group 12)

He explained how he had attained a scientific proficiency which enabled him to report with authority and with fewer scientific sources. The statement was not contested by the other group members but nor did they signify approval. By embracing the "expert" label, the climate journalist was an exception to the rule, as nearly all his colleagues rejected it. That was also the case for the climate scientists and citizens, who did not want climate journalists to act as experts.

The Role of Citizens

The discussion of the role of citizens was much narrower in scope than those concerning the other two actors, where a wealth of different subjects was touched upon. Furthermore, it seemed as though the climate scientists and climate journalists found it harder to conceive of the role of citizens relative to the other two roles. There was thus a tendency for this part of the discussion to need more moderator involvement in the homogeneous groups with climate scientists and climate journalists than it did in the groups with only citizens. Across the focus groups, the participants stressed that citizens, along with politicians and the business sector, are responsible for translating climate science information into decision-making, given their function as consumers and voters. However, the primary subjects related to the role of citizens regarded the information-seeking behavior expected of them as well as which kind of involvement in climate science communication the participants envisioned for laypeople.

Information-Seeking Behavior. In the discussion of what is to be expected of citizens in terms of their engagement with climate science information, the participants were divided into two approximately equal-sized groups: one that was in favor of exempting citizens from any information-seeking obligation and another maintaining that it was a civic duty to keep updated on the climate situation. A prime example of the former position was voiced by a

climate journalist, who rhetorically asked whether it was not the prerogative of every citizen "to go through life with blinders on" if they desired to. However, the notion that it is a civic duty to keep oneself informed about climate science was most prevalent among the citizens. While many participants of various kinds argued that citizens should follow all important societal matters, including climate change, some thought the climate deserved precedence over other issues. For instance, citizens in different groups framed it as "an acute crisis" and "a state of emergency," while there were also examples where climate scientists and climate journalists drew parallels between climate change and the coronavirus pandemic in terms of citizens' obligation to seek information.

In addition to the participants who outright rejected the notion that citizens bear a responsibility to know about climate science, others argued that they should be familiar with climate science to some extent but that this obligation rested with the education system rather than the individual. In the following passage from one of the heterogeneous groups, these different conceptions were juxtaposed.

> [. . .] I would like to ask you whether the individual citizen should try to keep updated on the climate situation. (Moderator)
>
> I don't think you can, I don't think you should require that from yourself or others that you ought to. But ehm, the primary school. There are some institutions, which have it as a duty anyway to make sure that it happens, but I don't think we can say ehm . . . (Climate scientist, Professor)
>
> (Interrupting) Well both as a citizen and as a teacher I actually think that you are obliged to or that you ought to. (Citizen, Neutral, 50s, schoolteacher)
>
> You cannot say 'I can't manage it. It is too difficult'? My old mother . . . (Climate scientist, Professor)
>
> (Interrupting) You can always manage a little part of it. Again, it depends on how much. [. . .] If we are citizens in a society [. . .] then we are also citizens on the climate part, I think. [. . .] Well, I maybe would not have said so two years ago, but I just think, that it has become even more acute and relevant in some way. (Citizen, Neutral, 50s, schoolteacher, Group 12)

While the climate scientist saw citizens' duty to engage with climate information as contingent on their personal circumstances, the schoolteacher comprehended it in a more universalistic way. This reflects the general dissensus across the groups regarding citizens' responsibility to be enlightened

about climate matters. Nevertheless, one of the few regularities was that the climate-skeptic citizens tended to downplay the onus to keep informed as they perceived the climate to be beyond human control, and spending time studying it was therefore not worthwhile.

Involvement. The way in which citizens should feature in the public discussion of climate science also received much attention in the focus group discussions, particularly from the citizens themselves. Across the three types of participants, the majority ascribed citizens with the potential to contribute to the deliberation of climate science and thereby cast them in a role as active participants in the discussion. Among the champions of this viewpoint, citizens were perceived as having the potential to provide different kinds of relevant input to the public discussion of climate science. Many climate journalists welcomed the idea that citizens could try to influence the journalistic agenda, for example by commenting on articles.

Another facet of the deliberation on this topic centered on the type of knowledge that citizens could contribute. Some participants reckoned that they could primarily supply experiential knowledge, while others believed they could serve as critics of climate science. The science journalists were especially prone to see citizens as "real life experts," while the critical ability of citizens was recognized by actors in all three camps in nearly equal shares. Different conceptions of what this critical role could entail were articulated. For example, a climate scientist thought that citizens were entitled to question how funds were allocated in climate science, while several other participants believed that citizens should ask critical questions regarding the veracity of the climate science information presented to them by the news media. One of the citizens from a homogeneous group, a female in her 40s working as a clerk in the public sector, encapsulated the latter position:

> Scientist or not, you are able to take a critical stance towards what's coming and the product that appears. [. . .] I definitely also think that the scientists ought to use something, well . . . should be fed by the citizens to some extent in relation to the research they conduct. [. . .] I know that the research of course should be based on a pure, objective, scientific foundation, but I think that the citizens should contribute with what they think could be relevant in the science they are conducting [. . .] (Citizen, Neutral, 40s, clerk, Group 8)

Nevertheless, not all participants endorsed the idea of participatory citizens. A few representatives from each segment envisioned a unidirectional flow in the communication stream, conceiving of citizens as mere "receivers" or "consumers" of climate science information. On a couple of occasions,

Table 2. Juxtaposition of Brüggemann's Proposition of Ideal Roles and the Ideal Roles Found in the Present Study.

Actor type	Proposition of Brüggemann et al.	Findings of present study
Climate scientists	Advocates Interpreters of scientific facts Dialogue brokers	Public communicators with a license to display emotion
Climate journalists	Advocates Interpreters of scientific facts Dialogue brokers	Neutral disseminators of scientific knowledge
Citizens	Extended peer community	Active participants in the public discussion of climate science

citizens also made clear that they did not find it to be within their role to critically reflect on climate science. One saw it as "provocative" for lay people to "believe that they are smarter than the scientist in his own field."

Analysis

In this section, the findings from the focus groups will be analyzed in the context of a post-normal understanding of the roles of climate scientists, climate journalists, and citizens. To conclude the analysis, an illustration of the ideal types of the three actors extracted from the data will be presented (Table 2).

The Role of Climate Scientists

The post-normal notion of climate science communication rests on a premise that climate scientists are expected to be active participants in the public discussion of climate-related issues. This resembles the near-unanimous view across the focus groups that climate scientists should be available to the public. Representatives from each segment argued that climate scientists have an especially pronounced responsibility to engage in public debate compared with researchers in other fields due to the post-normal traits connected to climate science, especially the urgency and high stakes involved.

According to Brüggemann et al., we should expect scientific advocacy to be on the rise (Brüggemann et al., 2020, pp. 10–11). However, the findings from this study indicate that this norm does not resonate with how any of the three actors perceive the role of climate scientists. While scientific activism was generally frowned upon, many participants from the various segments

found it acceptable for climate scientists to use emotional framing when disseminating their research. This means that a climate scientist formulating a political recommendation based on his or her research would act unacceptably, while a colleague who expressed worry connected to a certain result would receive a stamp of approval.

Based on the data from the focus groups, the role perceptions of the three actors seem to be largely aligned regarding the role of climate scientists. Hence, the expectations that climate scientists have for themselves of being public communicators with a license to display emotion correspond with the way most climate journalists and citizens perceived the role.

The Role of Climate Journalists

Akin to the prediction of further scientific advocacy, climate journalists have also been predicted to take on a more activistic role due to the post-normal character of the climate issue (Brüggemann et al., 2020, pp. 10–11). Again, the focus group interviews did not corroborate this expectation, instead pointing mainly toward an aversion to journalistic advocacy, not least from the climate journalists themselves. Most participants preferred journalistic outlets to stick to straight rather than slanted climate coverage. Some climate journalists explicitly stressed that climate journalism should not be viewed as an exceptional jurisdiction where another set of rules applies.

The post-normal circumstances have also been projected to turn climate journalists into interpreters of scientific facts. Nonetheless, the focus group discussions conveyed an impression that climate journalists were not expected to make independent interpretations of climate science. Across the different types of participants, there was thus agreement that climate journalists should not make these kinds of expert judgments, although they were expected to be well-versed in climate science in order to be able to translate it soundly for the public and be able to identify invalid knowledge claims.

Like in the case of climate scientists, the three actor groups largely agreed on how climate journalists should behave. What emerges from the focus groups is a perception that climate journalists ought to be neutral disseminators of scientific knowledge.

The Role of Citizens

The role of citizens in post-normal science communication is said to be that of an extended peer community and thereby active participants in the societal discussion of topics related to climate science (Brüggemann et al., 2020, p. 12).

This notion of citizens fits with how many participants viewed the role, although there was far from a consensus regarding whether citizens are obliged to keep up with developments in climate science.

In contrast to the overwhelming consensus on the roles of climate scientists and climate journalists, the role of citizens was far more disputed. Although there were some intergroup patterns in the different perceptions of the citizen role, the disagreement often operated on an intra-group level.

Table 1 serves to summarize the findings of the present study and compare them with Brüggemann et al.'s proposition of a new role configuration in climate science communication (Brüggemann et al., 2020). It is apparent that the focus group participants generally did not subscribe to the idea that climate scientists and climate journalists should be advocates, and the news media are expected to disseminate rather than interpret climate science. In relation to citizens, the findings presented here align somewhat with the notion of the public as an extended peer community, although there was far from consensus about what can rightly be expected of citizens.

There were no discernible effects of the intragroup differences among the climate scientists and climate journalists. The focus group interviews thus conveyed an impression that gender, experience level, and affiliation do not have a bearing on how the representatives of these segments view their respective roles. However, in terms of the citizens, climate sentiment seemed to have a large impact on participants' role perceptions. The less concerned the citizens were, the more they subscribed to the traditional role definitions.

Discussion

The backdrop of this article was the theoretically derived intuition that new winds are blowing in climate science communication due to the post-normal characteristics of the subject. Hence, the focus groups were intended to function as an anemometer to expose the assumption to empirical probing. Although the focus group interviews showed signs of slight changes in what is expected of climate scientists, climate journalists, and citizens, respectively, the overall picture was that of business as usual rather than a state of emergency.

One of the most striking findings of this study is the resilience of professional norms among climate scientists and climate journalists. While the literature has speculated that climate change might prove to be an external shock that would shake the traditional understandings of what it entails to be a scientist and a journalist, the professionals in the focus groups generally bought into a classic notion of their roles. Most climate scientists and climate

journalists did not find advocacy fitting, while the latter group largely accepted the scientists' monopoly on expertise. That climate journalists are dismissive of advocacy accords with contemporary Anglo-American studies (Gibson et al., 2016; Hibberd & Nguyen, 2013; Hiles & Hinnant, 2014), while the most recent scholarship on scientific advocacy indicates that climate scientists are increasingly integrating activistic communication into their self-understandings (Boykoff & Oonk, 2020; Getson et al., 2021). The discrepancy between the findings in the present study and the American ones might be testament to the effect that the strongly polarized political debate on climate change in the United States has on the role perception of climate scientists. It could be argued that climate science is more post-normal in the American context than in the Danish, as the values are more disputed in the United States (McCright & Dunlap, 2011).

Based on the focus group discussions, it seems warranted to dismiss notions of a profound revolution in Danish climate science communication; however, there are signs that role amendments are underway. Most notably, climate scientists are widely endowed with the right to extend their discursive repertoire to include messages of worry or anxiety. Many participants acknowledge that climate scientists are "citizens" at the same time as they are scientists and that they can act on that identity too. The duality of the role of climate scientists and the strain following from it has been characterized as a "double ethical bind" (Schneider, 1988). They must juggle being loyal to the scientific method by emphasizing the uncertainties of their research, while as citizens they are required to make the biggest possible difference with the knowledge they possess. Emotional communication seems to be a way of alleviating the dilemma stemming from this dual commitment as it offers climate scientists a way to stray from the narrow path of objectivity without getting lost in the risky terrain of advocacy. By conveying their concern for the future, climate scientists can prompt citizens to act without setting foot in the province of politics. Furthermore, recent research indicates that climate scientists are justified in their fear of losing credibility by making political recommendations, as this behavior has been found to decrease public trust in climatologists and foster skepticism about climate science in general (Palm et al., 2020, p. 833). On a similar (though more universal) note, scientists' participation in the March for Science has been demonstrated to not only widen the gulf between liberals' and conservatives' attitudes toward scientists but also to sway moderates toward having a more negative view of researchers (Motta, 2018, p. 786). Nonetheless, the literature on the subject does not necessarily suggest strict abstinence from scientific advocacy, as the work of Kotcher et al. attests that climate scientists can engage in milder forms of advocacy without losing credibility in the eyes of the public (Kotcher et al., 2017, p. 423).

Perhaps unsurprisingly, the role of citizens is less settled than the professional roles of climate scientists and climate journalists. In terms of citi- zens' appropriate engagement with climate science information, participants were divided into two factions: those who bought into the deliberative ideal of the knowledgeable and engaged citizen and those who accentuated the right to remain ignorant rather than the duty to keep informed in accordance with a liberal conception of citizenship (Árnason, 2013). That citizens are overrepresented in the first camp gives rise to the hypothesis that climate scientists and climate journalists underestimate the ability of the public to understand science. The participants expressing higher expectations of citizens tended to do so in relative rather than absolute terms. It was therefore not a matter of acquiring a specific level of climate scientific competence, but rather a case of intending to be informed. The emphasis on effort corresponds to the definition of the well-informed citizen offered by Schütz as "the citizen who aims at being well informed" (Schütz, 1946, p. 465). According to Schütz, an important feature setting this type of citizen apart from "the man on the street" is the insistence on broadening the sphere of interest to include not only matters intrinsically relevant to the individual, but also so-called "imposed relevances," significant events and situations outside the realm of personal control (Schütz, 1946, p. 474). In the eyes of many participants, climate change seems to constitute such an "imposed relevance" that cannot be ignored if one is to fulfill one's democratic responsibilities. Furthermore, the participants who ascribed citizens with the right to criticize climate science also tended to pose high demands on their information-seeking behavior. This congruence reflects the social contract underlying the concept of scientific citizenship, namely that citi- zens have a right to be included in public discussions of scientific develop- ments if they strive to be scientifically competent (Mejlgaard & Stares, 2010, p. 548).

By singling out scientists, journalists, and citizens as the objects of study, many other relevant actors are of course omitted from the present examination of climate science communication. This was also noted by several participants in the focus groups, who commented on the absence of politicians, companies, and nongovernmental organizations. However attractive a hexagon of climate science communication may sound, such an expansion would come at the expense of depth. The constellation of actors chosen here prioritizes a focus on the public deliberation of climate science over a policy-related one. Arguing for the value of non-policy-informing interaction between science and society, Davies and colleagues contend that this kind of communication "can be viewed as empowering participants for further debate" on the condition that the learning is symmetrical, meaning that

"enhanced understandings must occur within all those involved" (Davies et al., 2009, pp. 343–344).

This dialogical outlook on science communication is fashionable in modern science communication research, where the relevance of non-scientific forms of knowledge is increasingly acknowledged and bidirectional modes of communication endorsed (Reincke et al., 2020). While this aspect is attended to in the present paper, it is more thoroughly explored in another study based on the same data. This investigation shows that the potential for citizens to contribute experiential knowledge to public debates about climate-related matters is dependent on the scientific context, as lay input was perceived to be more pertinent in applied types of climate science than in more esoteric fields (Nicolaisen, 2022, p. 12).

A main contribution of the present article is its introduction of a reciprocity-oriented approach to the study of role perceptions in climate science communication. Hopefully, this can inspire further research where the alignment of expectations, or lack thereof, is center stage. It could be particularly interesting to do a similar study in an American context to see how actors there interpret their roles under circumstances of intense political polarization and widespread distrust of science and the news media. As mentioned earlier, studies show that U.S. climate scientists have a more accepting attitude toward scientific advocacy than the one espoused by their Danish counterparts in the focus groups (Boykoff & Oonk, 2020; Getson et al., 2021), while the findings of Kotcher and Myers (Kotcher et al., 2017) indicate that American citizens are more tolerant of normative communication from climate scientists than the representatives of the Danish public in this study.

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Note

1. Author's translation from Danish to English. This also applies to all the following interview citations.

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Appendix A: Overview of focus group composition

Homogeneous groups with climate journalists	Females	Males
Group 1 (5 participants)	Freelancer, short experience Nationwide media, short experience	Niche media, long experience Niche media, medium experience Nationwide media, long experience
Group 2 (5 participants)	Niche media, long experience	Freelancer, long experience Niche media, medium experience Nationwide media, long experience Niche media, medium experience
Group 3 (5 participants)	Freelancer, long experience Nationwide media, long experience	Freelancer, short experience Niche media, medium experience Nationwide media, long experience
Group 10 (4 participants)	Nationwide media, long experience	Nationwide media, short experience Niche media, short experience Niche media, short experience
Homogeneous groups with climate scientists		
Group 4 (5 participants)	Professor Postdoc	Professor Associate professor Associate professor
Group 5 (5 participants)	Assistant professor	Professor Professor Associate professor Assistant professor
Group 6 (7 participants)	Professor	Professor Professor Professor Associate professor Associate professor Senior scientist
Group 15 (4 participants)	Senior scientist Associate professor	Senior scientist Associate professor
Homogeneous groups with citizens		
Group 7 (6 participants)	Climate conscious, pensioner, 60s Neutral, product manager, 20s Climate sceptic, student, 20s	Climate conscious, construction consultant, 30s Climate sceptic, high school teacher, 50s Neutral, farmer, 40s
Group 8 (4 participants)	Neutral, pedagogue, 60s Neutral, clerk, 40s	Climate sceptic, geological consultant, 60s Climate sceptic, carpenter, 30s
Group 9 (4 participants)	Climate conscious, pensioner, 60s	Neutral, student, 20s Neutral, priest, 60s Climate sceptic, chief revenue officer, 50s
Group 14 (6 participants)	Neutral, unemployed, 50s Neutral, caregiver, 30s Climate conscious, outdoor consultant 50s Climate conscious, architect, 50s	Neutral, engineer, 20s Neutral, student, 20s
Heterogenous groups		
Group 11 (4 participants)	Neutral, early retiree 60s	Professor Professor Journalist from nationwide media, long experience
Group 12 (6 participants)	Professor Neutral, student, 20s Neutral, primary school teacher, 50s	Journalist from nationwide media, short experience Journalist from niche media, long experience Associate professor
Group 13 (6 participants)	Climate conscious, sustainability consultant, 40s	Journalist from niche media, medium experience Journalist from niche media, long experience Professor Neutral, truck driver, 60s Climate sceptic, associate professor in biomedicine, 40s

Appendix B: Moderator guide *(Translated from Danish)*

Informed consent form (2 minutes)

If any of you have not yet signed an informed consent form, you can do it now.

Introduction (5 minutes)

I would like to thank you for coming today.

This focus group is part of a PhD project examining climate science communication. Specifically, I am interested in the relation between climate scientists, climate journalists, and citizens. I have therefore set up fifteen focus groups with these three types of actors. The focus groups are meant to produce knowledge on how the actors see their own and each other's roles. Focus will therefore not be on the current situation but, rather, on how it ought to be according to you.

I have invited you because you represent a diversity of backgrounds. Today's discussion will depart from questions and exercises provided by me, but it is not me who should be centre stage today. Instead, I hope that you will discuss with each other. It is perfectly fine if it turns out that you disagree, and there are no right or wrong answers.

It is also important to emphasize that everything that is said in the focus group is confidential. I will therefore ask you not to reveal the content of today's discussion to outsiders.

Today's session will last one and a half hours. We will cover three different themes. First, you will discuss the role of citizens in climate science communication, then, the role of the journalists and, last, the role of the scientists. I will ask you a range of questions and present two exercises to you.

The interview will be recorded because I need to have a precise account of your discussion for when I analyse the data. The interview transcripts will be pseudonymised and treated according to the GDPR legislation, the European Union's data protection law.

Before we get started, I will ask you to briefly introduce yourself with your name, age, and occupation (citizens), years of experience, the media you represent (climate journalists), your position, and the university you are affiliated with (climate scientists).

Warm-up questions (5 minutes)

Homogeneous groups with citizens

Question 1: Climate change has been a major public issue for a long time. *Do you do something to follow or even contribute to the public climate discussion?*

Homogeneous groups with climate journalists

Question 1: What is your motivation for covering the climate topic?

Probe: Why is it interesting?

Homogeneous groups with climate scientists

Question 1: It differs how much climate scientists communicate their research in public. *What is your experience in doing it?*

Probe: Do you use social media to communicate professional messages?

Theme A: The role of citizens (20 minutes)

Question 1: Ought the individual citizen try to keep updated on the climate situation? Why? Why not?

Stimulus

In case this part of the discussion needed stimulation, the participants were presented with an engagement scale produced by the research. This scale served to illustrate different levels of engagement ranging from 'Totally disengaged' to 'Hyper engaged'. Each point of the scale was associated with specific behaviours, so the totally disengaged were not doing anything to seek information about the climate, while the moderately engaged learned about the climate situation through the media and the hyper engaged were reading scientific papers and reports about the climate. The participants were then asked to consider the scale when discussing how citizens should engage with climate science information.

Question 2: How do you perceive the importance of keeping up to date with climate change compared to other subjects such as the economic situation or global politics?

Question 3: How should citizens be involved in climate journalism?

Question 4: How do you perceive the possibility of citizens being experts?

Question 5: Modern technology has enabled more people to participate in the public debate on scientific topics such as climate change. *What is the significance of scientific knowledge for participation in the societal discussion of climate-related issues?*

Probe: Who should participate in this discussion?

Theme B: The role of climate journalists (20 minutes)

Question 1: The climate has a prominent position on the media agenda. *What is good climate journalism in your view?*

Probe: What characterizes bad climate journalism?

Stimulus

If the participants were unresponsive to the question, I showed them three pictures meant to illustrate different kinds of climate journalism. One picture showed the hockey stick graph, another showed a crossed-over beef, while the last picture showed a starving polar bear.

Sorting exercise

A variety of normative statements about climate journalism was written on cards. On the table, there was a label saying 'Agree' and a label saying 'Disagree'. The participants in turn received a card that they were told to read aloud, and afterwards, they were told to state whether they agreed or disagreed with the statement on it.

'Journalism should not only describe climate change. It should fight it'.

'We are not here to tell the public how to behave. We are here to tell them what is happening'.

'I think that the best climate coverage is local and shows how people are being affected by climate change'.

'It is not my task to be an expert. If I do that, I am committing a journalistic sin'.

'It is important to remain open towards climate denialists, although an overwhelming majority of the scientific evidence does not corroborate their claim'.

'It is an important task for journalists to facilitate interaction between climate scientists and citizens'.

‘I should be asking good questions, marshalling good facts, and letting readers draw their own conclusions. Journalists work in the fact industry’.

‘As a journalist I have never thought about how to make stories engaging and relevant to a particular audience. It’s not really our job to do that. I think it is our job to help people make sense of the world’.

‘The media should play down their headlines and write about facts and expertise. They should present things at a higher level and not make use of scare campaigns’.

Probes: Which statements do you agree and disagree with the most? Are there any aspects of the journalists’ role that you think are missing among the cards?

Break (8 minutes)

Theme C: The role of climate scientists (20 minutes)

Question 1: Traditionally, the task of scientists has been to do research and teach. *How do you perceive climate scientists’ responsibility to communicate their research to the public?*

Probe: How should climate scientists communicate their research?

Sorting exercise

The participants were presented with a scenario where a climate scientist publishes a study. Two labels were placed on the table. One read ‘Appropriate’ and the other ‘Inappropriate’. The participants were then collectively asked to place four hypothetic public statements made by the concerned climate scientists according to whether they were appropriate or inappropriate.

A climate scientist publishes a study that shows that the water level will rise 2.5 meters in 2100 if we continue to emit as much CO_2 worldwide as hitherto. That prediction exceeds what the UN’s climate panel perceives to be the most likely scenario by 50 centimetres. What is the scientist allowed to say based on the result?

A: ‘My research shows that the water level will rise 2.5 meters in 2100’.

B: ‘My research indicates that we need to do more to limit the emission of CO_2’.

C: ‘Based on my research, I assert that it will be a good idea to tax air travel and meat consumption further’.

D: ‘My results make me worried on behalf of my grandchildren’.

Probe: What defines whether a statement is acceptable or unacceptable?

Rounding off (10 minutes)

Taking departure in this triangle, I want you to put some labels on the roles of the different actors.

How would you describe the role of climate scientists in the communication of climate science?

If you should do the same for the climate journalists, how would that sound?

What about the citizens?

I want to end the session by thanking you for participating. If any of you have any comments, we can discuss them afterwards. You are also welcome to write or call me. My mail address and phone number are on the blackboard.

Note:

The ordering of the themes differed according to the group composition.

In the homogenous groups with climate scientists, the ordering was as follows: Theme C, Theme A, Theme B.

In the homogenous groups with climate journalists, the ordering was as follows: Theme B, Theme A, Theme C.

In the homogenous groups with citizens, the ordering was as follows: Theme A, Theme B, Theme C.

In the heterogenous groups, the ordering was as follows: Theme B, Theme A, Theme C. Further, the participants in these groups were not exposed to any warm-up questions.

Appendix C: Recruitment procedure

Recruitment of climate scientists

The identification of relevant researchers was initiated by web searches to locate climate scientists at each relevant university. The publication lists of researchers were used to decide if someone could be classified as a climate scientist. This effort resulted in a list of potential participants with varying seniority, research interests, and gender. The researchers were then contacted by phone. Here, they were introduced to the study and asked whether they agreed that their research is climate-related to a large extent. If they confirmed this, they were asked if they wanted to participate in the study and, thus, receive a written invitation at a later point. The researchers were also asked if they knew of colleagues who they thought could be relevant. This was done to identify potentially relevant researchers who were not detected by the web searches.

Recruitment of climate journalists
The identification of the relevant journalists began by approaching the chairmen of Danish Science Journalists (Danske Videnskabsjournalister) and The Association of Energy and Environmental Journalists (Foreningen af Energi- og Miljøjournalister). These inquiries resulted in a list of Danish journalists who covered climate-related subjects. The journalists were then contacted by phone. Here, they were introduced to the study and asked whether they agreed that their journalistic work focused on climate-related subjects to a large extent. If they confirmed this, they were asked if they wanted to participate in the study and, thus, receive a written invitation at a later point. The journalists were also asked if they knew of colleagues who they thought could be relevant. This was done to identify potentially relevant journalists who were not part of the associations. In the end, an exhaustive list of climate journalists with varying media affiliations, format specializations, and experience levels ensued.

Recruitment of citizens

The recruitment of citizens followed a targeted strategy, and a variety of channels were utilized. Facebook groups of social movements were used to identify citizens with strong either pro- or anti-environmental sentiments. The pro-environmental segment was targeted through Facebook groups connected to, for example, The Climate Movement (Klimabevægelsen) or The Grandparents' Climate Action (Bedsteforældrenes Klimaaktion), while the group belonging to The Climate Realists (Klimarealisterne) was used to get in touch with the group of citizens with an anti-environmental sentiment. Facebook groups for people with different professions (e.g., primary school teachers, high school teachers, entrepreneurs) were also used to locate potential participants with a neutral attitude towards the climate. Further, the network of the researcher was utilized to recruit participants of this type. Here, potential participants were required to be at two or more removes from the researcher. The citizens were contacted by phone. Here, they were introduced to the study. If they were interested in participating, they were promised a written invitation at a later point.

Appendix D: Example of invitation sent to climate scientists

(Translated from Danish)

Dear X

I would like to invite you to participate in a focus group that will be part of the data collection in my PhD project at the Danish Centre for Studies in Research and Research Policy.

My PhD focuses on climate science communication, as I investigate the interplay between climate scientists, climate journalists, and citizens. The focus groups will thus concentrate on the ideal role delegation between these three types of actors in the public discussion of the climate.

My study will rest on twelve focus groups with climate scientists from Danish universities, Danish journalists covering the climate, and citizens, which will represent a diverse sample of the Danish population. Nine groups will be comprised of only one actor type, while scientists, journalists, and citizens will be mixed in the remaining three.

Because your research is related to the climate, I would like to invite you to take part in a focus group. Together with other scientists with a similar focus, you will be asked to discuss which roles scientists, citizens, and journalists should have in the communication of climate science.

The aim with the focus groups is to generate new knowledge about the role perceptions of the three actors. This knowledge will subsequently be communicated in scientific articles to be published in international journals. Your personal information will be handled confidentially, and excerpts of the interview material will be published in a pseudonymized version. This means that no information that refers directly to you as a person will be published.

Because of COVID-19, everyone involved will have to have a valid corona passport when the focus group is conducted.

The focus group interview with you will take place in Location X on Y date and will last around one and a half hour.

I would appreciate it if you would get back to me about whether it is possible for you to participate in the focus group. You can either reply by phone (number) or email (email address). If you have any questions regarding the study or the project in general, you are very welcome to contact me.

Kind regards,

Author

Note: The invitations sent to the climate journalists and the citizens were identical to the above except for the fourth paragraph, which was tailored to each segment.

Appendix E: Information letter *(Translated from Danish)*

Background

The focus group will be a part of my PhD thesis, which investigates the interaction between climate scientists, climate journalists, and citizens. The project will examine how the three actors perceive their own and another's roles in the public debate about climate science. The aim of the focus groups is therefore to seek answers to a range of normative questions: How should climate scientists communicate their science publicly? How should the media cover climate science? How should citizens participate in the public discussion of climate science?

Practicalities

The focus group will be held at X Avenue, Y City. During the session, tea, coffee, and water will be served along with sandwiches and cake.

The focus group as a method

In this study, there will be around six participants in each group. Contrary to group interviews, it is the discussion among the participants that is central to focus groups. This means that the interviewer has a more retracted role than in ordinary interviews. The interviewer in a focus group therefore functions as a moderator who uses questions and exercises to stimulate a discussion between the participants.

The program of the day

Prior to starting up the focus group, I will collect your informed consent forms, which you are supposed to have read and signed beforehand and bring to the session. The focus group will be structured around three themes that revolve around the role of climate scientists, climate journalists, and citizens in climate science communication, respectively. The themes will be explored by way of a range of questions and two exercises. There will be a short break midway through the session. The focus group will finish with a short summary of the main points from the discussion.

Formal matters

The focus group discussion is confidential, so you are not allowed to reveal any of the content to outsiders. The conversation will be recorded and subsequently transcribed. All identifying information will be pseudonymised. This means that no information leading directly back to the individual participant will appear. All data will be treated in accordance with GDPR, the European Union's legislation regarding data protection, as stated in the informed consent form and the study's privacy policy.

I look forward to seeing you.

Kind regards,

Author

Appendix F: Informed consent form *(Translated from Danish)*

Informed consent form for participation in focus group study on climate science communication

Description of the project
In my PhD project at X Centre at Y University, I examine role perceptions among climate scientists, journalists, and citizens in climate science communication. The aim of the project is to cover the degree of agreement in the expectations of the three actors. The project is financed by Y University under the program 'Social Science and Business'.

The purpose of the focus group
The aim of the focus group is to examine how three central actors in the public climate discussion – climate scientists, journalists, and citizens – perceive the ideal delegation of roles in their interaction. The role perceptions of the three segments have hitherto been studied individually, but a central assumption of this PhD project is that it would be fruitful to examine them alongside each other. By putting together fifteen focus groups comprising Danish climate scientists, climate journalists and citizens, I will facilitate an exploration of the actors' expectations to themselves and one another. The participants' reflections regarding their own and others' roles will later serve as the primary data material of my PhD dissertation.

Use of data and communication of results
The focus group interview will be recorded with a dictaphone and subsequently transcribed in a pseudonymised manner.

Each participant in the focus group interview can demand to have his or her interview data removed at any time by a simple request to Author (author's email address). Data that is already published cannot be retracted. Further, participants can ask to see the interview transcripts.

The results from the focus groups will be analyzed, published, and made publicly available in one or more scientific journals. No personal information will be revealed at any point.

Breach of data security
In case of a breach of the data security, the affected participants will be contacted and the data will be removed temporarily from the concerned storage location.

Data protection officer
Questions regarding data protection can be directed to Author (author's email)

Consent
Participation is voluntary, and the participants can withdraw from the study at any point without further justification by contacting Author (email of the author).

By signing the informed consent form, you confirm that you agree to all the following points:

- I have read the provided information about the study. I have had the possibility to ask questions, and my questions have been exhaustively answered. I have had sufficient time to decide whether I want to participate.

- I am aware that participation is voluntary. I am also aware that I can decide not to participate or withdraw from the study at any point. It is not necessary for me to justify my withdrawal.
- I know that I have the possibility to read the interview transcripts if I ask to. This also applies to the other participants, who will then have the possibility to read what I have said.

- I give consent that the focus group interview can be recorded on tape.
- I give consent that the collection and use of my interview data take place in accordance with established guidelines for data protection (GDPR).
- I know that the purpose of the focus groups is to generate new scientific knowledge.
- I am aware that participation in a focus group can potentially be an emotionally distressing experience.
- I promise to keep the confidentiality of the information that is shared among the participants and the researcher in the focus group interview.
- I promise to have a valid corona passport at the time the focus group is conducted.
- I would like to participate in this study.

The participant's signature: The contact person's signature:

Name in capital letters:
Date:

Appendix G: Displays *(Translated from Danish)*

<table>
<tr><th colspan="3">Positioning (Climate journalists)</th></tr>
<tr><td colspan="3">Rejection of advocacy</td></tr>
<tr><th>Climate scientists</th><th>Climate journalists</th><th>Citizens</th></tr>
<tr><td>[…] so, what is good journalism? Is it journalism that also tells people what they should do and what they should not do? (Moderator)

No. I definitely don't think so. (Associate professor)

No, no. (Professor)

Well, like we talked about previously in relation to our role, when it becomes prescriptive, I don't think … (Associate professor) Group 4

It reminds me of the RT channel and Putin's Russia. There is no point in having journalism that is slanted in a certain direction. (Professor) Group 6</td><td>[…] I will say that to me, good climate journalism is journalism that lives up to the same criteria that you would use on other subjects. (Niche media, medium experience)

Agree. (Freelance, long experience) Group 2

Some people constantly try to undermine the credibility of the classical mainstream media. They say we have an agenda, and that is also why I think that to make campaign journalism … In a time of fake news, it is incredibly important that we stay as objective as possible […] (Nationwide media, long experience) Group 1</td><td>[…] But of course, when it is based on research, then there probably are some numbers or some statistics that can show something, but otherwise, I would think that journalism should, to some extent, be neutral so that you as a citizen can engage with it without the journalist imposing a certain view on you. (Climate, sceptic, 20s, student) Group 7

They should not be activists. That was what you seemed to agree on. (Moderator)

They should not. (Neutral, 60s, pedagogue)

Journalists? No. Why should they? Because that is another trade. Then they should have become politicians instead. (Climate sceptic, 60s, geological consultant) Group 8</td></tr>
<tr><td colspan="3">Approval of advocacy</td></tr>
<tr><th>Climate scientists</th><th>Climate journalists</th><th>Citizens</th></tr>
<tr><td>[…] Because suddenly, we make campaigns where we tell you 'You could do this to limit your carbon footprint'. That is not an objectively chosen article. Is that okay? (Nationwide media, long experience)

Yes, I would like to know that! (Moderator)

I think it is. (Professor) Group 11

A journalist is allowed to have an opinion if they just signal it clearly. (Professor) Group 12</td><td>But do you have to push an agenda? (Nationwide media, long experience)

I tend to think that you have to do that a little bit […] (Freelance, short experience) Group 1

I think you can do it in a lighter and more nuanced way, but I tend to agree (that journalism should not fight climate change). (Nationwide media, short experience) Group 10</td><td>Can journalists take an activistic stance? This is one who argues in favor of activistic journalism. (Moderator)

I guess they can if they are transparent about it, like The Guardian. It must be an obvious positioning. (Climate conscious, 40s, sustainability consultant) Group 13</td></tr>
</table>

The responsibility to communicate (Climate scientists)		
Duty to communicate		
Climate scientists	**Climate journalists**	**Citizens**
All scientists have a responsibility to communicate their findings. […] But nobody gets anything out of some scientists knowing a lot without telling it to others, and of course, it should be presented to your peers first, but if it should really be used, then you must make sure to make it more widely known. *(Assistant professor) Group 5* I think it is important, to put it simply. Well, as mentioned earlier, we are publicly funded, so it is not for us … If I had my own little institute and did research with my own money, then I would not feel a responsibility. But since I am a researcher and a citizen, I am presented with some obligations as a participant in the debate. *(Professor) Group 13*	I began speaking about it earlier. I think they have a huge responsibility. A gigantic responsibility. Both in helping us journalists understand what the meaning of their reports and studies is and in reaching the public. And I will say that the urgency has only increased in recent years, I think. I think they have a very big responsibility. […] *(Nationwide media, long experience) Group 3* I think they have a big obligation to communicate their climate research publicly. We are very dependent on the knowledge they produce. It is … We are engaging in a historically large transformation of society in every aspect based on what climate science has discovered, and it is therefore completely essential that they continue to communicate their findings so we know if we are heading in the right direction. *(Nationwide media, short experience) Group 10*	[…] I actually think they have a big responsibility to disseminate, because they have used a lot of resources to find out. And finding out what is true. So, I actually think that the most important thing is to communicate it, at least as important as doing the research. *(Neutral, 20s, engineer) Group 14* […] You certainly have a responsibility to share your knowledge. It is in everybody's interest that you don't just do research for the sake of doing research. *(Climate sceptic, 40s, carpenter)* I agree. *(Neutral, 60s, pedagogue) Group 8*
No duty to communicate		
Climate scientists	**Climate journalists**	**Citizens**
(This box features no examples, because no climate scientist disavowed his or her responsibility to communicate)	What do you think about the scientists' duty in relation to what you were saying about making their research accessible to a larger audience? Is it something that lies within the role as a climate scientist? That you go out and … *(Moderator)* You could say that is our role primarily, right? More than it is theirs. You could say that is maybe where we have our justification for existing, right? *(Nationwide media, long experience) Group 1*	[…] The journalists are the disseminators; the scientists are the ones who find the things that must be disseminated. It should not be the scientists who disseminate. *(Climate sceptic, 50s, high school teacher) Group 7*

Information-seeking behaviour (Citizens)		
Obligation to keep informed		
Climate scientists	**Climate journalists**	**Citizens**
[…] I think that as a citizen in every society, you have an obligation with the skills and the time and the resources that you have to keep informed about … Well, I don't think they should read the IPCC reports, but I think that you have an obligation to keep yourself informed to some extent. *(Senior scientist) Group 15* It is a general societal problem. As a citizen, you always have a duty to keep informed about what is going on in society. So, I definitely think that you should familiarize with it (information about the climate). […] I really think that you have a duty in that regard. *(Assistant professor) Group 5*	It is a matter of general edification in some way, right? That you are expected to know certain things. […] You ought to be informed about natural science and know basic stuff regarding how the climate works and how it is changing. […] I think that in relation to the climate, which is so encompassing, you have to say that you as a citizen have a duty to stay informed as an ordinary democratic citizen. *(Freelance, long experience) Group 3*	[…] it is some kind of civic duty to stay informed. In a critical fashion as well. I think that it is an important task because how in the world will we change anything if we don't keep ourselves informed. *(Neutral, 20s, student)* It is a civic duty. *(Climate sceptic, 50s, chief revenue officer)* That it also how I feel. It is a natural part of democracy in my view. *(Climate conscious, 60s, pensioner) Group 9* […] But I think that to some extent, it should be almost in our DNA that we should have some kind of interest in this […] Well, it is so important what surrounds us. So, I think that we ought to take an interest in it. *(Neutral, 40s, clerk) Group 8*
No obligation to keep informed		
Climate scientists	**Climate journalists**	**Citizens**
[…] What I hear from you is that you can at least expect a certain level of commitment. That that is fair. *(Moderator)* Yes, I hope so. *(Senior scientist)* I have a problem with all that talk of expecting and ought to. Well, I think that these are unpleasant words to use in connection with this. […] But if you don't do it (pay an interest in the climate situation), it won't make you a worse citizen in the Danish society. *(Professor) Group 6* I think it is difficult to speak of an obligation […] How do we discriminate between problems that are big enough to have an obligation to keep informed? I think that is hard, right? (A*ssociate professor) Group 15*	[…] Is it akin to a civic duty to make an effort to stay updated on the climate situation? *(Moderator)* You cannot really demand that, can you? *(Nationwide media, long experience)* No, I don't think so either. (*Freelance, short experience) Group 1* I don't think that citizens are obliged to do something beyond what they want to, so if they want to know about the world, which is moving quickly currently, then they should do that, but I don't think that citizens are obliged to keep themselves informed about a particular topic. *(Niche media, medium experience) Group 2*	[…] Is it a civic duty to keep updated on the climate situation? (Moderator) Civic duty is not so … it is a big word to use, right, because you can only do what you are able to. *(Neutral, 60s, early retiree) Group 11* […] Where is it reasonable that the ordinary citizen is placed on this scale (the engagement scale developed by the researcher)? What can we expect? *(Moderator)* It is just difficult to expect anything, I think. Because I would be between these two (refers to the points saying 'Unengaged' and 'Moderately engaged'). *(Neutral, 50s, unemployed) Group 14*

Chapter 6: Orchestrating the Climate Choir: The Boundaries of Scientific Expertise, the Relevance of Experiential Knowledge and Tackling Misinformation

Introduction

Over the past 30 years, climate change has gained an increasingly prominent position on the societal agenda. Until now science has held a seemingly unrivalled primacy in the public discussion of the subject (Sarewitz, 2011, p. 479). When we want to assess the climate's current state and predict how it will fare in the future, we turn to science. This also applies to the development of strategies for mitigating and adapting to the challenges posed by an increase in the average global temperature.

Recently, though, there has been a call for reconsidering the hegemonic status of scientific knowledge in the public deliberation of climate-related issues. It has been proposed that climate science should abandon its 'speaking agenda' in favour of a 'listening agenda' and thereby establish a more reciprocal stream of information between the climate scientific community and society more broadly (Dudman & de Wit, 2021). This suggestion echoes the trend in the public understanding of science literature, where the dialogical aspect of science communication has been accentuated for some time (Bucchi & Trench, 2014; Miller, 2001). An important question in this regard is how to create a dialectic between scientific knowledge and experiential knowledge, two types of knowledge with essentially differing natures. While scientific knowledge is derived by distinctive techniques and certified by the peer review process (Petts & Brooks, 2006, p. 1046), experiential knowledge is based upon individuals' 'everyday observations' as they engage in social practices and form communities of equals (Brossard and Lewenstein 2009, 15; Irwin and Walker 1999, 1312, 1320).

Wynne's seminal case study of Cumbrian sheep farmers is an example of how lay perspectives can enrich discussions of topics that appear to be within the exclusive realm of science (Wynne, 1992). In Wynne's study, the scientific assessment of the local radiation hazard in Cumberland following the Chernobyl radioactive fallout turned out to be neither flawless nor value-free, and he points out how the procedure could have gained from the inclusion of the experiential knowledge of the local sheep farmers. Studies have indicated that the contingency of scientific knowledge and relevance of experiential knowledge also apply in the context of climate science. Based on an examination of the hacked emails from climate scientists at the University of East Anglia, which fostered the Climategate controversy, Ryghaug and Skjølsvold

counterproductive because local knowledge was not considered in the decision process (Dewan, 2022). A central concern of the present paper is to examine whether an awareness of the limits of scientific knowledge is manifested among climate scientists, climate journalists and citizens.

Another related aspiration of this study is to investigate how three of the most central actors in climate science communication perceive the value of experiential knowledge. The aim is to assess the potential to realize Dudman and de Wit's appeal for a more inclusive public debate on climate change. Their call to expand the number of actors in the climate change debate corresponds with Funtowicz and Ravetz's idea of 'post-normal science' (Funtowicz & Ravetz, 1993). A central element in their train of thought is that it is necessary to operate with an extended peer community in relation to post-normal science issues like climate change, where 'problems lack neat solutions', 'phenomena are ambiguous' and 'all research techniques are open to methodological criticism' (Funtowicz & Ravetz, 1993, p. 752). In such uncertain situations, they argue that science can benefit from taking 'extended facts' from non-scientific stakeholders into consideration. The experiential knowledge may help in defining the problem at stake and be a resource for critical reflection on the scientific data (Funtowicz & Ravetz, 1993, p. 753).

However, while recognizing the significance of including non-scientists in scientific debates, Collins and Evans contend that opening the discussion to a wider range of participants breeds a new dilemma: 'the problem of extension' (Collins & Evans, 2002, p. 237). This describes the challenge of distinguishing relevant from irrelevant lay input in order to avoid watering down the scientific discussion. Their main concern is to prevent the 'disastrous' potential situation in which 'the distinction between expertise and democracy' is dissolved (Collins & Evans, 2002, p. 269). According to them, this calls for a normative theory of expertise to delimit the expansion of relevant participation (Collins & Evans, 2002, p. 270). Collins and Evans' focal argument is that relevance is a matter of possessing expertise and that this trait is not per definition reserved for scientists, as it is possible to find uncertified experts with relevant experience among the public. Further, they stress that it is essential to discriminate between different types of science, as the potential for relevant public contributions hinges on the scientific discipline in question. They argue that the public can more easily contribute scientifically relevant insights to research in public-use technologies and planning but claim that scientific debates regarding so-called esoteric sciences cannot benefit from non-scientific contributions as these should be reserved for the core set of researchers with a highly specialized proficiency within that field (Collins & Evans, 2002, p. 242).

New communication technology has facilitated the expansion of possible participants in public debates about scientific matters in a way that could not have been foreseen when the idea of the extended peer community was conceived. At the time Funtowicz and Ravetz launched their theory, journalists were still the primary gatekeepers with respect to deciding who should enter the societal debate (Bucchi, 2017; van Dalen, 2020). The advent of the internet and especially social media have altered the gatekeeping function of journalists by paving the way for an increasing range of actors to contribute directly to the public debate on science-based issues (O'Neill & Boykoff, 2010, pp. 241–242). According to Bucchi and Trench, this development

poses new questions regarding how to guarantee the quality of knowledge introduced in public discussions of science (Bucchi & Trench, 2014, p. 9). A final objective of this inquiry is thus to find out how climate scientists, climate journalists and citizens perceive the issue of quality assurance for climate-related knowledge claims in the new media landscape.

Recognizing that a reassessment of the role of different kinds of knowledge in the societal climate discussion is needed, and that the traditional quality assurance of publicly stated knowledge claims is challenged, this paper seeks to answer the following research questions:

How do climate scientists, climate journalists and citizens negotiate the role of scientific and experiential knowledge in the public discussion of climate-related issues?

Who should ensure the quality of the knowledge claims proposed in the public discussion of climate-related subjects according to the three actors?

Conceptual framework

Based on the scholarship mentioned above, I have constructed two ideal types of the public sphere,[1] which I label traditional and post-traditional (see Figure 1). These are ideal types in the Weberian sense as they serve as analytical tools displaying certain features of the public sphere in a pure form, and thereby do not purport to give an accurate picture of reality (Psathas, 2005, p. 147). In the traditional public sphere, it is solely journalists who decide which knowledge is worthy of featuring in the public deliberation of science-based issues, where scientific and experiential knowledge are evaluated differently and where the former weighs far more heavily than the latter. This hierarchical ordering of the different knowledge types resonates with the 'knowledge deficit' mode of public understanding of science, which assumes an ignorant and passive public (Bauer et al., 2007, p. 81; Trench, 2008, p. 131)The post-traditional public sphere is characterized by the opportunity for citizens and scientists to provide unmediated contributions to the public deliberation, which accordingly is less reliant on journalistic gatekeeping. Here the different types of knowledge are deemed to be more equal, essentially chiming with the listening agenda proposed by Dudman and de Wit (Dudman & de Wit, 2021) and the public participation approach to the science-society relationship (Trench 2008, 132).

[1] In this paper the concept of the public sphere will be used in a simplified way to describe an all-encompassing public forum potentially open to all citizens where the discussion of topics with societal relevance takes place. A thorough consideration of the conceptualization of the public sphere is outside the scope of this study.

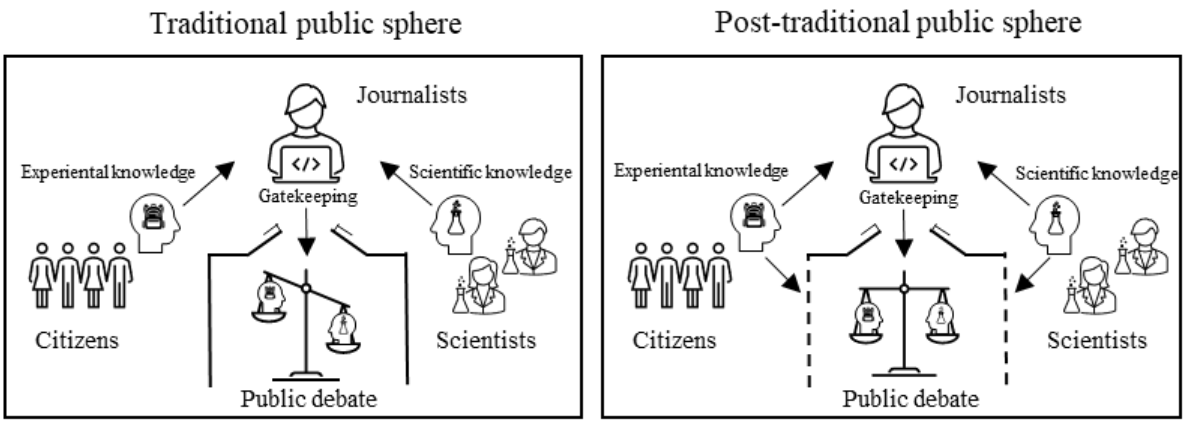

Figure 1: Illustration of the traditional and post-traditional public spheres.[2]

Methods

Case selection

The present study was carried out in Denmark, a country with a solid legacy of citizen involvement in questions of science and technology. Largely owing to consensus conferences, public hearings and scenario workshops organized by the Danish Board of Technology, Denmark has been regarded a frontrunner on public participation in science and technology matters (Mejlgaard, 2009, p. 486). In a cross-European analysis concerned with a range of science in society dimensions, Denmark was placed in the cluster of countries with a consolidated science communication culture and a formalized tradition of public involvement in science and technology decision-making (Mejlgaard & Stares, 2012, pp. 745–746). Given the Danish history of strong public involvement in discussions of science, it might be expected that lay input into the climate debate should be more treasured in this setting than elsewhere. Denmark therefore approximates a critical case of the most-likely kind in this regard (Flyvbjerg, 2006, pp. 229–232). Moreover, the Danish context can also tell us something about the need for journalistic filtering of the societal conversation about science-based issues when the distance between science and society is ostensibly modest.

Research design

The research questions were investigated with 15 focus groups composed of different constellations of Danish climate scientists, climate journalists and citizens (the same data has been used to produce another research article focusing on these actors' role perceptions; see (Busch Nicolaisen, 2022c)). This method was chosen as it accords with the study's interest in the collective sense-making of the actors and for its likelihood to yield the nuanced answers begged by the research questions. Indeed, a strength of focus groups is their ability to capture processes of group-level negotiations in all their complexity (Bloor et al., 2001, p. 4). Another argument for employing focus groups is that they can be used to support the triadic perspective of this

[2] It is important to note that the two models do not contain a causal claim pertaining to the relationship between the extent of journalistic gatekeeping and the evaluation of different types of knowledge. The figure thus merely serves to visualize these as two parallel developments. Investigating the causal relationship between these is outside the scope of this paper.

study, due to a research design with both homogeneous (featuring only one actor type) and heterogeneous (featuring all three actor types) focus groups. The homogeneous groups allowed for an exploration of intra-segment as well as inter-segment consensus on the topics discussed, while the heterogeneous groups enabled a direct observation of inter-segment negotiation.

During the fall of 2021, I conducted four homogeneous focus groups with each type of actor as well as three heterogeneous groups. The groups consisted of between four and seven participants each (see Appendix A for group composition). In total, 26 climate scientists, 24 climate journalists and 26 citizens participated. A semi-structured moderator guide encompassing two sorting exercises was employed to organize the discussions (see Appendix B for moderator guide), which lasted around 90 minutes and were conducted in Danish. The focus group interviews were audio-recorded and later transcribed with the aid of student assistants.

A climate scientist was defined as a university researcher who studies either the physical basis of climate change or how to mitigate or adapt to it, while a climate journalist was qualified by having produced in-depth climate journalism and self-identifying as such. The defining trait of a citizen was an individual over the age of 18.

The sampling of participants was performed with a purposive approach (R. Barbour, 2018, p. 69) to achieve maximum variation on key characteristics linked to each actor type (Flyvbjerg, 2006, p. 230). Regarding the climate scientists (N=26), this meant that the participants were affiliated with a range of Danish universities, and varied with respect to seniority (i.e., post.doc., associate professor, professor) and academic specialties (i.e., glaciology, carbon capture and storage technologies, macro ecology). The climate journalists (N=24) represented varied types of media (nationwide media, niche media, freelancers) and levels of experience (long (10+years), medium (5-10 years), short (<5 years), while the sample of citizens (N=26) represented a broad range of the Danish population in terms of age (20-35, 35-50, 50+), educational level, occupation and climate attitude (climate concerned, neutral, climate sceptical). Participants with specific educational and occupational backgrounds (e.g., primary school teachers, self-employed) and distinct climate attitudes in either direction were recruited via Facebook groups. The researcher's network was also used to find people with relevant profiles. However, to qualify for participation, persons had to be at two or more removes from the researcher (for details about the recruitment procedure see Appendix C).

Strategy for analysis and coding

The analysis of the focus group interviews was assisted by coding in NVivo and was greatly inspired by Auerbach and Silverstein's principles for coding qualitative data (Auerbach & Silverstein, 2003, pp. 34–84). Guided by the research questions, the material was inductively coded in three waves. First, a within-case analysis of each focus group was performed. Here the 15 transcripts were thoroughly examined to detect units of data where the participants reflected on either scientific knowledge, experiential knowledge, or the quality of the public climate debate. Each unit of relevant text was then provided with a code describing its content. In the second wave of analysis, an across-case approach was used as the codes from the different focus

groups were compared to assemble text units with similar content under the same repeated idea. The final phase of analysis was fixated on the identification of themes in the data by grouping the repeated ideas into more inclusive categories. Displays were created to help navigate the different themes (see Appendix D for displays related to the different facets of the research questions).

Analysis

The first subsection below showcases the main themes of the participants' deliberations of scientific knowledge, while the following subsection presents the essence of their discussion of experiential knowledge. Next the participants' negotiations of who should ensure the quality of the societal debate on climate science will be displayed. At the end of each subsection, the findings are analysed in the context of the traditional and post-traditional understandings of the public sphere presented in the introduction (see Figure 1). Finally, a brief synthesis of the analysis is provided.

Perceptions of scientific knowledge

During the inductive coding of the focus group material, it became apparent that the deliberation of scientific knowledge across the different group compositions could be arranged around two dimensions: scope and certainty (see Figure 2). The discussions connected to the former pertained to the extent of climate scientists' area of expertise, while the ones revolving around the latter focused on the certainty of scientific knowledge claims. Below, these two central aspects of participants' understandings of scientific knowledge will be examined in turn.

Figure 2: Illustration of dimensions in the participants' discussions of scientific knowledge

When reflecting on the scope continuum of scientific knowledge, participants from all three segments agreed about a narrow delimitation of scientific expertise. They generally perceived scientific expertise to be bounded to a specific research niche. The following examples show how this viewpoint was commonly articulated by climate scientists, climate journalists and citizens alike:

> But a lot of the requests [from the media], as you say, might be a bit on the fringes and then you must sometimes say 'I don't know anything about that', and that is an important part, I think, to kind of say 'Here I will make a statement, here I don't really …' At least

> there I won't be able to speak as a scientist, there I would just speak as a citizen, but that is not what they are looking for.[3] *Climate scientist (male, senior scientist), Group 15*

> I think that the scientists' biggest obligation in this regard is to communicate exactly what they are knowledgeable about and exactly what their studies show and not anything else. The most dangerous, I think, for us journalists are all-round experts [...] *Climate journalist (male, medium experience, niche media), Group 2*

> Well, so Option A [referring to card in sorting exercise with different fabricated public statements made by a climate scientist],[4] that is what he studies. Option C that is a further conclusion, which he has not studied, so I don't think that he should say that. He should only speak about what he has studied. *Citizen, (neutral, female, 20s, product manager), Group 7*

Of the three types of actors, the climate scientists were by far the most vocal in stressing the limited breadth of scientific knowledge. One noted that credibility might be lost if colleagues acted as experts on subjects outside their home turf, while another found it to be 'one of the biggest problems out there' that climate scientists are making media appearances related to topics 'far beyond what they have research-based knowledge on'. However, there were also a few exceptions to the rule, as some climate scientists perceived it to be legitimate for them to contribute insights on research themes neighbouring their own. This is exemplified in the excerpt below from one of the homogeneous groups:

> The talk that they want to have for 10 minutes or whatever you get on Deadline [Danish news program] is maybe something which basically relates to papers written by maybe 50 different authors, and I am not the author of all 50, but I am able to recap in round numbers the content of the 50 papers, and there I don't feel that I am compromising my professionalism. On the contrary, I think that a big part of my professionalism lies in the ability to embrace larger quantities of literature and sort of present the overall implications of it. *Climate scientist (male, professor), Group 4*

A similar attitude was voiced by a climate scientist who argued that you could be the most knowledgeable person in the country on a subject outside your own niche of research. He therefore preferred to say 'based on my knowledge' instead of 'based on my research' when making statements to the media. None of the climate journalists and citizens backed this interpretation of climate expertise, as they subscribed to a more restricted notion of scientific knowledge about climate change.

Regarding the certainty axis, two opposed positions were apparent in the focus groups. One cluster of participants saw scientific knowledge as authoritative and as something that non-scientists must accept without question. A citizen in a homogenous group sharply articulated this attitude:

> I lean on science, what the scientists have found out, and what the UN communicates based on many scientists who agree. So, so that is what I must stick to. I am not a scientist. I am not even a biologist. I am just a [former] teacher. [...] I think what is important to me is to listen to what they say, the ones who know something about it, and then I try to figure out, what can I, little me, do. [...] *Citizen (climate conscious female, 60s, pensioner), Group 9*

The contrasting view was that scientific knowledge is inherently uncertain and that science-based propositions about the state of the world should therefore always be

[3] This and all the following quotations have been translated from Danish by the author.

[4] See Appendix B for details.

met with scepticism. One citizen from a heterogeneous group, a biomedical scientist, was particularly adamant about this critical stance towards science:

> I think there is … and now you will hate me in a minute and that is also fair enough. I think that there is a little bit of researcher hubris involved in saying that you can predict how the earth will look in nearly a hundred years. We have *never* ever been able to do that before, and you have no idea whether you can now. *Citizen (climate sceptic, male, 40s, associate professor in biomedicine), Group 13*

He explained how his conception of scientific knowledge as uncertain had been fuelled by his recent involvement with COVID-19 research, where he had experienced scientific prognoses to be wrong on many occasions. However, his view was heavily contested by the other participants, primarily a climate scientist and a climate journalist, who both argued for the reliability of climate science based on the high level of consensus in the research community and the fact that climate models dating back to the 1970s have proved to be rather accurate. A parallel mechanism was triggered in a homogeneous group with citizens when a participant questioned the veracity of climate science:

> But what if science is mistaken? That, that, that climate change is not man-made? *Citizen (climate sceptic, male, 40s, carpenter)*

> Yeah, yeah, what if, and what if? Well, we also need to, well, in my view you also need to say, well, a lot of science is available, which is what you need to argue based on, ehm, when there isn't anything else. […] *Citizen (neutral, female, 40s, clerk) Group 8*

The two instances show how a similar assessment of scientific uncertainty was articulated by participants with varying proximities to science, with one being an insider (the associate professor of biomedicine) and the other an outsider (the carpenter). Furthermore, in both cases the other group members were quick to challenge their scepticism towards climate science.

In the main, the focus groups gave the impression that the three types of actors were rather aligned in their views on scientific knowledge as certain but very domain-specific. In the few instances where the reliability and predictive power of climate science was questioned by citizens, these views were quickly confronted by other group members with more confidence in the certainty of climate-scientific endeavours. Meanwhile, in the instances where something akin to blind faith in climate science was expressed, this was either positively reinforced or unchallenged by the other group members. This discrepancy in reactions indicates that the participants were generally more inclined towards a traditional than a post-traditional notion of scientific uncertainty. Yet the fact that one of the most pervasive patterns in the focus groups was the insistence that scientific knowledge is restricted to a certain field shows that the participants' perceptions of the authority of climate science was not unbounded. This finding accords with Collins and Evans' assertion that scientists must function as 'specialists' rather than 'generalists' when acting as experts in the public domain (Collins & Evans, 2002, p. 270).

Perceptions of experiential knowledge

Several participants from each segment contributed views on whether experiential knowledge is a valid currency in the public discussion of climate-related issues. Most of these participants acknowledged that laypeople could provide valuable insights to supplement science-based knowledge.

In many groups the discussion progressed from focusing on whether experiential knowledge was relevant to how it could be integrated into climate journalism and climate science. Regarding climate journalism, this leap seemed straightforward as most participants, especially the climate journalists, could easily imagine the incorporation of lay perspectives into climate stories. Here citizens could be granted the status of 'everyday experts' used to ground an otherwise abstract discussion in the experiential knowledge of the public, accumulated through professional experience (for example, as farmers) or by engaging in certain lifestyle practices such as going on 'climate-friendly vacations'.

However, it was stressed on several occasions that the experiential knowledge of citizens did not qualify them to contribute to the scientific debate. Climate journalists in different groups explained how scientific credentials were required to be considered a legitimate participant in discussions of the substance of climate science. While not denying that citizens could potentially deliver relevant input on scientific matters, the climate journalists argued that it would simply be too difficult to verify their knowledge as nothing akin to the peer review process exists for this kind of information. A citizen in a homogeneous group also expressed concern about using citizens to provide scientific input into climate reporting:

> […] But that a farmer […] has experienced that there has been more rain or more erratic weather or whatever. It might just be a single case. It is not very scientific and, well, correct to cite him. […] Then you get some outlier, and that would be totally wrong in relation to the general picture […] Well, then you should have conducted an investigation of a thousand farmers or something like that and then kind of see, what is the tendency in Denmark and kind of use the scientific method to do it […] *Citizen (neutral, male, engineer, 20s), Group 14*

Compared to climate journalism, the linkage between experiential knowledge and climate science seemed more difficult for the participants to envision, not least for the citizens themselves. While some citizens recognized the compatibility of lay and scientific knowledge, others found it difficult to see how climate science could benefit from incorporating the experiences of the public. This contrast was apparent in one of the homogeneous groups with citizens when one participant proposed that climate science should be receptive to the experiential input of citizens:

> […] I definitely also think that the scientists ought to use something, well … should be fed by the citizens to some extent in relation to the research they conduct. […] I know that the research of course should be based on a pure, objective, scientific foundation, but I think that the citizens should contribute with what they think could be relevant in the science they are conducting, but I don't think that it is isolated. I think there's a synergy to it. *Citizen (neutral, female, 40s, clerk)*

> What do you say, [name of participant]? *(Moderator)*
>
> Yeah, but … I will, well … I am not sure that the arrow goes both ways [refers to an illustration of the relationship between climate scientists and citizens]. Because I think that these scientists are researching things that we don't know anything about, because we just don't know, and that is how it is, and what can I then contribute to that research? *Citizen (neutral, female, 60s, preschool teacher) Group 8*

In another homogeneous group with citizens, a similar exchange occurred when a participant expressed enthusiasm about the knowledge potential stored in the public:

> I have experience with driving an electric car, I have solar panels on the roof, and I grow vegetables on the roof […] I have some practical experience, and that can be relevant for science in relation to building a bridge between the climate knowledge that they are responsible for […] something that can be carried out in reality, right? *Citizen (climate conscious, female, 60s, pensioner)*
>
> So, your knowledge can actually fertilize the research with new ideas? (*Moderator)*
>
> Yes, I definitely think so. *Citizen (climate conscious, female, 60s, pensioner)*
>
> I would like to hear something concrete about that. Which tangible things do you imagine that that could be? *Citizen (climate sceptic, male, 50s, high school teacher)*
>
> I have a suggestion about that […] *Citizen (climate conscious, male, 30s, construction consultant) Group 7*

In the above passage, the high school teacher challenges the pensioner's conviction about the usefulness of experiential knowledge for climate science. The high school teacher had previously stated his view that citizens did not possess the competences to generate any valid knowledge pertaining to the climate. Although the question in the example was directed at the pensioner, another participant answered. He thought that researchers in sustainable architecture could learn helpful lessons by studying the energy self-sufficient houses built by his company. A concrete example of how the experiential knowledge of citizens could contribute to climate science was also offered in another group by a climate scientist working within sustainable agriculture, who explained how he had derived new hypotheses based on the experiences of farmers. In relation to this, a climate journalist also described how the experiences of citizens had provided him with the impetus for generating new journalistic ideas.

The rejection of citizens' abilities to produce any knowledge useful to climate science was found in a small fraction of participants. However, this viewpoint seemed to be connected to a narrow understanding of climate science as exclusively being about examining geophysical processes. One climate journalist, for example, argued that climate science was 'too technical' for laypeople to be able to deliver valuable inputs. In a homogeneous group with climate scientists, two participants expressed a similar attitude as they agreed that non-scientists would be incapable of engaging in a discussion about how to, for example, 'date an ice core based on isotopes and dust'. This assessment was mirrored by a citizen in another group, who did not think she 'knew enough' to participate in the debate. According to another citizen, the only role of the

public in climate science was to 'pay for the research', as members of the public 'should have enough self-insight to realize that they are not smarter than the scientists in the scientists' own area of expertise'.

In relation to Funtowicz and Ravetz's idea of an extended peer community (Funtowicz & Ravetz, 1993), the focus groups showed that the perceived relevance of the extended facts provided by non-scientific actors was highly dependent on the context. In climate journalism, the experiential knowledge of citizens was seen as an important supplement to scientific knowledge, but it was also evident that it would never qualify citizens to take part in the media's coverage of scientific disputes. The usefulness of experiential knowledge to climate science also proved to be caveated as it varied between different branches of research, backing Collins and Evans' recommendation to evaluate the pertinence of lay input based on the type of science considered (Collins & Evans, 2002, pp. 265–266). It was apparent that the participants saw the esotericism of the science to be inversely correlated with the potential for relevant lay input. Citizens were seen to be able to contribute experiential knowledge to more solution-oriented research fields, while their voices had no application in more technical sciences such as climate modelling or glaciology.

Quality-assuring the public debate on climate science

It was evident from the focus group interviews that numerous participants from each segment perceived the quality of public deliberation on climate change to be under threat. Misinformation turned out to be a key concept in their discussions. However, the participants diverged in their perceptions of the causes of false information and the consequent remedies to alleviate it.

Most participants pointed to the unmediated debate on social media as the primary liability regarding the dissemination of false knowledge claims. A climate journalist saw the increased communicative power of citizens as a potential pitfall for the quality of the information shared:

> I will say that social media has changed the role distribution so that people like us and climate scientists, their voices weigh less heavily, right, than they did previously, right. Then the voice of an ordinary and in some cases ignorant citizen weighs more heavily, you can say, right. And that can pose a problem in relation to misinformation and fake news and such, right. *Climate journalist (male, long experience, nationwide media), Group 1*

Several citizens also lamented the standard of discussions about climate change on social media, which one participant described as 'mudslinging'. Moreover, another citizen explained how she got nothing but confusion out of engaging in Facebook debates about climate-related subjects:

> […] some of what I think is like quite annoying is when I have sometimes tried to seek out something and then I have maybe seen it referred to on Facebook. I know it's not the best source […] I read something about something. I think it was these floods or something, and suddenly someone wrote that it had something to do with the turn of the Gulf Stream and then I become totally confused. […] *Citizen (neutral, female, 30s, caregiver), Group 14*

In line with the above quote, the participants in a homogeneous citizen group agreed that unmediated online climate discussions often featured random facts and that journalistic mediation was therefore necessary. This view was also shared by a group of climate scientists. One argued that 'old-fashioned classic media' strive to 'eliminate the noise to get the signal through', while social media 'self-reinforced the noise'.

Among the climate journalists there was a broad recognition that the value of the public discussion of climate change hinged on journalistic moderation. In a heterogeneous group, a climate journalist warned the participating climate scientists about the possible consequences of bypassing the 'old media' when communicating publicly:

> But well, we have accumulated credibility over a long period, which we safeguard ferociously. The new media haven't and so the risk that they don't comment content and don't sort it emerges. What might happen is that you go out on a platform as a scientist and then the debate runs amok. *Climate journalist (male, long experience, nationwide media), Group 11*

He warned that without a journalistic filter in the discussion, trust in science may drop like it has done in the United States. In another group, a climate journalist asserted that 'any debate not controlled in some way becomes bad'.

However, a small cluster of citizens perceived legacy media to be the primary source of misinformation. In a homogeneous citizen group, a participant maintained that almost all Danish climate journalism consisted of misinformation and that he only knew of one newspaper which treats the climate issue in a 'serious manner', namely *Stavanger Aftenblad*, a Norwegian media outlet. Additionally, a citizen in a heterogeneous group contended that 'journalism has already chosen sides' and that this was evident in the reporting. This claim was strongly opposed by the attendant climate journalists, who said that the media were merely 'listening to the science'. A notion of a certain inclination in climate journalism was also held by a citizen in a homogeneous group, who explained how his realization of the skewedness of the media had made him take responsibility for seeking supplementary information elsewhere:

> When I first got a look at the other side of the coin, I felt like that what I experience in the mainstream media [...] becomes incredibly one-sided and focuses a lot on this doomsday narrative [...] Then I began searching for alternative ways to get informed, and one of the things that you have heard very frequently is that the science is settled, right? There is total agreement on the science. As soon as you begin to go that way some alarm bells must per definition start to ring. [...] *Citizen (climate sceptic, male, 50s, chief revenue officer), Group 9*

A small minority ascribed climate scientists a role in combating the spread of misinformation. On two separate occasions a climate scientist and a citizen argued that climate scientists should interfere when they come across unwarranted knowledge claims in the public debate.

Generally, in terms of how to ensure a certain level of quality in the public climate debate, most participants in each segment held a view conforming to a traditional

understanding of the public sphere. They thus preferred journalists to be exclusively responsible for sorting the wheat from the chaff. Still, the focus group discussions also showed that a small number of citizens favoured the post-traditional roles where journalists are less dominant as gatekeepers, because they did not trust the media to engage with knowledge claims in an unbiased way.

Synthesis

Overall, the focus groups showed that the participants' perceptions did not align squarely with either model of the public sphere. The knowledge produced by climate scientists was rarely questioned in any of the fifteen groups, in line with the traditional approach to public debate where scientific knowledge is highly esteemed. However, the more post-traditional notion that scientists are not omnicompetent was highly prevalent among the participants. The relevance of experiential knowledge was perceived to differ according to the scientific context. This implies that the hierarchical ordering of the different knowledge forms associated with the traditional public sphere was valid for esoteric sciences, while the participants subscribed to a post-traditional understanding of a more equal relationship regarding applied types of climate science. Concerning the quality assurance of the public climate debate, there was a rather clear-cut consensus in favour of the traditional model, where journalists are the designated arbiters of knowledge claims.

Discussion

By examining the role of the extended peer community in the public deliberation of climate-related issues, this study has engaged with an alleged weakness of post-normal science (Yearley, 2000, p. 110). While it is not possible to derive clear-cut guidelines about what constitutes pertinent lay input from this study, it gets partway there by showing that it is warranted to discriminate between different fields within climate science. Contrary to Funtowicz and Ravetz's original idea, it seems that the more post-normal a specific research endeavour is, the less relevant the extended facts provided by the public are perceived to be. Instead, the focus group data resonate with Collins and Evans' notion that esoteric sciences will not gain from the experiential knowledge of citizens. This is related to what Beck is capturing by describing new types of risks facing modern societies as 'second-hand non-experiences' (Beck, 1992, pp. 71–72). Beck's point is exactly that many aspects of risks like climate change are 'by nature beyond human perception'. This underlines the difficulty of implementing a universal 'listening agenda' in climate science as some aspects of the climate challenge can only be comprehended by scientific means. However, the focus groups also revealed that citizens felt geared to contribute to more applied types of climate science, and their potential to supplement the scientific knowledge in these areas was also recognized by climate scientists. This application of the extended facts appears to be in accordance with Funtowicz and Ravetz's conception of the extended peer community, which Ravetz later stressed was never conceived of as a 'replacement peer community' (Ravetz, 2011, p. 156). The justification for involving other kinds of stakeholders in science is thus exactly that they can contribute other kinds of input. It was also clear that this was the role the participants intended for the public in climate journalism.

In a study of experts' conceptualisations of lay knowledge in environmental decision-making, Petts and Brooks argue for the need to know how experts perceive lay input, as they could potentially pose a barrier to the incorporation of citizen perspectives in the deliberative process (Petts & Brooks, 2006, p. 1048). The research design employed in the present study is underpinned by a similar philosophy, acknowledging the dependency structures among the investigated actors in climate science communication. For example, if climate science and climate journalism are not ready to listen, the public's input will fall on deaf ears. However, whereas Petts operates with a unidirectional, one-dimensional outlook, the present study has a reciprocal and three-dimensional perspective on the use of different types of knowledge in the public debate on climate-related issues. A significant contribution of this research thus lies in the juxtaposition of the actors' perceptions of the different forms of knowledge and the quality assurance of the debate by showing that there was generally a high degree of consensus between the three actor groups on these questions. This widespread concord was testified to by the low conflict level in the heterogeneous focus groups. While the homogeneous groups with climate scientists and climate journalists were also relatively harmonious, the groups consisting exclusively of citizens tended to be more prone to disagreement when the participants deliberated the relevance of lay input and the credibility of journalists as gatekeepers.

While the definition of what constitutes quality in the public debate could potentially be construed in a variety of ways, the participants in the focus groups were quite univocal in emphasizing that avoiding unsubstantiated knowledge claims was a central concern in securing a decent public discussion. According to the participants, the diffusion of sub-standard knowledge claims could be the result of either ignorant or ill-intended people interfering in the discussion of scientific facts. In this regard, it is relevant to consider Treen et al.'s distinction between misinformation and disinformation, which proposes a distinction based on the intention of the sender. Misinformation pertains to 'misleading information that is created and spread, regardless of whether the intent is to deceive', while disinformation is transmitted with the intent of deceiving the receiver (Treen et al., 2020, p. 2). This differentiation helps gain a more nuanced appreciation of the participants' preference for keeping the gatekeeper function within the ranks of journalists. Some participants endorsed journalists as gatekeepers because their perceived scientific proficiency was assumed to make them better equipped to curate knowledge claims. Others trusted journalists to be more likely to engage with knowledge in an unbiased way due to the professional norms guiding journalistic practice. The evidence from the focus groups therefore corroborates Vos' claim that journalistic 'gatekeeping is not declining, dying, or dead' (Vos, 2020, p. 90) and indicates that the 'crisis of mediators' (Bucchi & Trench, 2014, p. 9) in science communication is not as pressing as it might seem.

This paper has contributed insights into two topical discussions in the public understanding of science literature based on a comprehensive focus group study of climate science communication in Denmark: 1) the possibility of a more dialogical approach to science communication involving experience-based knowledge from the public and 2) quality assurance of knowledge claims in the Science Communication 2.0 era. The study has shown that experience-based input is welcomed in the public discussion of the climate challenge, with two important caveats: it cannot replace but must

rather serve as a supplement to scientific knowledge, and its relevance is largely restricted to applied research fields. Further, the study has revealed that journalists are still favoured as gatekeepers in a time when alternative communication channels are mounting. Yet when reflecting on the participants' inclination to keep journalists at the helm of the public climate discussion, it is essential to be mindful of the context in which the study was conducted. A trademark of Danish society is its high level of general trust (Svendsen & Svendsen, 2015), which also translates into a particularly high degree of trust in the media (Newman et al., 2021, p. 19). The approval of placing the gatekeeping responsibility with journalists is therefore not surprising. If the study were repeated under more media-sceptical circumstances, such as those found in the United States (Newman et al., 2021, p. 19), it is plausible that the picture would diverge markedly.

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Appendix A: Overview of focus group composition

Homogeneous groups with climate journalists	Females	Males
Group 1 (5 participants)	Freelancer, short experience Nationwide media, short experience	Niche media, long experience Niche media, medium experience Nationwide media, long experience
Group 2 (5 participants)	Niche media, long experience	Freelancer, long experience Niche media, medium experience Nationwide media, long experience Niche media, medium experience
Group 3 (5 participants)	Freelancer, long experience Nationwide media, long experience	Freelancer, short experience Niche media, medium experience Nationwide media, long experience
Group 10 (4 participants)	Nationwide media, long experience	Nationwide media, short experience Niche media, short experience Niche media, short experience
Homogeneous groups with climate scientists		
Group 4 (5 participants)	Professor Postdoc	Professor Associate professor Associate professor
Group 5 (5 participants)	Assistant professor	Professor Professor Associate professor Assistant professor
Group 6 (7 participants)	Professor	Professor Professor Professor Associate professor Associate professor Senior scientist
Group 15 (4 participants)	Senior scientist Associate professor	Senior scientist Associate professor
Homogeneous groups with citizens		
Group 7 (6 participants)	Climate conscious, pensioner, 60s Neutral, product manager, 20s Climate sceptic, student, 20s	Climate conscious, construction consultant, 30s Climate sceptic, high school teacher, 50s Neutral, farmer, 40s
Group 8 (4 participants)	Neutral, pedagogue, 60s Neutral, clerk, 40s	Climate sceptic, geological consultant, 60s Climate sceptic, carpenter, 30s
Group 9 (4 participants)	Climate conscious, pensioner, 60s	Neutral, student, 20s Neutral, priest, 60s Climate sceptic, chief revenue officer, 50s
Group 14 (6 participants)	Neutral, unemployed, 50s Neutral, caregiver, 30s Climate conscious, outdoor consultant 50s Climate conscious, architect, 50s	Neutral, engineer, 20s Neutral, student, 20s
Heterogenous groups		
Group 11 (4 participants)	Neutral, early retiree 60s	Professor Professor Journalist from nationwide media, long experience
Group 12 (6 participants)	Professor Neutral, student, 20s Neutral, primary school teacher, 50s	Journalist from nationwide media, short experience Journalist from niche media, long experience Associate professor
Group 13 (6 participants)	Climate conscious, sustainability consultant, 40s	Journalist from niche media, medium experience Journalist from niche media, long experience Professor Neutral, truck driver, 60s Climate sceptic, associate professor in biomedicine, 40s

Appendix B: Moderator guide *(Translated from Danish)*

Informed consent form (2 minutes)

If any of you have not yet signed an informed consent form, you can do it now.

Introduction (5 minutes)

I would like to thank you for coming today.

This focus group is part of a PhD project examining climate science communication. Specifically, I am interested in the relation between climate scientists, climate journalists, and citizens. I have therefore set up fifteen focus groups with these three types of actors. The focus groups are meant to produce knowledge on how the actors see their own and each other's roles. Focus will therefore not be on the current situation but, rather, on how it ought to be according to you.

I have invited you because you represent a diversity of backgrounds. Today's discussion will depart from questions and exercises provided by me, but it is not me who should be centre stage today. Instead, I hope that you will discuss with each other. It is perfectly fine if it turns out that you disagree, and there are no right or wrong answers.

It is also important to emphasize that everything that is said in the focus group is confidential. I will therefore ask you not to reveal the content of today's discussion to outsiders.

Today's session will last one and a half hours. We will cover three different themes. First, you will discuss the role of citizens in climate science communication, then, the role of the journalists and, last, the role of the scientists. I will ask you a range of questions and present two exercises to you.

The interview will be recorded because I need to have a precise account of your discussion for when I analyse the data. The interview transcripts will be pseudonymised and treated according to the GDPR legislation, the European Union's data protection law.

Before we get started, I will ask you to briefly introduce yourself with your name, age, and occupation (citizens), years of experience, the media you represent (climate journalists), your position, and the university you are affiliated with (climate scientists).

Warm-up questions (5 minutes)

<u>Homogeneous groups with citizens</u>

Question 1: Climate change has been a major public issue for a long time. *Do you do something to follow or even contribute to the public climate discussion?*

<u>Homogeneous groups with climate journalists</u>

Question 1: What is your motivation for covering the climate topic?

Probe: Why is it interesting?

Homogeneous groups with climate scientists

Question 1: It differs how much climate scientists communicate their research in public. *What is your experience in doing it?*

Probe: Do you use social media to communicate professional messages?

Theme A: The role of citizens (20 minutes)

Question 1: Ought the individual citizen try to keep updated on the climate situation? Why? Why not?

Stimulus

In case this part of the discussion needed stimulation, the participants were presented with an engagement scale produced by the research. This scale served to illustrate different levels of engagement ranging from 'Totally disengaged' to 'Hyper engaged'. Each point of the scale was associated with specific behaviours, so the totally disengaged were not doing anything to seek information about the climate, while the moderately engaged learned about the climate situation through the media and the hyper engaged were reading scientific papers and reports about the climate. The participants were then asked to consider the scale when discussing how citizens should engage with climate science information.

Question 2: How do you perceive the importance of keeping up to date with climate change compared to other subjects such as the economic situation or global politics?

Question 3: How should citizens be involved in climate journalism?

Question 4: How do you perceive the possibility of citizens being experts?

Question 5: Modern technology has enabled more people to participate in the public debate on scientific topics such as climate change. *What is the significance of scientific knowledge for participation in the societal discussion of climate-related issues?*

Probe: Who should participate in this discussion?

Theme B: The role of climate journalists (20 minutes)

Question 1: The climate has a prominent position on the media agenda. *What is good climate journalism in your view?*

Probe: What characterizes bad climate journalism?

Stimulus

If the participants were unresponsive to the question, I showed them three pictures meant to illustrate different kinds of climate journalism. One picture showed the hockey stick graph, another showed a crossed-over beef, while the last picture showed a starving polar bear.

Sorting exercise

A variety of normative statements about climate journalism was written on cards. On the table, there was a label saying 'Agree' and a label saying 'Disagree'. The participants in turn received a card that they were told to read aloud, and afterwards, they were told to state whether they agreed or disagreed with the statement on it.

'Journalism should not only describe climate change. It should fight it'.

'We are not here to tell the public how to behave. We are here to tell them what is happening'.

'I think that the best climate coverage is local and shows how people are being affected by climate change'.

'It is not my task to be an expert. If I do that, I am committing a journalistic sin'.

'It is important to remain open towards climate denialists, although an overwhelming majority of the scientific evidence does not corroborate their claim'.

'It is an important task for journalists to facilitate interaction between climate scientists and citizens'.

'I should be asking good questions, marshalling good facts, and letting readers draw their own conclusions. Journalists work in the fact industry'.

'As a journalist I have never thought about how to make stories engaging and relevant to a particular audience. It's not really our job to do that. I think it is our job to help people make sense of the world'.

'The media should play down their headlines and write about facts and expertise. They should present things at a higher level and not make use of scare campaigns'.

Probes: Which statements do you agree and disagree with the most? Are there any aspects of the journalists' role that you think are missing among the cards?

Break (8 minutes)

Theme C: The role of climate scientists (20 minutes)

Question 1: Traditionally, the task of scientists has been to do research and teach. *How do you perceive climate scientists' responsibility to communicate their research to the public?*

Probe: How should climate scientists communicate their research?

Sorting exercise

The participants were presented with a scenario where a climate scientist publishes a study. Two labels were placed on the table. One read 'Appropriate' and the other 'Inappropriate'. The participants were then collectively asked to place four hypothetic public statements made by the concerned climate scientists according to whether they were appropriate or inappropriate.

A climate scientist publishes a study that shows that the water level will rise 2.5 meters in 2100 if we continue to emit as much CO_2 worldwide as hitherto. That prediction exceeds what the UN's climate panel perceives to be the most likely scenario by 50 centimetres. What is the scientist allowed to say based on the result?

A: 'My research shows that the water level will rise 2.5 meters in 2100'.

B: 'My research indicates that we need to do more to limit the emission of CO_2'.

C: 'Based on my research, I assert that it will be a good idea to tax air travel and meat consumption further'.

D: 'My results make me worried on behalf of my grandchildren'.

Probe: What defines whether a statement is acceptable or unacceptable?

Rounding off (10 minutes)

Taking departure in this triangle, I want you to put some labels on the roles of the different actors.

How would you describe the role of climate scientists in the communication of climate science?

If you should do the same for the climate journalists, how would that sound?

What about the citizens?

I want to end the session by thanking you for participating. If any of you have any comments, we can discuss them afterwards. You are also welcome to write or call me. My mail address and phone number are on the blackboard.

Note:

The ordering of the themes differed according to the group composition.

In the homogenous groups with climate scientists, the ordering was as follows: Theme C, Theme A, Theme B.

In the homogenous groups with climate journalists, the ordering was as follows: Theme B, Theme A, Theme C.

In the homogenous groups with citizens, the ordering was as follows: Theme A, Theme B, Theme C.

In the heterogenous groups, the ordering was as follows: Theme B, Theme A, Theme C. Further, the participants in these groups were not exposed to any warm-up questions.

Appendix C: Recruitment procedure

Recruitment of climate scientists

The identification of relevant researchers was initiated by web searches to locate climate scientists at each relevant university. The publication lists of researchers were used to decide if someone could be classified as a climate scientist. This effort resulted in a list of potential participants with varying seniority, research interests, and gender. The researchers were then contacted by phone. Here, they were introduced to the study and asked whether they agreed that their research is climate-related to a large extent. If they confirmed this, they were asked if they wanted to participate in the study and, thus, receive a written invitation at a later point. The researchers were also asked if they knew of colleagues who they thought could be relevant. This was done to identify potentially relevant researchers who were not detected by the web searches.

Recruitment of climate journalists

The identification of the relevant journalists began by approaching the chairmen of Danish Science Journalists (Danske Videnskabsjournalister) and The Association of Energy and Environmental Journalists (Foreningen af Energi- og Miljøjournalister). These inquiries resulted in a list of Danish journalists who covered climate-related subjects. The journalists were then contacted by phone. Here, they were introduced to the study and asked whether they agreed that their journalistic work focused on climate-related subjects to a large extent. If they confirmed this, they were asked if they wanted to participate in the study and, thus, receive a written invitation at a later point. The journalists were also asked if they knew of colleagues who they thought could be relevant. This was done to identify potentially relevant journalists who were not part of the associations. In the end, an exhaustive list of climate journalists with varying media affiliations, format specializations, and experience levels ensued.

Recruitment of citizens

The recruitment of citizens followed a targeted strategy, and a variety of channels were utilized. Facebook groups of social movements were used to identify citizens with strong either pro- or anti-environmental sentiments. The pro-environmental segment was targeted through Facebook groups connected to, for example, The Climate Movement (Klimabevægelsen) or The Grandparents' Climate Action (Bedsteforældrenes Klimaaktion), while the group belonging to The Climate Realists (Klimarealisterne) was used to get in touch with the group of citizens with an anti-environmental sentiment. Facebook groups for people with different professions (e.g., primary school teachers, high school teachers, entrepreneurs) were also used to locate potential participants with a neutral attitude towards the climate. Further, the network of the researcher was utilized to recruit participants of this type. Here, potential participants were required to be at two or more removes from the researcher. The citizens were contacted by phone. Here, they were introduced to the

study. If they were interested in participating, they were promised a written invitation at a later point.

Appendix D: Displays

The role of scientific knowledge		
Scope		
Climate scientists	**Climate journalists**	**Citizens**
First and foremost, I must speak about facts, well, I have to speak about the results that I have produced myself. *Climate scientist (female, post-doc) Group 4* But who should then provide the answers to how to solve this problem if it is not the ones who … if it is not the climate scientists? *Citizen (neutral, female, early retiree, 60s)* Yes, but it is another climate scientist. It is a bit like when you go up to the doctor and say you have knee pain, and you need to have surgery. Then it isn't the doctor who looked at your knee, it is another doctor, and that is where things often go wrong. *Climate scientist (male, professor) Group 11*	Well, for my part it unfortunately becomes a bit of, you know, a trite point, well to me it is really all about whether you are talking about something that is within your specialty. *Climate journalist (male, niche media, medium experience) Group 2* Well, a good example here in the interview is actually that in relation to IPCC I interviewed someone about methane, who knows something about methane and ice and all that, right? But then she shouldn't comment on agriculture and methane emissions from cows and all such things, because it isn't, it isn't something that she knows anything about. *Climate journalist (male, niche media, long experience)* But that can … I actually think that it happens more and more often, well that someone like Mernild [Danish climate scientist] speaks about something that he basically does not know anything about. Well, where you … and that I think is actually a bit of a problem. *Climate journalist (female, nationwide media, short experience) Group 1*	Is it a kind of humility towards their own …? *(Moderator)* It must be something with knowing your own limits, right? *Citizen (climate conscious, female, 40s, sustainability consultant) Group 13* […] So that is problematic, I think. Then another scientist is needed […] So in that way I don't think that he should conclude something about anything he has not studied. *Citizen (neutral, male, 20s, engineer) Group 14* Well, I think that he [a fictive climate scientist in a sorting exercise] should provide the conclusion to what he has studied and then he should not start to connect it to everything else, then he must just let it stand alone […] *Citizen (climate sceptic, female, 20s, student) Group 7*

Certainty		
Climate scientists	**Climate journalists**	**Citizens**
[…] Well, it [climate scepticism] is like when people come and say that the world is flat or that the earth is flat. Well to me that is a claim that is not tenable. We have enough evidence that, ehm, and there is a certain … well to me it is also … well we can continue to discuss these things and well as you said it is 5000 to 2. *Climate scientist (male, professor) Group 13*	I remember that I was a little bit climate sceptical the first year […] But then I was very quickly pretty convinced by reading different reports and speaking to different scientists that we bear the primary guilt for this, right, and then it has occurred to me, well, the magnitude is enormous regarding what climate change does and we are to blame for it and … I have developed a very, very strong impression bordering on evidence that we are 100 percent responsible for the climate changes that are ongoing right now […] *Climate journalist (male, nationwide media, long experience) Group 1*	Science must seek the truth. *Citizen (climate sceptic, male, 60s, geological consultant)* Yes! *Citizen (neutral, female, 40s, clerk) Group 8* I think that most scientists communicate way too … *Citizen (climate conscious, female, 40s, sustainability consultant)* Conservatively? *Climate journalist (male, niche media, medium experience)* Too … well they don't dare to say it pointedly. It becomes something like 'We maybe think that it will be like this' 'There is a high likelihood that …' Instead of just saying … and it has taken 100 IPCC reports before they kind of said that this is what is going on. *Citizen (climate conscious, female, 40s, sustainability consultant) Group 13*

The role of experiential knowledge		
In climate journalism		
Climate scientists	**Climate journalists**	**Citizens**
That is what citizens can do. They can maybe say something about how it is experienced out there in some way, and that is also relevant [...] *Climate scientist (female, senior scientist) Group 15* Well, it depends, it depends a bit on the subject. If the subject is the scientific facts, then it is pretty important that you have a decent idea about how science works, ehm. If the subject is which personal choices you can make in this regard and how you can contribute to solve the climate then, then, then, ehm, then I would maybe think that you would be better able to say that everybody can participate. So, I will say that it really depends on the subject. *Climate scientist (male, associate professor) Group 11*	I want the word consequence experts. *Climate journalist (male, nationwide media, long experience)* Yes. *(Moderator)* [Explains the concept of consequence expert] How does it affect my every day? It may very well be that you are not educated to be an expert, but you are an expert in the consequences that it presents you with. *Climate journalist (male, nationwide media, long experience) Group 11* No but well I am probably in agreement with what has been said already. Well, I think that you should use the citizens if the citizens can be used to put a face on some topics. Use their stories to illustrate what is going on. *Climate journalist (male, freelancer, short experience)* Yes, simply as cases. *Climate journalist (female, nationwide media, long experience)* Simply as cases, yes. *Climate journalist (male, freelancer, short experience) Group 3*	Well, can you use a citizen as expert? Let's say that an engineer or someone who is not a scientist, but who has read all the climate reports and has built an extensive knowledge about the climate. Can you use him as an expert? *(Moderator)* No, no. Unfortunately. *Climate journalist (male, nationwide media, long experience)* A citizen is an expert in being a citizen. *Citizen (neutral, female, 60s, early retiree) Group 11* Yes, you can ask the citizens: What is your experience? Well, that is a whole other thing than that you are generally supposed to have an opinion about everything. *Citizen (climate conscious, female, 50s, outdoor consultant) Group 14*

In climate science		
Climate scientists	**Climate journalists**	**Citizens**
But I think that it is a big problem if people start to speak about something that they don't know anything about. That pertains both to citizens and to us. So, if you start to come with absolute statements, ehm, with quantitative statements, ehm, then it is a problem, whether it regards the climate or, or what should you say, the natural scientific aspect of the climate or the societal. *Climate scientist (male, associate professor) Group 15* So, should we really expect … is it reasonable to expect that citizens are competent in terms of scientific questions? *(Moderator)* I think that the most important cue is that they must appreciate the importance of the research. *Climate scientist (male, professor) Group 6*	But I am a bit like … I don't know … Were you asking whether there should be an exchange between the citizen and the scientists? Because then I anyway doubt that some research project about the climate, ehm … At least if you are speaking about the development of climate models and that sort and examinations and treatment of data and so on, then I don't think that a major … *Climate journalist (male, freelancer, long experience) Group 2*	Well, but with regard to a field of research … Well, yes, well, it is not just for fun that you study for five years to learn something and then it is a bit too much if a citizen or a politician comes up and thinks he is much smarter. I think that is too provocative. *Citizen (climate sceptic, male, 60s, geological consultant)* Well, I also think that, that the scientists a bit – no, it may sound a bit stupid – kind of feed themselves, because they are in that environment […] *Citizen (neutral, female, 60s, pedagogue) Group 8* Well, I think that I have read about ice core, ehm, drillings and have watched films and think that … But I would never start to call myself anything approaching an expert. You need to be careful with such things. *Citizen (neutral, female, 50s, primary school teacher) Group 12*

Quality-assuring knowledge claims		
The traditional media as gatekeepers		
Climate scientists	**Climate journalists**	**Citizens**
We have good journalists in Denmark, who work with the climate professionally and who are not climate science experts, but who still know very much about the area, and they can, they can call a bluff. When somebody says something stupid, then they are able to pose some good counter-questions. *Climate scientist (male, associate professor) Group 4* So, journalists, they are interpreters. Have you also said mediators? *(Moderator)* They can also be critics. They can perform a kind of criticism and play us out against each other to a certain extent. Get more angles on the same thing. *Climate scientist (male, associate professor) Group 5*	What about something like curator, well? There is a lot of information that we discard. *Climate journalist (male, niche media, short experience)* […] Yes, yes. I also feel like saying something with navigating or something like that. *Climate journalist (male, niche media, short experience)* Yeah, yeah. *Climate journalist (female, nationwide media, long experience)* But, ehm, I can't exactly … I think curator is the best word really. *Climate journalist (male, niche media, short experience) Group 10* Must they [climate journalists] be experts? *(Moderator)* No! *Climate scientist (male, professor)* But they can be fact-checkers, as was mentioned earlier. We are actually supposed to be that. *Climate journalist (male, nationwide media, long experience) Group 11*	[…] I think that we are dependent on, well, we can't all go out and investigate and verify all the knowledge we are presented with. In that regard we need to trust that the people who are working *professionally* with these things and are really committed, together are able to create a picture that is so realistic that we can relate to it, because we don't have the ability to do that. *Citizen (neutral, male, 60s, priest) Group 9* But I will say the whole technology surrounding it, it has made it easier to write. It was far more cumbersome back in the day to write an opinion piece to a newspaper or something. Well, you, you … But that also means that people are much more inclined to do something without having any prior considerations. And there I think you have a great problem. *Citizen (neutral, female, 50s, primary school teacher) Group 12*

Alternative gatekeepers		
Climate scientists	**Climate journalists**	**Citizens**
And then again on the researcher side it will sometimes be appropriate that you should respond and do a fact check. *Climate scientist (male, professor) Group 11*		And, and, and our newspapers … as I understood it, was also part of the topic, well the media. They don't inform about it. They don't inform about data. They can show nice curves about stock prices and the oil price which rises, but to show data about how the climate has varied even just during the last 50,000 years or 800,000 years or half a billion years, that, that they cannot figure out and they don't want to. It is not because we are not able to. *Citizen (climate sceptic, male, 60s, geological consultant) Group 8* If a scientist is sitting privately and reading something which is nonsense in some newspaper, then he should contact the journalists and say that it is not right. Well, so in principle it should be the experts who do it, because the citizens do not know, do not have any foundation to, ehm, correct it. *Citizen (neutral, male, 20s, engineer) Group 14*

Chapter 7: Discussion

This chapter will discuss the results of the three papers included in this dissertation. While each paper comprises its own discussion, this chapter will employ a broader lens by considering the findings of the three studies in conjunction.

A crushed prospect of change

All three articles contained in this dissertation were motivated by the conjecture that the climate challenge could shake the conventions in the science–society interface. Whereas Article 1 and Article 2 were preoccupied with a prospective development in the configuration of the ideal roles of climate scientists, climate journalists, and citizens, Article 3 was stimulated by an assumption that the perceived relevance of different types of knowledge and gatekeepers in climate science communication could be shifting. Juxtaposing the results from the three studies, it is evident that they do little to nourish the anticipation that an upheaval in climate science communication is looming.

Scientific objectivity was one of the normative bastions that were believed to be under siege because of the post-normal conditions characterising climate science communication. Yet, the research of this dissertation finds little backing for this hypothesis. Article 1 implied that acceptance of scientific advocacy is mainly an emerging American phenomenon (Busch Nicolaisen, 2022b), and Article 2 unveiled a rather stark dismissal of prescriptive communication from climate scientists in the Danish setting (Busch Nicolaisen, 2022c). However, recent research published after the literature search for Article 1 was conducted invites another interpretation of the link between the two studies. By way of a cross-country survey of the attitude towards policy advocacy among German and American climate scientists and citizens, Cologna et al. substantiate that both groups of respondents in each country tend to agree that climate scientists should endorse climate-related policies (Cologna et al., 2021). This could mean that the conservatism regarding the role of climate scientists observed in Denmark is in fact more of an outlier than the American approval of advocacy detected in the literature review, which instead might be seen to herald a more extensive trend. At least, it is striking that climate scientists from a country with relatively low division on the climate question such as Germany (Metag et al., 2017, pp. 446–447) are more aligned with counterparts from the polarised American setting (Leiserowitz et al., 2021, p. 99) when it comes to scientific advocacy than they are with colleagues from a

neighbour state whose citizens have a similar high level of climate concern (CONCITO, 2022, p. 23).

The research of this dissertation also punctures the expectation that the rise of social media sites and user-generated content platforms will profoundly reshape the distribution of responsibility between the three actors, at least when the Danish context is considered. Even in an era where the public is not dependent on the traditional media to retrieve and sift through climate information, Article 3 attests that journalists remain the preferred gatekeepers (Busch Nicolaisen, 2022a). This finding is in harmony with other studies conducted on the public's outlook on journalistic gatekeeping in Scandinavian countries. In an investigation of citizens' views on the news media's function as gatekeepers during the COVID-19 crisis in Norway, Olsen et al. find that most of their respondents 'strongly agreed that it is important that news about the coronavirus pandemic is quality controlled by Norwegian journalists' (Olsen et al., 2022, p. 189). Furthermore, examining Swedish citizens' opinions on public participation in journalism via focus groups, Karlsson et al. conclude that the gatekeeping work of journalists is appreciated, while the authors were left with the overall impression 'that the respondents are happy to take a seat in the stands' (Karlsson et al., 2018, pp. 589–590).

The fact that journalists are still trusted with the responsibility for quality-assuring the public climate discussion might be a component in explaining why they are generally not expected to step further into the expert role as witnessed by Article 2 (Busch Nicolaisen, 2022c). There is thus no need to reinvent the journalistic profession by making climate journalists into quasi-scientists as the traditional preserve of the legacy media is not perceived to be especially threatened by the competition from alternative channels of science communication. The lack of a strong public demand for knowledge-based journalism adds to the list of obstacles hindering its implementation (van Witsen & Takahashi, 2018, pp. 720–723). For instance, Giannoulis et al. report that lack of scientific training is not perceived as a problem among environmental reporters (Giannoulis et al., 2010, p. 450), while Dunwoody and Griffin provide indications that journalism students would rather avoid statistics courses (Dunwoody & Griffin, 2013, p. 534).

The constraining and enabling effect of objectivity

The focus group discussions that provided the empirical basis for Article 2 and Article 3 revealed a noticeable duality connected to the journalistic norm of objectivity. Article 2 displayed the participants' hostility towards advocacy journalism and the sustained sway of the classic journalistic value of objectiv-

ity even under post-normal conditions. The insistence on neutrality was prevalent among all three segments of participants, not least among the climate journalists themselves. In relation to this, it is interesting to notice that one of the most well-consolidated discoveries of Article 3 was the continued significance of journalistic gatekeeping. It was evident that the trust that journalists were most fitted to fulfil this task was derived from the expectation that they would use certain professional standards in evaluating the knowledge claims stemming from different sources. Taken together, these two findings show how conforming to the objectivity norm both constrains and enables climate journalists. On the one hand, adhering to what Patterson calls the 'defining norm of modern journalism' (Patterson, 1998, p. 28) withholds them from stepping into the advocate role, but on the other, it helps them hold on to the gatekeeper function. What seems to transpire is a zero-sum game where the climate journalists are forced to choose between being gatekeepers and advocates as these two roles appear irreconcilable. The present thesis should not be credited for the discovery of the dichotomous relationship between the two roles, though. Nearly 50 years ago, Janowitz described 'the gatekeeper' and 'the advocate' as two competing models of journalism, emulating the scientific method and the legal profession, respectively (Janowitz, 1975, pp. 621, 626). In his view, the professional mission of the gatekeeper 'is to retain and develop essential concern with the inherent search for objectivity' to support 'the enlightenment of the mass public' (Janowitz, 1975, p. 626), while 'the advocate-journalist would like to relate to his clients in the role of the lawyer but in the setting of the mass media' (Janowitz, 1975, p. 621). Yet, the two roles are not of equal importance according to Janowitz as he deems gatekeeping 'the core task of journalism' and demotes the advocate role to be 'secondary' (Janowitz, 1975, p. 626).

This thesis is a testament that objectivity is still a cherished quality in journalists and that gatekeeping is continuously prioritised over advocacy almost half a century after Janowitz made this assertion. Taking other studies from the Danish context into account only reinforces this impression. Based on a survey among close to half the population of Danish journalists, Skovsgaard et al. find that they loyally obey the objectivity norm (Skovsgaard et al., 2012, 2013). More recent data show that almost two thirds of the Danish journalists surveyed perceived it as either 'extremely' or 'very' important to be a 'detached observer' (Skovsgaard & van Dalen, 2016, p. 2), while Hartley and Askanius describe how the 'entrenched objectivity norm' meant that much of the journalistic coverage of #MeToo in Denmark incorporated perspectives of men to attain a goal of 'balanced reporting' (Møller Hartley & Askanius, 2021, p. 866). Moreover, in an exploration of the public's attitude specifically towards cli-

mate journalism, Willig et al. conclude that the Danish audience to a large extent expects the media's climate coverage to resemble traditional journalism (Willig et al., 2022, p. 17). In their representative sample of Danish citizens, 56 percent of the respondents indicated that verification of information was a central function of climate journalists, whereas only 14 percent thought that the provision of guidance was vital (Willig et al., 2022, p. 12). Along with the research of this dissertation, Willig et al.'s study serves to dispute the assumption ingrained in post-normal science communication that climate journalism might become the Wild West of journalism where regular professional principles do not apply. Objectivity thus appears to stand its ground as a hallmark of journalism even in the face of the climate challenge.

Nonetheless, the vintage line of criticism levelled against the objectivity norm in journalism from a moral standpoint does not become any less potent in the context of climate change. In an opinion piece from 1984, Glasser claims that objectivity has:

> robbed journalists of their passion and their perspective [...] And most unfortunate of all, objective reporting has denied journalists their citizenship; as disinterested observers, as impartial reporters, journalists are expected to be morally disengaged and politically inactive (Glasser, 1984, p. 15).

In Glasser's opinion, 'objectivity in journalism is biased in favor of the status quo' (Glasser, 1984, p. 13). Bringing Glasser's perspective to bear on climate journalism, it could be argued that objectivity is morally questionable given the major societal transitions that most climate scientists consider necessary to successfully respond to the climate challenge (IPCC, 2022b). If Glasser is correct that objective journalism aids in upholding the current situation, it could thus be perceived as irresponsible to continue this practice in a time when drastic and urgent society-wide changes are called for. Siding with Glasser, Stoker maintains that objectivity 'relegates journalists to a subservient, spectator role in serving the public interest' (Stoker, 1995, p. 11). Instead of blindly following the traditional conventions of objective reporting, Stoker proposes that journalists adopt an existential approach to their metier. According to him, such a stance would position the journalist as 'an autonomous moral agent who can choose to promote the overall welfare and freedom of others' (Stoker, 1995, p. 12). Existential journalism requires the individual journalist to make an independent evaluation of which course of action he or she will pursue without contemplating the consequences (Stoker, 1995, pp. 13, 15). Only by disregarding the possible effects of one's actions can the existential ideal of authenticity be attained (Stoker, 1995, p. 14). From the perspective of existential journalism, a journalist concerned with the future development of the climate would be right to push for political climate action through his

or her coverage as this would simply be a way to achieve authenticity by being true to oneself. Notwithstanding, existential journalism does not offer journalists a carte blanche to promote their cause at any cost. It thus acknowledges the sacredness of facts as integrity is one of the key components of existential journalism (Stoker, 1995, p. 18).

Glasser and Stoker may not be particularly at odds with the modern interpretation of the objectivity norm in climate journalism after all. They would likely oppose the mechanistic equal interrogation of both sides of the climate argument – what Boykoff and Boykoff term 'balance as bias' – that has previously haunted climate journalism (M. T. Boykoff & Boykoff, 2004; Hiles & Hinnant, 2014, pp. 438–439). However, the contemporary understanding of objectivity in climate journalism would possibly be more digestible for traditional critics of the norm. As evinced by Hiles and Hinnant, climate journalists increasingly grant themselves the right to make independent evaluations of facts in their coverage while still self-identifying as objective reporters (Hiles & Hinnant, 2014, pp. 442, 445). Borrowing Daston and Galison's term (Daston & Galison, 2007), Fahy labels this concept of objectivity in climate journalism 'the application of trained judgement' (Fahy, 2017, 2018, p. 858). This image of objectivity was also prevalent among the participants of the focus groups of this dissertation.

The peculiar legitimacy of feelings

The objectivity theme reoccurs in the examination of the ideal role of climate scientists. Article 1 demonstrated the presence of a considerable span in the attitudes towards scientific advocacy depending on the context in question, predominantly among the climate scientists themselves. In contrast, Article 2 established the existence of a widespread dismissal of climate scientists' right to use activistic rhetoric in the Danish context of climate science communication. It nonetheless also revealed a somewhat surprising sympathy for the expression of emotions on the part of climate scientists communicating their research among all three actor types. During the focus group discussions, it was frequently noted that 'climate scientists are also human beings' and therefore entitled to articulate their feelings.

The fact that this view was not least manifested among the climate scientists runs contrary to other investigations of the link between climate science and emotions. In an interview-based study with Australian climate scientists, Head and Harada found that the interviewees sought to distance their emotions from their research. One of their participants described this as 'keeping the heart a long way from the brain' (Head & Harada, 2017). Likewise, in an analysis of IPCC's tendency to underpredict the impacts of climate change,

Brysse et al. suggest that the scientific norm of restraint is leading climate scientists to 'err on the side of least drama' (Brysse et al., 2013). They raise the concern that 'scientists who come across as "too emotional" or "too personal" may thus be taken to be "unscientific" by their peers' (Brysse et al., 2013, p. 335). This worry taps into the traditional view of emotionality being associated with 'intellectual inferiority, irrationality, weakness and submissivity' (Fischer, 1993, p. 304). Using Kahneman's distinction between 'System 1' and 'System 2' thinking (Kahneman, 2011), Kahan remarks that scientists traditionally have been perceived to make sense of risks using the latter mode of cognition, which is conscious and reasoned, while the public has been thought to employ the affect-driven System 1 to make risk assessments (Kahan, 2014, p. 205). The findings of this thesis indicate that the supposed opposition between the ideals of science and emotional communication might be dissolving.

Climate change has been labelled one of the most emotionally loaded matters of all time (Mosquera & Jylhä, 2022, p. 357), and as argued by Head and Harada, climate scientists find themselves in the eye of the storm as 'they experience the intensity of the issues and debates on a day to day basis' (Head & Harada, 2017, p. 35), see also (Clayton, 2018, p. 260). However, as scholars have only recently begun inquiring into the mental effect of working within climate science, little is known about the topic at this point (Clayton, 2018; Renouf, 2021, p. 14). Duggan's web-based initiative 'Is This How You Feel?' (Duggan, n.d.) provides some anecdotal evidence on the psychological consequences of being a climate scientist. From 2014 to 2020, Duggan collected hand-written letters from 50 climate scientists out of which 23 contributed a second letter approximately five years after the first (Duggan et al., 2021, p. e854). Upon conducting a thematic coding of the letters, Duggan determined that there was a heavy overrepresentation of negative sentiments such as anger, anxiety, and distress in the content (Duggan et al., 2021, p. e854).

The focus group discussion on the appropriateness of climate scientists communicating emotions in relation to their research also centred on feelings like anxiety and worry. This may, nevertheless, be a consequence of the stimuli material, which specifically asked the participants to consider the suitability of voicing concern for your grandchildren as a climate scientist. It is an open question whether the difference in the emphasis placed on the passions of climate scientists when comparing the Danish case study to the results from the review is a consequence of the focus group moderation or if emotional communication is genuinely foregrounded in Denmark. Furthermore, it remains unsettled whether the license to express emotions only applies to negative feelings or if it would also be rendered apt for climate scientists to convey hope, for example. Mosquera and Jylhä posit that climate emotions have been

'normativised' in the sense that increasing focus has been directed at how people ought to feel about climate change (Mosquera & Jylhä, 2022, p. 358). They argue that it is not given that hope is deemed an acceptable emotion in relation to climate change as it can be seen as unfitting due to the dire and uncertain prospects of the future climate. For instance, at the 2019 World Economic Forum, Greta Thunberg rejected hope as an appropriate feeling in relation to climate change:

> I don't want your hope. I don't want you to be hopeful. I want you to panic. I want you to feel the fear I feel every day. (Greta Thunberg, January 25th, 2019, World Economic Forum)

A strand of research has examined the effect of different types of emotional messages on climate risk perceptions and support for political action (Brosch, 2021; Moser, 2016, p. 350). However, these inquiries have not produced a clear answer as to what constitutes the most effective form of climate communication. One camp of studies cautions against the use of fear-inducing emotional appeals as these are found to lead to apathy (O'Neill & Nicholson-Cole, 2009a) and climate scepticism (Feinberg & Willer, 2011) on the part of the receiver along with reduced motivation for engaging in mitigative behaviour (Feinberg & Willer, 2011; Rapley et al., 2014, p. 60). In line with these findings, scholars have promoted a hope-generating framing of the climate risk (Ojala, 2012; Roeser, 2012a). Yet, the potency of hopeful climate messages has been questioned on the grounds that it might lead to complacency (Hornsey & Fielding, 2016, p. 27, 2020, p. 24), and instead, the utilisation of fear-based communication is endorsed as this is found to result in higher levels of efficacy (Hornsey et al., 2015, p. 60). This correlation is hypothesised to be a consequence of the mechanism of 'motivated control', i.e., 'people imagining control and efficacy as a palliative measure to tamp down anxiety associated with an objectively difficult-to-control global threat' (Hornsey & Fielding, 2020, p. 24). Due to the uncertainty related to the impact of emotional appeal in climate communication, Chapman et al. recommend that vigilance is exerted when prescribing emotion-based communication strategies, while they simultaneously recognise the large potential of such approaches (Chapman et al., 2017, p. 852).

The neglected, contested, and limited role of citizens

With respect to the ideal role of citizens in climate science communication, Article 1 revealed the extant literature's meagre involvement with the subject. Further, the focus group discussions underpinning Article 2 and Article 3 exposed that the expectation towards the public's engagement with climate science information varied across the participants, although they generally

acknowledged that non-scientists could deliver qualified input to scientific debates. However, experiential input was primarily judged as valuable within solution-oriented research fields. Overall, the dissertation testifies to the dearth of studies on the ideal role of the public in climate science communication while providing evidence that the character of the model citizen is disputed and that the relevance of experiential knowledge is restricted.

While highlighting the negligence of the ideal role of citizens in climate science communication, it is nevertheless important to specify that the available scholarship has not ignored the public altogether. However, these examinations usually approach the study of the public in climate science communication from quite a different angle than the one pursued in this dissertation. The standard operating procedure in much empirical research within this field is to conduct experiments measuring the effect of given interventions on a variety of climate-related attitudes. Scholars have followed this recipe to analyse how communication of consensus messages influence climate change beliefs (Bolsen et al., 2014; Bolsen & Druckman, 2018; Myers et al., 2015) and consensus beliefs (Goldberg et al., 2019; Myers et al., 2015); how exposure to conspiracy theories impacts consensus beliefs and pro-environmental behaviours (van der Linden, 2015); how priming messages about geoengineering influence climate concern (Kahan et al., 2015); and how dissonant climate science messages affect institutional trust (E. C. Nisbet et al., 2015). What unites all these investigations is the conceptualisation of the public as an audience. While this type of lab-like inquiries can tell us something about how different kinds of communicative approaches can help achieve certain ends, it does not afford insight into how the public envisions its proper position in the ecosystem of climate science communication. They therefore leave the question of whether citizens accept being mere spectators open. As reported in Article 1, very few studies have interrogated the role of citizens with a normative inclination, and among the ones that do, it was usually only a minor priority (Busch Nicolaisen, 2022b).

The lack of normatively oriented empirical studies about the public's role in climate science communication stands in stark contrast to the wealth of opinion-based articulations on the need for further public engagement by climate scientists (Anderegg, 2010; Hulme & Ravetz, 2009; Jasanoff, 2010; Mann, 2014; Oreskes, 2020; Rapley et al., 2014) that chime with the insistent endorsements of further coupling of science and society in general (Gibbons, 1999; Leshner, 2003; Lubchenco, 2017; Shugarta & Racaniello, 2015). These calls appear to assume that citizens per default want to be involved with science. The self-evident nature of this presupposition has, nonetheless, been objected (Einsiedel, 2000, p. 211, 2007, p. 5; Felt, 2000, p. 13; Felt & Fochler, 2008, p. 489), and the findings presented in this dissertation corroborate this

challenge. A desire to be further included in discussions of climate science was not universally conveyed by the citizens in the focus groups. Indeed, the fact that citizens would not per se appreciate an invitation to be further engaged with science also seems to hold true outside of climatology. Based on a focus group study of different stakeholders' attitudes towards the communicative aspects of the public–science relationship in relation to biotechnology and genomics in the Netherlands, Dijkstra and Gutteling conclude that citizens are not always interested in engaging in dialogical communication about these subjects and that one-way communication processes in some cases suffice (Dijkstra & Gutteling, 2012, p. 386). According to them, 'contrary to the often assumed expectation that people will participate at large – engagement of the public is not always possible or necessary' (Dijkstra & Gutteling, 2012, p. 386). Similarly, assessing Belgian citizens' sentiments towards participation in research on nuclear installations via survey methodology, Turcanu et al. demonstrate that almost one third of their respondents did not intend to take part in engagement activities (Turcanu et al., 2014, p. 338).

Large-scale survey data from a variety of contexts serve to further question the assumption about an automatically engagement-eager public. Eurobarometer data affirm that nearly 60 percent of respondents think that the public should not participate in decision-making about science and technology, while less than half talk about science or technology-related issues with family or friends (European Commission Directorate-General for Communication, 2021, pp. 59, 68). Similarly, Australian data from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) show that 'people who are either not engaged or uninterested in science make up around 40 percent of the population' (Cormick, 2019, p. 30). Moreover, 28 percent of Britons are not interested in being involved in decision-making about science issues, and 41 percent like the idea of public participation but do not want to pitch in personally (Department for Business Energy & Industrial Strategy, 2020, p. 80). Considering the discrepancy between the ideal thinking about public involvement in science in scholarly circles and the de facto wishes of citizens, Mejlgaard and Stares' suggestion to include so-called preferred participation as a parameter in analyses of public engagement activities comes off as sensible (Mejlgaard & Stares, 2012, p. 662).

While an appetite for being involved is a necessary condition for public engagement with climate science, it alone is insufficient. According to Rowe and Frewer, full-blown engagement entails a reciprocal stream of information between climate science and society (Rowe & Frewer, 2005, p. 255). The contributory potential of citizens is hence an essential factor to bear in mind when assessing the feasibility of further public inclusion in the societal climate dis-

cussion. The focus groups of this dissertation uncovered that the citizens generally perceived their ability to enrich scientific debates to be topic dependent. This view corresponds to Callon's assertion, who – much along the same lines as Collins and Evans – maintains that no single scheme of public participation will fit all scientific disciplines (Callon, 1999, pp. 93–94). Distinguishing between three different models of public participation (the Public Education Model, the Public Debate Model, and the Co-production of Knowledge Model) varying in their level of lay involvement, Callon argues that endeavours like particle physics do not lend themselves to fraternisation with the public, while research related to the environment, health, or food safety invites a more active presence from non-scientists (Callon, 1999, pp. 93–94).

A couple of rather recent studies cast some empirical light on whether citizens' engagement with climate science is already directed towards the niches of climate science where they supposedly would be able to make the biggest impact. In a Twitter-based investigation, Haunschild et al. show that the public is more attentive to scientific work devoted to climate forecasts, the consequences of a changing climate, and issues related to adaptation and mitigation than it is to scientific work on climatologic methodology and the causes of climate change (Haunschild et al., 2019, pp. 701–702). Nonetheless, a content analysis of expert blogs, newspaper articles, and reader comments from Germany attests that citizens infrequently mention the causes and consequences of climate change as well as mitigation and adaptation measures and that they are as disinclined to discuss the latter two subjects as the former pair in their posts (Lörcher & Taddicken, 2017, p. 11). The signals from these inquiries are mixed as the findings stemming from the Twitter data signify a topical selectivity from the public that matches Callon's contention, whereas Lörcher and Taddicken's content analysis does not imply any pattern of discrimination.

Like Callon, Turner is in agreement with the citizens and climate scientists from the focus groups of this dissertation who claimed that more esoteric types of climate science are best served by minimal public interference. Speaking about the position of expertise in liberal democracies, he warns about treating science as 'an analogue to political decision-making':

> 'Politicizing everything' […] would lose the advantages of the intellectual division of labour and make reasoned persuasion impossible. Some facts need to be taken for granted in order for there to be genuine political discussion, and some of the work of establishing the facts is, properly, delegated to experts (Turner, 2001, p. 144).

Turner does not hold scientists' privilege to define certain questions based on their cognitive authority to be democratically problematic. He thus insists that the public is never reduced to mere 'recipients of science and the prejudices

and errors of scientists' since scientific experts continuously need public legitimation to uphold this cognitive authority (Turner, 2001, pp. 141–142). If a scientist loses credibility in the eye of the public, his or her expert status will plummet. While Turner's thoughts are primarily intended for a political context, they also seem useful regarding public discussions of inaccessible scientific issues like the ones found within certain disciplines of climate science. In the highly responsive and lush media environment of today, citizens hence have ample opportunity to express their disavowal of certain scientists or try to seek out media outlets with a different cast of experts. This could, for example, become relevant if climate scientists cross the red line of advocacy that Article 1 reveals the existence of in a variety of contexts (Busch Nicolaisen, 2022b) and which Article 2 undoubtedly finds to be present in Denmark (Busch Nicolaisen, 2022c). So, while they may not be able to speak about all subjects, citizens will possibly be able to steer the allocation of cognitive authority. In this way, it might not always be a matter of speaking and listening but also of silencing.

Chapter 5: Conclusion

In this concluding chapter, I will present the primary findings of this dissertation and draw out their overall implications. As a final measure, I will highlight the most significant contributions of my work and map out interesting avenues for future research.

The gist of the dissertation

One of the main ambitions of the dissertation was to examine the ideal role perceptions of climate scientists, climate journalists, and citizens.

By way of reviewing the extant literature connected to the three ideal roles, Article 1 demonstrated that the actors are aligned in their attitudes towards the roles of climate scientists and climate journalists as these are still understood in rather traditional terms. The thematic rendering of the existing research revealed that advocacy was a focal point regarding both roles. Generally, prescriptive communication was deemed inappropriate for both climate scientists and climate journalists, although a couple of recent studies found American climate scientists to be more accepting of scientific advocacy. The overall picture of the ideal role of climate scientists was that of a public service provider as they were expected to make themselves available to the wider society, whereas climate journalists were imagined to be curators of scientific information by all three segments. With respect to the ideal role of citizens, the review lay bare the shortage of research concentrating on this question. In the few studies preoccupied with citizens, the emphasis was on their scientific competence, and they were thus cast in the role as mere receivers of scientific information.

The focus group data underlying Article 2 reinforced the impression that the roles of climate scientists and climate journalists are still conceived of in a chiefly orthodox manner. There was near unanimity that climate scientists should engage with the public, while some representatives from all three segments claimed that climatologists have a special responsibility to reach out due to the high-stakes and urgency of the climate challenge. However, the focus group data was testament to a marked agreement that climate scientists should refrain from advocacy, mimicking the general tendency noticed in the review. Another central finding related to the role of climate scientists was the noticeable approval of their right to publicly state the emotions that their research evokes in them. Turning to the role of climate journalists, they were expected to be knowledgeable about climate science, albeit not to an extent

where they could take on an expert role. Like the climate scientists, the climate journalists were also not supposed to partake in advocacy as activistic discourses in climate journalism were condemned. While there was a level of agreement about the roles of climate scientists and climate journalists, the proper role of citizens was disputed. Although the proper information-seeking behaviour of citizens was highly divisive, the apt degree of public involvement in climate science communication was similarly subject to some disagreement. However, this contestation was largely lacking discernible patterns as a sweeping divergence in the attitudes towards the role of citizens was evident within each actor segment.

A second goal of the dissertation was to empirically probe how the relevance of scientific and experiential knowledge in the public climate debate is perceived by the three actor groups.

Article 3 set out to explore this concern by investigating the focus group material used in Article 2 with an alternative analytical optic. This effort showed that the knowledge produced by climate science was commonly assessed to be certain but also to have a limited span of applicability. Climate scientists were, therefore, seen as important contributors in the public climate discussion, but only if they commented on subjects within their own niche of research. This position was pervasive in all three groups of actors. In relation to the significance of experiential knowledge, Article 3 attested to a contingent view on its pertinence in the societal deliberation of climate-related matters. Input from citizens was hence considered germane in connection to debates pertaining to applied fields of research, whereas it was adjudged trivial regarding more esoteric topics.

A third objective of the project was to examine who the actors think should ensure the quality of the knowledge claims put forth in the public climate deliberation.

Drawing on the focus group data, Article 3 provided resounding backing for the continued importance of traditional media as gatekeepers. The journalistic professional ethos was thus understood as the most effective antidote against the spread of misinformation by most of the focus group participants. However, a contrary current was traced among the climate sceptic participants as they saw the legacy media as one of the main sources of misinformation, and they therefore thought that the citizens themselves should do the quality assurance of the knowledge claims.

When contemplating the results of the three articles in tandem, a coherent image of stasis emerges. It is obvious that the suspected meteoric ability of the climate challenge to fundamentally rearrange the existing order in the universe of science communication has gained little support. The orbits of scientists, journalists, and citizens seem little affected by the supposed post-normal

character of climate science. Notwithstanding the pressing need for concerted action to halt greenhouse gas emissions, neutrality is still the golden standard for climate scientists and climate journalists. The professional norms connected to both vocations seem to rule out that either position can be utilised to affect politics. An additional example of the rigidness of the customs is that journalists are trusted as the primary gatekeepers of the societal climate debate even after new communication platforms have facilitated an unmediated public sphere. In further keeping with tradition, scientific knowledge is held in high esteem. Moreover, while some of the findings indicate that citizens might be ascribed a more active role in climate science communication than what they have conventionally been afforded, there are also clear limitations to their participation as the experiential input they can deliver is perceived to have restricted applicability.

Yields for several fields

From a theoretical perspective, the results presented above can provide impetus to discussions within various research fields.

One of this dissertation's major contributions is its introduction of a more holistic empirical approach to the study of climate science communication than what has been achieved by the extant literature. A considerable pool of studies has investigated how climate scientists and climate journalist perceive their roles, but little research has interrogated the reciprocal aspect of the roles in the climate science–media–public interface. Although the triadic perspective presented in this dissertation only amounts to a simplified version of the complex ecosystem of climate science communication, it nevertheless offers a more comprehensive way of conceiving of the subject than the usual single actor research designs. The research of this dissertation serves to illustrate that climate science communication does not occur in a void and that it is necessary to be aware of the actors' mutual expectations.

Post-normal science is a recurrent theme in all three articles, and in different ways, their outcomes reflect on the theory. Article 1 and Article 2 empirically assess the theory's relevance for the roles of climate scientists, climate journalists, and citizens, while Article 3 addresses an alleged Achilles heel of post-normal science: 'the vagueness' surrounding the realisation of the extended peer community (Collins and Evans 2002, 282; Yearley 2000, 110). The dissertation also informs ongoing discussions in the field of public understanding of science. In recent decades, much scholarly attention within this domain has been directed at more dialogical approaches to science communication (Bauer et al., 2007; Irwin, 2014), and a renegotiation of the authority of non-scientific forms of knowledge has been urged (Irwin et al., 1999, p.

1323). The results contained in the dissertation are highly pertinent in this regard as they provide an empirical testament to how scientific and experiential knowledge are evaluated in connection to a specific subject, namely the climate. Moreover, scholars have speculated that mediation from science journalists might become obsolete following the advent of social media (Bucchi, 2017, p. 891; Dunwoody, 2014, p. 27). The findings from Article 3 feed into this debate by emphasising the continued justification for journalistic gatekeeping in the digital age.

As documented by Article 1, the role of citizens in climate science communication is largely a blind spot in the existing literature. Another original facet of my work is therefore to provide insights into what is expected of citizens in terms of their involvement in the public debate on climate science by themselves as well as by climate scientists and climate journalists. By filling this void, the dissertation supplies empirical stimulus to the wave of scholarship occupied with the concept of scientific citizenship as well (Árnason, 2013; Blue & Medlock, 2014; Marks, 2014).

Additionally, by displaying an extensive amount of championship for climate scientists' right to express personal feelings related to their work among all three actor types, the dissertation provides input to the literature within science communication research that has focused on the role of emotions in climate change communication (Chapman et al., 2017; Gustafson et al., 2020; Myers et al., 2012; Nabi et al., 2018; O'Neill & Nicholson-Cole, 2009b; Roeser, 2012b).

A separate key contribution of this dissertation is methodological as focus groups have rarely been utilised to study climate science communication. By applying focus group methodology, the dissertation has been able to deliver a rare breed of data, namely first-hand evidence on the social negotiation of climate science communication's conventions. Further, the heterogeneous focus groups provide an independent contribution to the literature on focus group research. In the canon pertaining to the conduction of focus groups, it has often been stressed that heterogeneity may hamper the group dynamic (R. S. Barbour & Morgan, 2017, p. 416; Halkier, 2016, p. 31; Krueger & Casey, 2009, p. 67). However, the focus group-based studies of this dissertation demonstrate that creating focus groups with participants from very diverse backgrounds can foster a fruitful discussion. Although the participants hailed from different echelons of society, the potential power discrepancy did not impact the proceedings in a negative fashion. Instead, the mixed focus groups facilitated a productive juxtaposition of the viewpoints found in the different segments of actors.

Real world relevance

Aside from the findings' theoretical and methodological ramifications, they imply a range of practical implications too. I will highlight the most important ones in the following.

More so in the Danish context than anywhere else, the results of this dissertation can be taken as a guideline for how climate scientists should communicate their research and how climate journalists should cover their beat. This is due to the extensive agreement among the three actor groups about the principles that should direct the communicative behaviour of climate scientists and climate journalists.

Accordingly, aspiring climate scientists can draw on this dissertation to be made aware that they are counted on to be available to the public via the media. The findings also serve to warn them about the risk of being frowned upon by their peers and large parts of the citizenry if they take up policy advocacy. On top of that, they can lean on the insights of this dissertation to be reassured that they are on safe ground if they feel disposed to state the worry or anxiety their research might invoke in them. Nevertheless, the area of applicability for this code of conduct may be quite confined since Article 1 shows that a different set of norms regarding scientific advocacy is gaining momentum in the United States. Moreover, new research observes the rise of a similar tide in Germany (Cologna et al., 2021).

Practitioners of climate journalism can likewise use the evidence of this dissertation as a means of navigation. Essentially, it instructs them to stick to the beaten path of their profession if they are to fulfil the expectations of their colleagues, sources, and audiences. They should become neither experts nor advocates. In contrast to the commandments that could be extracted for climate scientists based on this research, the etiquette for climate journalists appears to have a more universal scope as the outcome of the Danish case study mirrors the results of the review vis-à-vis the ideal role of the media in climate science communication.

Shifting to an institutional focus, it is striking that both the literature review and the focus group study showed that interacting with the public is seen as a vital part of climate scientists' role by all three actors. It therefore seems essential that academic establishments prepare aspiring climatologists for outreach activities by providing them with communication courses and media training. During the focus groups, some climate scientists stated that they shied away from the media because they felt unequipped to deal with journalists. Further, several climate scientists remarked that it is time-consuming to engage with the public. It is therefore worth considering allocating time in the work portfolios of climate scientists for media appearances and other types of

public engagement and possibly also to include such activities in the assessment and promotion criteria alongside the quality and quantity of their teaching and research.

Another point worth noticing is that the focus group participants did not view social media as an alternative to traditional media but rather as a supplement (Busch Nicolaisen, 2022a). However, as declared by a climate journalist during one of the focus groups, people tend to forget that journalism is not for free. A requisite for the continued existence of legacy media is the audiences' willingness to pay for their products. The acknowledged need for journalism in a time when most legacy media struggle financially seems to support a model like the Danish with wholly or partly state-subsidised media.

Finally, in Article 2, the ideal role of citizens was portrayed as that of active participants in the public discussion of climate science, while Article 3 disclosed the high value placed on experiential knowledge in terms of the solution-oriented part of the climate debate. Nevertheless, several citizens expressed that they lacked an outlet where they could share their experiences. It therefore seems warranted to ponder the possibility of creating formal channels that could allow citizens to feed their experiential knowledge into the climate debate.

Paths for future research

As recounted in Chapter 1, this research project was fuelled by my desire to answer what I perceived to be some of the most pressing unresolved questions in climate science communication. At the end of this quest, I have a far better understanding of the continued need for professional climate journalism, the legitimacy of scientific advocacy, and the role of citizens. Yet, while I have undoubtedly attained a higher degree of sophistication on the subject, I feel approximately as ignorant as I did at the outset. New conundrums that could fertilise subsequent academic endeavours have appeared at the same pace as my work with this dissertation has enabled me to straighten out puzzles.

A stimulating line of research would be to pursue some of the same research interests in a different context – preferably one heavily diverging from the Danish regarding the climate question, such as the United States. In relation to the findings presented in Article 2, it is, for instance, noteworthy that a recent survey-based study included in Article 1 has shown that American climate scientists perceive scientific advocacy to be permissible (M. Boykoff & Oonk, 2020). On the backdrop of this result, it would be fruitful to conduct a focus group study with a research design akin to the one I have employed to better understand why climate scientists in the United States see advocacy as permissible. Further, such a study would help to ascertain whether American

citizens and climate journalists hold a similar view on the role of climate scientists. It could similarly be worthwhile to study how the quality assurance of the public debate is perceived under more media-sceptic and polarised circumstances such as those found in the United States (Leiserowitz et al., 2021, p. 99; Newman et al., 2021, p. 19). In that case, it would be fascinating to probe if the likely devaluation of journalistic gatekeeping would translate into a more positive appraisal of the unmediated debate than was found in the Danish case.

However, as pointed out by Article 1, the prevailing research on ideal role perceptions in climate science communication is already marked by a distinct Western slant. I therefore concurrently propose that future scholarship should focus more on countries outside Europe and Northern America. The need for an increase in the attention span of climate communication scholars is corroborated by the work of Schäfer and Painter as they find that current knowledge on climate journalism is modest when it comes to Asia and slight with respect to Africa and Latin America (M. S. Schäfer & Painter, 2020, p. 14).

Another compelling path for future studies would be to adjust the research focus in a more policy-oriented direction. Specifically, this could be done by exploring how different political actors such as politicians, government officials, and NGOs perceive the usefulness of experiential knowledge in the process of developing new climate policies. This agenda seems particularly topical because Ireland, the United Kingdom, and Denmark have recently established citizen climate assemblies, which are supposed to deliver recommendations for prospective climate legislation (Danish Ministry of Climate Energy and Utilities, 2020; Devaney et al., 2020; House of Commons, 2020).

Based on the results of this dissertation, I also suggest that future research explores the boundaries of affective communication from climate scientists. As part of a general examination of the role of climate scientists, Article 2 displayed a far-reaching acceptance of their prerogative to convey concern when communicating their research. However, it could be intriguing to instigate a research project that focused narrowly on the emotional ingredient to understand the specificities connected to its rightful usage. Such a study could set out to discover whether climate scientists have a carte blanche to announce their worry or if it is only tolerated within certain limits.

Furthermore, the research presented in this dissertation could be followed up by examining how the ideal role prescriptions discussed in Article 1 and Article 2 compare to the enactment of the roles. One way of pursuing this aim would be through an ethnographic approach. For instance, future research could use ethnography to explore the production of climate journalism. Re-

garding journalism at large, Mellado and Van Dalen have shown that journalists' role conceptions may diverge significantly from how journalism is practiced (Mellado & van Dalen, 2014). By gaining access to the engine room of climate journalism, it would be possible to observe whether a similar discrepancy exists here.

Summary

Populations and decision-makers worldwide recognise anthropogenic climate change as one of the most pressing challenges of our time. This realisation stems from climate science, which has pointed at the likely detrimental effects of an increased atmospheric level of greenhouse gases for decades. With a certain delay, the leading discourse in climate science has thus gained prominence in the public debate. Ahead awaits a task that is at least as big: transforming the consciousness of the human component in the changing climate into action. Science's largely unanimous message is that global CO_2 emissions ought to be lowered significantly if future societies are not to be plagued by rising sea levels, increased drought, intensified famines, more wildfires, and other potential consequences of a radically changed climate. This effort requires continuous exchange between climate science and the wider society. It is this interaction that takes centre stage in this dissertation. Specifically, I examine the relationship between climate scientists, climate journalists, and citizens.

A central theme in the dissertation is the role perceptions of the three actors. In the scientific literature, a theory has suggested that scientists, journalists, and citizens will step out of their traditional roles and into new functions when it comes to so-called post-normal topics. This concept refers to scientific questions that, like climate change, are characterised by uncertainty, disputed values, high stakes, and urgency. Under such circumstances, the theory, for instance, expects that scientists and journalists would be inclined to disregard the objectivity norm that has formed both professions and instead increasingly act in an activistic fashion. According to the theory, this shift would be instigated by the high stakes and the need for acute decision-making. In relation to the journalist role, it has also been argued that improved scientific competence in the individual journalist is needed to cover the climate beat satisfactorily. This means that the journalists should approach the knowledge level of the scientists to be able to act as experts in the field. In the theory on post-normal science communication, it is further expected that citizens will cease being passive recipients of scientific information and become active participants in the public discussion of the climate question aided by web-based communication platforms.

One of this dissertation's main ambitions has been to probe whether the theoretical assumptions about a reconfiguration of the three roles resonate with the actors' perceptions of their own role and that of each other. Two out of the three studies included in the dissertation pursue this aim, but they do so by different means. The first study reviews the existing scientific literature

on the subject to assess how the three roles have been described in empirical studies from different periods and national contexts. This approach makes it possible to discern temporal and geographical patterns. It shows that the view on the roles of climate scientists and climate journalists has been rather stable over time and place and that the three actors largely agree on what the two roles should encompass. The prevailing research on the subject determines that climate scientists are expected to be available to the public, while most studies indicate that it is inappropriate for them to weave in policy recommendations when they convey their research. Likewise, the academic literature bears witness that climate journalists are expected to provide politically neutral coverage of their beat. However, they must be able to distinguish between good and poor research on behalf of their readers. Moreover, the investigation reveals that scholars have hitherto dedicated very sparse attention to the role of citizens in climate science communication. The dissertation´s other role-oriented study is based on fifteen focus groups with Danish climate scientists, climate journalists, and citizens. In the focus groups, the three roles were discussed in various settings as some groups consisted exclusively of one actor type while others comprised representatives of each segment. Along the lines of the literature review, the study demonstrates that the actors generally subscribe to a conventional notion of the roles of climate scientists and climate journalists. Accordingly, activistic communication is frowned upon for both professions. At the same time, the participants do not prefer that the climate journalists take on a role as experts. An interesting finding nonetheless is the widespread acceptance of climate scientists' right to express worry when communicating their findings. The citizen role is more contested. Not even within the respective segments of actors does any consensus materialise whether, for instance, citizens ought to actively seek to keep informed about the climate issue.

The third study is based on the same data as the previous, but it has a separate analytical focus. Rather than focusing on specific roles, it examines how the actor's perceive the value of different kinds of knowledge in the climate debate and who can effectively ensure the quality of this knowledge when dispersed publicly. This study is also tasked with exploring whether theoretical ideas are anchored in reality. In the scientific literature, there has been a longstanding resistance towards the classic one-way approach to science communication where the sole aim is to feed citizens with scientific knowledge through a unidirectional information stream from the scientists to the public. It has thus been asserted that scientific knowledge should not be placed on a pedestal. According to this wave of scholarship, the experience-based knowledge of citizens should be further included in discussions of scientific topics, not least climate change. Other scholars have warned that the days

where journalists guaranteed a certain standard in the public exchange of knowledge claims could be numbered due to the competition from social media. However, the focus group discussions do not signify that a revolution is looming. The overall picture is that the actors regard scientific knowledge as certain albeit narrow. Consequently, there is a pronounced agreement that climate scientists should only speak about their own research field when they appear in the media. With respect to experience-based knowledge, the actors perceive its relevance to be highly topic dependent. Citizen input is seen as valuable in applied fields but of little use regarding more technical questions. Additionally, the study backs the need for journalistic gatekeeping as the three actors in general agree that the quality in the public climate debate is best preserved with the traditional media at the helm.

This dissertation contributes to the scientific literature on climate science communication in several ways. It empirically examines a range of hitherto untried theoretical predictions regarding the climate question's potential to change the ground rules of science communication. Overall, the three articles of the dissertation show that a break with the norm is not imminent. This appears to a high extent to be a cross-country trend. However, by zooming in on Denmark, the dissertation provides an especially forceful testament that the status quo is not endangered here. Because extant scholarship within the field has typically studied the three actor types separately, the dissertation's three-dimensional perspective contributes by advancing the understanding of their mutual expectations. Furthermore, the dissertation illuminates a subject neglected in current research, namely the role of citizens in the communication of climate science.

Resumé

Befolkninger og beslutningstagere verden over anerkender i vid udstrækning menneskeskabte klimaforandringer som en af nutidens største udfordringer. Denne erkendelse stammer fra klimaforskningen, som i årtier har påpeget de mulige ødelæggende konsekvenser af et øget niveau af drivhusgasser i atmosfæren. Med en vis forsinkelse er det dermed lykkedes den herskende diskurs i klimaforskningen at vinde fodfæste i den offentlige debat. Forude ligger dog en mindst lige så stor opgave: at omsætte bevidstheden om menneskets andel i det forandrende klima til handling. Videnskabens nærmest enstemmige budskab er, at det globale CO_2-udslip skal nedsættes væsentligt, hvis fremtidens samfund ikke skal hærges af stigende vandstande, mere tørke, øget hungersnød, flere skovbrande og andre potentielle bivirkninger af et radikalt ændret klima. Denne indsats kræver et vedvarende samspil mellem klimaforskningen og det øvrige samfund. Det er netop denne interaktion, der er i centrum i denne afhandling. Mere specifikt undersøger den forholdet mellem klimaforskere, klimajournalister og borgere.

Et centralt tema i afhandlingen er de tre aktørers rolleopfattelser. I den videnskabelige litteratur er der blevet fremsat en teori om, at forskere, journalister og borgere vil bryde ud af deres vante roller og træde ind i nye funktioner, når det gælder såkaldt post-normale forskningsemner. Det vil sige forskningsspørgsmål, der som klimaet er præget af usikkerhed, omdiskuterede værdier, behov for akut handling og høj risiko. I disse tilfælde forventer denne teori, at forskere og journalister vil være tilbøjelige til at se bort fra den norm om objektivitet, der har formet begge professioner, og i stedet i stigende grad agere aktivistisk. Dette eventuelle skift vil ifølge teorien være drevet af de omfattende skadevirkninger ved klimaforandringer samt behovet for hurtig politisk handling. I forhold til journalistrollen er der desuden blevet argumenteret for, at en øget videnskabelig kompetence hos den enkelte journalist er nødvendig for at kunne dække klimastoffet på tilfredsstillende vis. Journalister skal med andre ord nærme sig forskernes vidensniveau for at kunne agere eksperter på området. Teorien om post-normal forskningskommunikation forventer samtidig, at borgerne vil gå fra at være passive modtagere af videnskabelig information til at blive aktive deltagere i den offentlige debat om klimaforskningen hjulpet på vej af webbaserede kommunikationsplatforme.

En af afhandlingens primære ambitioner har været at efterprøve, hvorvidt de teoretiske antagelser om de tre rollers re-definition kan genfindes i aktørernes opfattelser af deres egne og hinandens ideelle roller. To af afhandlingens tre studier har på hver deres måde forfulgt dette mål. Det første studie gennemgår eksisterende videnskabelig litteratur på området for at belyse,

hvordan de tre roller er blevet beskrevet i empiriske studier fra forskellige perioder og nationale kontekster. Denne tilgang gør det muligt at identificere tidslige og geografiske mønstre. Det viser sig, at opfattelsen af klimaforskernes og klimajournalisternes roller har været ret stabil over tid og sted, og at de tre aktører i høj grad er enige om, hvad de to roller ideelt bør indebære. Den hidtidige forskning på området fastslår, at klimaforskere forventes at stå til rådighed for offentligheden, mens de fleste studier peger på, at det bliver anset som upassende for dem at blande politiske anbefalinger ind i deres forskningsformidling. På samme måde vidner forskningslitteraturen om, at klimajournalister forventes at dække deres stofområde på politisk neutral vis. Til gengæld skal de på læsernes vegne være i stand til at sondre mellem god og dårlig forskning. Undersøgelsen afslører desuden, at den hidtidige forskning har kastet begrænset lys på borgernes rolle i kommunikationen af klimaforskningen. Afhandlingens andet rolleorienterede studie baserer sig på femten fokusgruppeinterviews med danske klimaforskere, klimajournalister og borgere. Her blev de tre roller diskuteret under forskellige gruppesammensætninger. Nogle grupper bestod udelukkende af én aktørtype, mens andre indeholdt repræsentanter fra alle tre segmenter. Studiet demonstrerer i lighed med resultaterne af litteraturgennemgangen, at de tre aktører var på bølgelængde i forhold til klimaforskernes og klimajournalisterne roller. Generelt abonnerer de på en konventionel forståelse af de to professioner. Politisk aktivisme er derfor ikke velset for hverken forskere eller journalister. Samtidig er der blandt deltagerne ikke tilslutning til, at klimajournalister skal påtage sig en rolle som eksperter. Der er dog en udbredt accept af klimaforskeres ret til at udtrykke bekymring, når de fremlægger deres resultater. Borgerrollen er mere omstridt. Ikke engang inden for de enkelte aktørsegmenter er der konsensus om, hvorvidt borgerne for eksempel bør gøre en aktiv indsats for at holde sig opdaterede om klimaspørgsmålet.

Det tredje studie hviler på det samme datagrundlag som det forrige, men har et andet analytisk sigte. I stedet for roller handler det om aktørernes syn på værdien af forskellige typer af viden i klimadebatten, og hvordan man bedst sikrer kvaliteten af den viden, der udbredes her. Også dette studie har til hensigt at undersøge teoretiske forestillingers forankring i virkeligheden. I den videnskabelige litteratur har der længe været modstand mod den traditionelle forståelse af forskningskommunikation, hvor målet er at fylde videnskabelig viden på borgerne via en ensrettet strøm af information fra forskerne til offentligheden. Der har således været slået til lyd for, at videnskabelig viden ikke bør placeres på en piedestal. Ifølge denne strømning bør borgernes erfaringsbaserede viden i stedet inddrages mere i diskussioner af videnskabelige emner. Dette gælder ikke mindst på klimaområdet. Andre forskere har også advaret om, at konkurrencen fra sociale medier kan ende med at underminere

journalisters rolle som garanter for kvaliteten af den offentlige udveksling af viden. Diskussionerne i fokusgrupperne tyder dog ikke på, at en revolution er undervejs. Det overordnede billede er, at aktørerne anser videnskabelig viden for at være sikker, men samtidig også snæver. Der er derfor udpræget enighed om, at klimaforskere udelukkende bør udtale sig om deres eget felt, når de optræder i medierne. I forhold til den erfaringsbaserede viden er der blandt de tre typer af aktører en forståelse af, at dens relevans er meget emneafhængig. Borgerinput anses for at være brugbare på anvendelsesorienterede områder, men ikke i relation til mere tekniske spørgsmål. Desuden giver studiet opbakning til klimajournalisters fortsatte eksistensberettigelse som gatekeepere. De tre aktører er gennemgående enige om, at kvaliteten i den offentlige klimadebat bedst opretholdes med de traditionelle medier ved roret.

Denne afhandling bidrager på flere måder til den videnskabelige litteratur om klimaforskningskommunikation. Den foretager en empirisk undersøgelse af en række hidtil uprøvede teoretiske forudsigelser om klimaproblematikkens potentiale til at ændre de gængse spilleregler for forskningskommunikation. Samlet set viser afhandlingens tre artikler, at et normskred på området ikke er forestående. Dette ser i høj grad ud til at være tilfældet på tværs af lande. Ved at zoome ind på Danmark kommer afhandlingen med et særligt stærkt vidnesbyrd om, at status quo ikke er truet her. Fordi den eksisterende forskning på området typisk har studeret de tre aktørtyper separat, medvirker afhandlingen med sit tredimensionelle perspektiv til at fremme forståelsen af deres gensidige forventninger. Derudover sætter afhandlingen spot på et indtil nu negligeret emne i forskningen, nemlig borgernes rolle i den offentlige samtale om klimaforskning.

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Appendix A: Protocol for focus group study on climate science communication[1]

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[1] The protocol describes how the focus group study was imagined prior to its conduction. As explained in Chapter 3, the way it was carried out differs slightly from how it was planned. The primary adjustment was that I decided to increase the number of groups from twelve to fifteen.

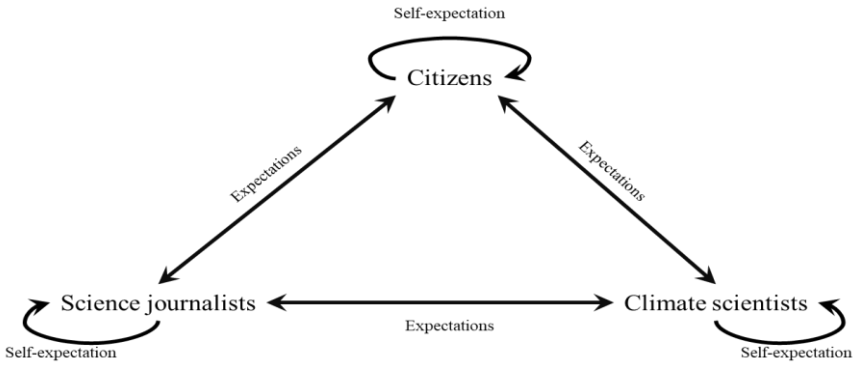
Introduction

This focus group study is the cornerstone of a dissertation that examines how climate scientists, science journalists, and citizens see the ideal roles of themselves and each other when they communicate about climate science. The aim is to reveal points of alignment and discrepancy in the actors' role perceptions to improve the climate science communication of the future.

Climate change is widely regarded as one of the most pressing problems facing modern societies. Due to its abstract and complex nature, climate change is mainly made comprehensible by way of scientific endeavours. At the same time, the solution to the challenge hinges on the actions of the wider public. The alignment of climate scientists, climate journalists, and citizens therefore seem an integral part of engaging with the problem. However, certain characteristics ingrained in climate science challenge the traditional understandings of the interaction between the three actors (Brüggemann et al., 2020). Climate science is thus marked by uncertainty, disputed values, high-stakes, and urgency (Bray & Storch, 1999). Further, the influx of social media has provided opportunities for new ways of interaction. It is therefore highly relevant to investigate the ideal role perceptions of climate scientists, climate journalists, and citizens as communicative actors.

This study will provide insight into the role perceptions prevalent among the three actors by way of twelve focus group interviews with Danish climate scientists, climate journalists, and citizens. At stake is the perception related to their own role as well as the perception connected to the roles of the other actors (see Figure 1).

Figure 1: Illustration of research interest



The study will feature nine homogeneous groups composed of one actor type and three heterogeneous groups blending climate scientists, climate journalists, and citizens (see more details below). The knowledge gained from the focus groups will be communicated in two research articles.

Methodology

The focus group approach has been chosen to study the ideal role perceptions of climate scientists, climate journalists, and citizens. This method is renowned for being particularly suitable for exploring how groups negotiate socially constructed phenomena such as ideal role perceptions and embrace their complexity (Cyr, 2019, pp. 19–20; Halkier, 2016, p. 10). Focus groups are, therefore, useful for examining the level of consensus regarding the ideal role perceptions within and across the three types of actors. Further, the design with homogeneous and heterogeneous focus groups enables a comparison of how groups with different constellations of actors influence this negotiation. The relatively large number of groups is intended to take account of the fact that the study comprises three types of participants with a high level of intra-segment variation (see paragraph on study participants). It is expected that the point of saturation will be reached despite the large variety of features represented in the study with twelve groups (Bryman, 2004, p. 505). With a narrower delineation of segments (i.e., glaciologists, TV journalists, and middle-aged women), fewer groups would be needed.

Design and analysis

Moderator guide

The focus group interviews will follow a semi-structured moderator guide with a limited amount of pre-defined questions and exercises as the study is not intended to be hypothesis testing nor entirely explorative (Morgan, 1997, p. 52). The moderator guide will be largely similar across all group compositions. The main difference will be that the introductory questions and some of the probes will be adjusted to the type of participants in question (see Appendix I–IV for examples of moderator guides). However, the same three themes will be discussed in each focus group, and the participants will also be presented with the same two sorting exercises.

- Themes
  The moderator guide for each group will revolve around three themes: the ideal role of climate scientists, the ideal role of climate journalists, and the ideal role of citizens. The ordering of the themes as well as the probes connected to certain questions will differ between the groups according to the constellation of participants.

- Exercises
  One sorting exercise will be connected to the theme about the ideal role of climate scientists and will ask the participants to judge whether different

kinds of rhetoric are appropriate for climate scientists to use when they communicate in public. The other sorting exercise is part of the theme regarding the ideal role of journalists. Here, the participants will be presented with normative statements about climate journalism, and they will then be asked to indicate whether they agree with the statement in question.

The questions and exercises in the moderator guide will be informed by the researcher's prior work on role perceptions among climate scientists, climate journalists, and citizens (Busch Nicolaisen, 2022b).

Pilot test

To test the moderator guide prior to the beginning of the study, a pilot focus group will be organised. Ideally, this group would comprise representatives of all three segments to get an impression of how they each react to the questions and exercises. However, due to the difficulties in recruiting climate scientists and climate journalists, the pilot focus group will consist of a mix of citizens from the researcher's network and academic staff from the Danish Centre for Studies in Research and Research Policy with focus group experience.

Research questions

The focus group study will address the following research questions:

1. How do Danish climate scientists, journalists, and citizens perceive the ideal roles of themselves and each other in climate science communication?

This question will be answered by incorporating topics on the ideal roles of climate scientists, climate journalists, and citizens in each focus group. By way of relevant questions and exercises, the aim is to facilitate an in-depth discussion of the ideal roles of the three actors.

2. To which degree are the actors' ideal role perceptions compatible?

As all participants are asked to reflect on their own roles as well as each other's with similar questions and exercises, it will be possible to make cross-group comparisons. In the homogeneous focus groups, the compatibility of the actors' role perceptions will be apparent when the groups are compared in the analysis phase, while the level of agreement among the different segments will already be evident during the data collection in the heterogeneous focus groups.

3. How does the group composition influence the negotiation of the ideal roles of climate scientists, climate journalists, and citizens?

The design with homogeneous and heterogeneous focus groups enables an examination of how the deliberation of ideal role perceptions is influenced by the group composition. When analysing the focus group discussions, it is possible to compare the types of arguments occurring in the uniform and the mixed groups.

Recording, transcription, and analysis

The focus group interviews will be audio recorded, transcribed, and subsequently coded in NVivo applying first and second cycle coding (Saldana, 2013). The analysed focus group material will be the basis of two research articles. One article will aim at answering the first two research questions, while the second article will focus on the last research question.

Practical implementation

The focus group interviews will be carried out in Copenhagen and Aarhus. The three homogeneous focus groups with climate journalists, two homogeneous focus groups with climate scientists, and two heterogeneous groups will take place at a conference centre in Copenhagen, while the remaining five focus groups will be held at the Department of Political Science at Aarhus University. All focus groups will be conducted in Danish. The same applies to the written material sent to participants beforehand. The choice of language rests on an assumption that not all citizens and possibly journalists are fluent in English. The aim of doing the material and the focus groups in Danish is to ensure that all participants are able to fully understand what their participation entails and express themselves optimally in the discussion.

The focus group study will follow this timeline:

May 2021–August 2021

Development of research design, recruitment of participants, and ethical approval of study

September 2021–October 2021

Carrying out and transcribing twelve focus group interviews

November 2021–June 2021

Coding, analysis, and reporting of the focus group data

Data management

The study's data management procedures will comply with the General Data Protection Regulation (GDPR) of the European Union. The procedures for

data management and privacy are specified in the privacy policy. The privacy policy will be sent to the participants ahead of their participation in the focus group to make sure they are informed about the procedures regarding data management and privacy.

A secured Aarhus University network drive dedicated to store data from the project will be created. This drive will only be accessible to the researcher and the involved research assistants.

During the interviews, recording equipment from the Danish Centre for Studies in Research and Research Policy will be used. When it has been verified that the audio files have been transferred to the secured network drive, they will be deleted from the recorder. The recordings will be deleted from the secured network drive five years after the last publication from the study has been published. In case of a data security breach, it will be reported according to the guideline of security breaches at Aarhus University.

Study participants: selection and recruitment

A purposeful sampling strategy will be used to select the participants (Morgan, 1997, p. 56). The aim is to display a diverse representation of climate scientists, climate journalists, and citizens based on key criteria within each segment (see below). A general selection criterion is that all participants must be fluent in Danish.

Selection and recruitment of climate scientists

In the context of this study, a climate scientist is defined as a researcher specialised in either monitoring the climate system, predicting its natural and socioeconomic consequences, or investigating mitigation options.

To ensure a diverse sample, the participating climate scientists must represent variance on the following variables: institutional affiliation, scientific field (i.e., glaciology, atmospheric chemistry, climate economics, and biodiversity), position, and gender.

The aim is to construct a sample that consists of researchers conducting climate science from all Danish universities (Aalborg University, Aarhus University, the Technical University of Denmark, and the University of Copenhagen). Further, it must feature scientists working within a variety of climate-related fields with different ranks (assistant professor, associate professor, and professor) and have a balanced gender composition.

The identification of relevant researchers will be initiated by web searches to locate climate scientists at each relevant university. The publication lists of researchers will be used to decide if someone can be classified as a climate scientist. This effort is expected to result in a list of potential participants with

varying seniority, research interests, and gender. The researchers will then be contacted by phone. Here, they will be introduced to the study and asked whether they agree that their research is largely climate related. If they confirm this, they will be asked if they want to participate in the study and receive a written invitation at a later point. The researchers will also be asked if they know of colleagues who they think might be relevant. This will be done to identify potential relevant researchers that are not detected by the web searches.

Selection and recruitment of climate journalists

A climate journalist is defined here as someone who has experience in producing in-depth climate-related content for media outlets.

To guarantee diversity, the participating climate journalists must represent variance on the following variables: media affiliation, format, seniority, and gender.

The sample of climate journalists will thus consist of journalists with varying media affiliations (established media, niche media, and freelance) producing content for different formats (newspaper, radio, TV, and online). It will also showcase journalists with different levels of experience and strive to be gender balanced, although there probably will be a male dominance reflecting the actual gender distribution among climate journalists.

The identification of the relevant journalists will be initiated by approaching the chairmen of Danish Science Journalists (Danske Videnskabsjournalister) and the Association of Energy and Environmental Journalists (Foreningen af Energi- og Miljøjournalister). These inquiries are expected to result in a list of Danish journalists who cover climate-related subjects. The journalists will then be contacted by phone. Here, they will be introduced to the study and asked whether they agree that their journalistic work largely focuses on climate-related subjects. If they confirm this, they will be asked if they want to participate in the study and receive a written invitation at a later point. The journalists will also be asked if they know of colleagues who they think could be relevant. This will be done to identify potential relevant journalists who were not part of the associations. In the end, this will hopefully result in an exhaustive list of climate journalists with varying media affiliations, format specialisations, and levels of experience.

Selection and recruitment of citizens

A citizen is defined as a person at least 18 years of age.

To secure a diverse sample of citizens, the participants will vary on the following characteristics: age, education, employment, climate attitude, and gender. Consequently, the sample of citizens will include people from different

age groups (20–35, 35–50, and 50+) with different levels of education (low, medium, and high) and occupational status (privately employed and publicly employed) as well as varying climate sentiments (pro-environmental, climate change sceptics, and neutral).

The recruitment of citizens will follow a targeted strategy, and a variety of channels will be utilised. Facebook groups of social movements will be used to identify citizens with strong either pro- or anti-environmental sentiments. The pro-environmental segment will be targeted through Facebook groups connected to, for example, the Climate Movement (Klimabevægelsen) or the Grandparents' Climate Action (Bedsteforældrenes Klimaaktion), while the group belonging to the Climate Realists (Klimarealisterne) will be used to get in touch with the group of anti-environmental citizens. Facebook groups for people with different professions (e.g., primary school teachers, high school teachers, and entrepreneurs) will also be used to locate potential participants. Further, if the other techniques do not yield a sufficiently diverse sample, the researcher's own network will be utilised to recruit participants. Here, potential participants must be at least twice removed from the researcher. The citizens will then be contacted by phone, where they will be introduced to the study. If they are interested in participating, they will then receive a written invitation at a later point.

Composition of focus groups

Each of the twelve focus groups will consist of six participants. This number of participants ensures that each person will have adequate time to express his or her views, while still safeguarding the group dynamic against reticent participants (Bloor et al., 2001, p. 27). Further, with six participants, the groups will not be overly vulnerable to cancellations (Bloor et al., 2001, p. 27). Different kinds of considerations will feed into how the four types of focus groups will be composed. However, the common goal is for each group to display a high degree of diversity to stimulate a lively discussion environment.

Homogeneous focus groups with climate journalists (three groups)

Journalists working at the same media outlet will not feature in the same group. Further, the focus groups will include journalists from different media types and with varying levels of experience and gender.

Homogeneous focus groups with climate scientists (three groups)

These focus groups will include climate scientists from a range of research fields with varying seniority. Due to logistical concerns, the focus groups in Aarhus will only feature researchers from Aarhus University, while the focus

groups in Copenhagen will consist of researchers from more than one university. Climate scientists belonging to the same focus group should preferably not have had any prior research collaborations. The gender composition of the focus groups will preferably be balanced.

Homogeneous focus groups with citizens (three groups)

Each focus group will feature citizens with various occupational backgrounds and educational levels from different age categories. Within each group, different sentiments towards climate change will also be represented. Further, an equal distribution of men and women will be strived for in each group.

Heterogeneous focus groups (three groups)

These focus groups will include two representatives of each actor type. Again, the main priority is to have a rather diverse representation within each segment. The focus groups will, therefore, feature climate scientists from different research fields and ideally also with different ranks and institutional affiliations, climate journalists from different media and ideally also with different levels of experience, and citizens with a span in occupational background and age. Citizens within the same focus group will not necessarily differ in their sentiment towards climate change, but the aim is to have a variety of sentiments represented across the heterogeneous focus groups.

If it is not possible to attain an equal gender distribution within each segment, the aim will be to achieve gender balance in the group as a whole. This means that if two male climate scientists participate, two female citizens will be sought to compensate for the skewedness.

Ethical considerations

An ethical approval of the study has been obtained from the Research Ethics Committee at Aarhus University on 6 September 2021 (See Appendix XI).

Confidentiality

To create an environment where everyone feels that it is safe to contribute, it is essential that the focus group discussion is confidential. This will be addressed by pointing out that it is not permitted to disclose anything from the focus group discussion to outsiders both in the introduction to each session as well as in the informed consent form.

Informed consent

A major ethical concern is to secure that all participants have given informed consent prior to the initiation of the study. This means that all participating climate scientists, climate journalists, and citizens should know about the purpose of the study and what the focus groups will entail.

This will be ensured by presenting all participants in the focus groups with an information letter (see Appendix VIII) and an informed consent form (see Appendix IX). These include information on the project's purpose, communication of research results, all matters concerning data collection, analysis and protection of the participants' personal information, the participants' opportunities for leaving the study, and for viewing and – if relevant – commenting on transcriptions of interviews and quotations. In the informed consent form, it is very clearly described what the participants give their consent to by signing the form. The informed consent form follows the guidelines of Aarhus University.

Data and identity protection

In the recruitment phase, the participants have been promised that their identities will not be revealed to outsiders at any point in the research process. To achieve this, data will only be stored and treated on secured Aarhus University network drives with relevant access restrictions, and all information that could reveal the identity of a participant, such as name and workplace, will be anonymised. In the dissemination phase, the climate scientists will be identified by their gender, rank, and scientific field (e.g. 'A female professor in atmospheric chemistry mentioned…'); climate journalists will be identified by their experience level, gender, and media type (e.g. 'An experienced male journalist from a niche media added that…'); while citizens will be identified by their age, gender, profession, and potential affiliation with climate-related associations (e.g. 'This statement was backed by a 42-year-old female nurse from the Climate Movement…').

Securing an equal discussion environment

In the data collection phase, other ethical concerns materialise. One of them is the responsibility to secure that none of the participants are harmed during the focus groups. A particular risk arises in the heterogeneous groups where differences in educational background and knowledge of climate science pose a challenge to secure an equal discussion among the participants, particularly with respect to the participating citizens. As especially climate scientists and

to some extent also climate journalists belong to the knowledge elite, it is important to be aware of the power dynamic in the conversation and intervene in case of an imbalanced dialogue when moderating the discussion.

COVID-19 considerations

To ensure that everybody feels that it is safe to participate in the study, a valid corona passport will be a requirement for all involved. This will be made clear in the invitation letter. Further, by signing the informed consent form, the participants promise that they have a valid corona passport at the time of the study.

Remuneration

As a means of appreciating their contribution to the project, the research participants will receive a box of chocolates worth DKK 100 at the end of the session. This will not be advertised in the recruitment phase. Further, the participants' transport expenses will be covered to minimise the inconveniency of participating.

Expected scientific and social benefits

The primary academic contribution of the study lies in the novelty of the comprehensive research design featuring climate scientists, climate journalists, and citizens alongside each other. Research on the ideal role perceptions of each of these actors exists, but they have not been studied within the same framework before. The focus group study therefore offers the opportunity to gain new knowledge on the actors' reflections on their mutual expectations as well as an avenue to observe how the ideal role perceptions are negotiated between the actors. The results from the focus groups will be disseminated in two research articles to be published in peer-reviewed journals.

The primary societal contribution of the study lies in its potential to improve the future communication of climate science by detecting possible misalignments in the role perceptions of climate scientists, climate journalists, and citizens. An enhanced mutual understanding between the three actors is likely to foster a more well-functioning communication environment. More concretely, the insights gained from this study can potentially be used in the training of climate scientists and climate journalists.

Expected outputs

The focus group study is intended to result in two research articles that will be aimed at international peer-reviewed journals either broadly preoccupied

with science communication such as *Public Understanding of Science* or more narrowly focused on climate such as *Environmental Communication*. The first article will focus on which expectations the actors hold for themselves and each other in relation to climate science communication, while the second article will revolve around how the different group compositions impacted the negotiation of the roles.

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Appendix I: Moderator guide for citizens

Moderator guide

Generic introduction

Presentation of consent form

Practical issues

Presentation of researcher

Framing the session

Presentation of participants

Homogeneous focus groups with citizens

Introduction
Climate change has had a prominent position on the societal agenda for some time. *How interested are you in the topic?*
Climate change is an issue which is intimately linked with science. *When I say climate science, what do you think of?*
News media often refer to climate science. *What is your impression of climate science (settled, controversial, or trustworthy)?*

The role of citizens in climate science communication
On the one hand, you can argue that citizens in modern society have a lot to attend to and you therefore cannot expect them to devote resources to engage with complex scientific issues such as climate change. On the other hand, scientific knowledge is taking an increasingly important position in society in general, and it may, therefore, seem reasonable to expect citizens to engage with science in order for them to be able to have a qualified opinion about science-laden issues such as climate change. *Do you think it is appropriate to expect citizens to engage with climate science?* Please elaborate your position. *Do you see climate change as a topic that is particularly important for citizens to engage with? Why, why not?*

If you believe that citizens should engage with climate science, I would like to know which kind of engagement you think is fitting. Keeping up to date with the media coverage? Studying climate reports? Seeking dialogue with climate scientists by way of social media for example? Creating a blog?

How do you rate your current degree of knowledge about climate science?

Nowadays anyone can voice their opinion in public, for example, by starting a blog or posting on Facebook. *Do you see knowledge of climate science as an entry ticket to the public debate on climate change, or do you think anyone should be able to participate regardless of their level of knowledge? What determines whether you are worthy of participating in the public climate debate?*

The role of journalists in climate science communication

Climate change is frequently covered by the media. *How would you describe your current intake of climate news stories? What is your overall impression of the media's climate coverage?*

What is good climate journalism in your view? What would make you interested in a climate news story? Can you think of any examples of good climate journalism? Which traits do you want a climate journalist to exhibit?

What is bad climate journalism in your view? Can you think of any examples of bad climate journalism?

Climate science is a complex field dominated by intricate models and elaborate mechanisms. *How much do you think journalists should know about climate science to be able to cover it properly?*

What do you expect journalists to do when they receive scientific information from climate scientists? Translate it into everyday language? Critically scrutinize it? Put it into a context relevant to the lives of citizens?

Some Danish media outlets have declared that they will combat climate change through their journalism. *What do you think about the media taking this sort of stance?*

The role of climate scientists in climate science communication

A significant amount of money is being invested in climate research these years. *What do you see as the core function of climate science?*

Teaching and researching are the traditional core tasks of scientists, but in recent years, increasing emphasis has been paid to public outreach. *How do you perceive scientists' responsibility to make themselves available to the public? Do you think this obligation is more pronounced for climate scientists than for scientists in other fields?*

Social media has made it far easier to get in touch with climate scientists. *Would you like to have direct contact with climate scientists? If you contact a climate scientist on Twitter or Facebook, do you think he or she ought to answer you back?*

Which traits would you prefer in a climate scientist as a public communicator?

How do you think climate scientists should behave when they communicate in public? Can you think of any forms of communicative conduct that would be improper for climate scientists?

Climate science is marked by the use of technical terms like parts per million, CO2-equivalents, and cryosphere. *Would you expect climate scientists to explain their work in a way that non-specialists can comprehend?*

Appendix II: Moderator guide for climate journalists

Moderator guide

Generic introduction

Presentation of consent form

Practical issues

Presentation of researcher

Framing the session

Presentation of participants

Homogeneous groups with climate journalists

Introduction

What kind of climate reporting are you doing?
What is your personal attitude towards climate change in terms of its severity and the need for action?

The role of climate journalists in climate science communication
Journalists covering climate change can take on a variety of roles. *Which role do you think that journalists should have when interacting with scientific sources and conveying climate information to the public?*

You can argue that the actions of journalists should not only be guided by their own professional ethos but also by the ethos guiding citizens as they also belong to this group. *How do you perceive the duality of being a journalist and a citizen at the same time?*

How does the nature of climate change as a topic impact the journalistic role in your view?

Do you ever face dilemmas when covering climate change? Which?
What defines good climate journalism according to you?

What defines bad climate journalism according to you?

What authority do you think journalists should be granted in handling scientific knowledge claims?

Climate change is intimately connected to science in terms of monitoring its current development and forecasting its future progress. *How would you rate your current level of knowledge regarding climate science? Do you find this sufficient to cover the topic?*

The role of citizens in climate science communication
Technology has made it easier to engage in a dialogical relationship with the audience. *How do you think journalists should approach this opportunity?*

In which way do you think the public should be engaged in the societal discussion of climate change? Who is responsible for engaging them, and how should this be done?

How will you describe the obligation you feel towards your audience? What do you think you have to provide them with?

Which challenges, if any, do you experience in conveying a highly technical subject to non-specialists? What kind of assumptions do you have about your audience?

The role of climate scientists in climate science communication
Research and teaching are core tasks of climate scientists. *How do you view climate scientists' responsibility in terms of being available to the media? Do you think this responsibility is different to the one they have if citizens approach them directly by email or via social media?*
Do you think scientists working with climate-related research have a special obligation to reach out to the public?

Interacting with scientists is a natural part of being a climate journalist. *What is the biggest challenge working with scientific sources?*

Appendix III: Moderator guide for climate scientists

Moderator guide

Generic introduction

Presentation of consent form

Practical issues

Presentation of researcher

Framing the session

Presentation of participants

Homogeneous groups with climate scientists

Introduction

What kind of experience do you have with the media?

Have you performed other kinds of outreach activities?

How will you describe your own interest in interacting with citizens and the media?

Do you feel equipped to participate in the public discussion of climate science?

What is your personal sentiment towards climate change in terms of its severity and the need for action?

The role of climate scientists in climate science communication
How do you perceive the mandate of climate scientists when they communicate in public?
What would constitute improper behaviour of a climate scientist communicating in public?

How does the responsibility of climate scientists compare to that of scientists within other fields in terms of public communication?

In Denmark, some climate scientists feature in the media very frequently. *Can you think of any of your colleagues who are doing a good job communicating in public?*

Scientists have traditionally been expected to teach and research. *How do you perceive your responsibility to participate in the public discussion of climate science? What is a fair expectation towards climate scientists in terms of engaging with the public? Participation in interviews? Responding to emails from citizens? Social media activity? Blogging?*

How do you perceive the duality of being a climate scientist and a citizen simultaneously? Which dilemmas, if any, do you see for climate scientists who communicate in public?

Climate scientists worldwide are signing petitions warning against climate change and encouraging political action. *What do you think of this sort of behaviour?*

Climate science is a complex field that must be assumed to be difficult to relate to for most non-specialists. *What responsibility do climate scientists have for making their research understandable to a lay audience?*

The role of climate journalists in climate science communication
What defines good climate journalism? Can you think of any examples of this?

What defines bad climate journalism? Can you think of any examples of this?

What authority do you think journalists should be granted in handling scientific knowledge claims?

Imagine you are being interviewed by a journalist. *What would be your expectations towards the journalist as an interlocutor in that situation?*

The role of citizens in climate science communication
Climate change is one of the most talked about topics of our time. *Which role do you see for non-specialists in the societal debate on the climate? What is the significance of scientific knowledge for participation in the societal discussion of climate-related issues?*

In what form do you think the public needs to know about climate science?

Do you think it is acceptable for citizens to be disinterested in climate science? Who would have the responsibility to make them engaged?

Appendix IV: Moderator guide for heterogeneous groups

Moderator guide

Generic introduction

Presentation of consent form

Practical issues

Presentation of researcher

Framing the session

Presentation of participants

Heterogeneous groups

The role of climate journalists in climate science communication
Journalists covering climate change can take on a variety of roles. *Which role do you think that journalists should have when interacting with scientific sources and conveying climate information to the public?*

You can argue that the actions of journalists should not only be guided by their own professional ethos but also by the ethos guiding citizens as they also belong to this group. *How do you perceive the duality of being a journalist and a citizen at the same time?*

How does the nature of climate change as a topic impact the journalistic role in your view?

Do you ever face dilemmas when covering climate change? Which?

What defines good climate journalism according to you?

What defines bad climate journalism according to you?

What authority do you think journalists should be granted in handling scientific knowledge claims?

Climate change is intimately connected to science in terms of monitoring its current development and forecasting its future progress. *How would you rate your current*

level of knowledge regarding climate science? Do you find this sufficient to cover the topic?

The role of citizens in climate science communication
Technology has made it easier to engage in a dialogical relationship with the audience. *How do you think journalists should approach this opportunity?*

In which way do you think the public should be engaged in the societal discussion of climate change? Who is responsible for engaging them, and how should this be done?

How will you describe the obligation you feel towards your audience? What do you think you have to provide them with?

Which challenges, if any, do you experience in conveying a highly technical subject to non-specialists? What kind of assumptions do you have about your audience?

The role of climate scientists in climate science communication
Research and teaching are core tasks of climate scientists. *How do you view climate scientists' responsibility in terms of being available to the media? Do you think this responsibility is different to the one they have if citizens approach them directly by email or via social media?*
Do you think scientists working with climate-related research have a special obligation to reach out to the public?

Interacting with scientists is a natural part of being a climate journalist. *What is the biggest challenge working with scientific sources?*

Appendix V: Exercise 1

Exercise 1: Sorting exercise used in the theme on the ideal role of climate scientists

The participants are presented with a scenario where a climate scientist publishes a study. On the table, two labels are placed: 'Passende' (appropriate) and 'Upassende' (inappropriate). The participants are then collectively asked to place four hypothetic public statements made by the concerned climate scientists according to whether they are appropriate or inappropriate.

Original text

En klimaforsker udgiver et studie, der viser, at vandstanden vil stige med 2.5 meter i 2100, hvis vi fortsætter med at udlede lige så meget CO_2 på verdensplan som hidtil. Det er en halv meter mere, end FN's klimapanel ser som det mest sandsynlige scenarie. Hvad må forskeren sige på baggrund af sit fund?

A: "Min forskning viser, at vandstanden vil stige 2.5 meter i 2100."

B: "Min forskning indikerer, at vi er nødt til at gøre mere for at begrænse CO_2-udledningen."

C: "På baggrund af min forskning vurderer jeg, at det vil være en god idé at beskatte flyrejser og kød hårdere."

D: "Mine resultater gør mig nervøs på mine børnebørns vegne."

Translated text

A climate scientist publishes a study showing that the water level will rise 2.5 meters in 2100 if we continue to emit as much CO_2 worldwide as hitherto. That prediction exceeds what the UN's climate panel perceives to be the most likely scenario by half a meter. What is the scientist allowed to say based on the result?

A: 'My research shows that the water level will rise 2.5 meters in 2100.'

B: 'My research indicates that we need to do more to limit the emission of CO_2.'

C: 'Based on my research, I assess that it will be a good idea to tax air travel and meat consumption further.'

D: 'My results make me worried on behalf of my grandchildren.'

Appendix VI: Exercise 2

Exercise 2: Sorting exercise used in the theme connected to the ideal role of journalists

A variety of normative statements about climate journalism has been written on cards. On the table is a label saying 'Enig' (agree) and a label saying 'Uenig' (disagree). The participants in turn receive a card that they are told to read aloud and afterwards indicate whether they agree or disagree with the statement.

Original statements
"Journalistikken skal ikke bare beskrive klimaforandringerne. Den skal bekæmpe dem."

"Vi journalister er ikke sat i verden for at fortælle folk, hvordan de skal opføre sig. Vi er her for at fortælle dem, hvad der sker."

"Jeg mener, at den bedste klimadækning er lokal og viser, hvordan mennesker bliver påvirket af klimaforandringerne."

"Det er ikke min opgave at agere ekspert. Hvis jeg gør det, begår jeg en journalistisk synd."

"Det er vigtigt at blive ved med at være åben over for klimabenægterne, selvom langt størstedelen af den videnskabelige evidens ikke underbygger deres påstand."

"Jeg skal stille gode spørgsmål, videreformidle valide fakta og lade læserne drage deres egne konklusioner. Journalister arbejder i faktaindustrien."

"Som journalist har jeg aldrig tænkt over at gøre historierne interessante og relevante for et særligt publikum. Det er ikke rigtig vores opgave at gøre det. Vores opgave er at hjælpe folk til at forstå verden."

"Medierne bør nedtone deres overskrifter og formidle fakta og ekspertudsagn. De skal præsentere tingene på et højere niveau og ikke gøre brug af skræmmekampagner."

Translated statements
'Journalism should not only describe climate change. It should fight it.'

'We journalists are not here to tell the public how to behave. We are here to tell them what is happening.'

'I think that the best climate coverage is local and shows how people are being affected by climate change.'

'It is not my task to be an expert. If I do that, I am committing a journalistic sin.'

‘It is important to remain open towards climate denialists, although an overwhelming majority of the scientific evidence does not corroborate their claim.’

‘I should be asking good questions, disseminating valid facts, and letting readers draw their own conclusions. Journalists work in the fact industry.’

‘As a journalist, I have never thought about making stories engaging and relevant to a particular audience. It’s not really our job to do that. It’s our job to help people make sense of the world.’

‘The media should tone down their headlines and write about facts and expertise. They should present things on a higher level and not make use of scare tactics.’

Appendix VII: Invitation letters

Original invitation letter for homogeneous focus groups with climate scientists

Invitation til fokusgruppeinterview om klimaforskningskommunikation

Kære X

Jeg vil gerne invitere dig til at deltage i en fokusgruppe, der kommer til at indgå som en del af dataindsamlingen i mit ph.d.-projekt ved Dansk Center for Forskningsanalyse på Aarhus Universitet.

I min ph.d. beskæftiger jeg mig med klimaforskningskommunikation, hvor jeg undersøger samspillet mellem klimaforskere, klima- og videnskabsjournalister og borgere. Fokusgrupperne vil derfor handle om den ideelle rollefordeling mellem disse tre aktørtyper i den offentlige samtale om klimaet.

Mit studie kommer til at hvile på tolv fokusgrupper med klimaforskere fra danske universiteter, danske journalister, der dækker klimastoffet, samt borgere, der repræsenterer et bredt udsnit af den danske befolkning. Ni grupper vil bestå af udelukkende én aktørtype, mens forskere, journalister og borgere vil blive blandet i de resterende tre.

Fordi din forskning er relateret til klimaet, vil jeg gerne invitere dig til at indgå i en fokusgruppe. Her skal du sammen med andre forskere med et lignende fokus diskutere, hvilke roller forskere, borgere og journalister hver især bør have i kommunikationen af klimaforskningen.

Hensigten med fokusgrupperne er at generere ny viden om de tre aktørers rolleopfattelser. Denne viden vil efterfølgende blive formidlet i videnskabelige artikler rettet mod internationale tidsskrifter. Dine personlige oplysninger vil blive behandlet strengt fortroligt, og uddrag af interviewmaterialet vil blive udgivet i pseudonymiseret form. Det betyder, at der ikke vil blive offentliggjort oplysninger, der henviser direkte tilbage til dig som person.

Af hensyn til COVID-19 vil alle involverede skulle have et gyldigt coronapas på tidspunktet for fokusgruppernes afholdelse.

Fokusgruppeinterviewet med dig vil foregå i X den x.x klokken x og vil vare omkring halvanden time.

Jeg vil sætte stor pris på at få en tilbagemelding på, om du har lyst og mulighed for at deltage i fokusgruppen. Du kan enten give besked telefonisk (40863987) eller pr. mail (pbn@ps.au.dk). Hvis du har spørgsmål til undersøgelsen eller projektet generelt, må du også meget gerne henvende dig til mig.

Venlig hilsen
Peter Nicolaisen, ph.d.-studerende ved Dansk Center for Forskningsanalyse på Aarhus Universitet

Translated invitation letter for homogeneous focus groups with climate scientists

Invitation for focus group interview about climate science communication

Dear X,

I would like to invite you to participate in a focus group that will be part of the data collection in my PhD project at the Danish Centre for Studies in Research and Research Policy.

My PhD focuses on climate science communication as I investigate the interplay between climate scientists, climate journalists, and citizens. The focus groups will thus concentrate on the ideal role delegation between these three types of actors in the public discussion of the climate.

My study will rest on twelve focus groups with climate scientists from Danish universities, Danish journalists covering the climate, and citizens who represent a diverse sample of the Danish population. Nine groups will be comprised of only one type of actor, while scientists, journalists, and citizens will be mixed in the remaining three.

Because your research is related to the climate, I would like to invite you to take part in a focus group. Together with other scientists with a similar focus, you will discuss which roles scientists, citizens, and journalists should have in the communication of climate science.

The aim of the focus groups is to generate new knowledge about the role perceptions of the three actors. This knowledge will subsequently be communicated in scientific articles to be published in international journals. Your personal information will be handled confidentially, and excerpts of the interview material will be published in a pseudonymised state. This means that no information that refers directly to you as a person will be published.

Due to COVID-19, everyone involved will have to have a valid corona passport when the focus group is conducted.

The focus group interview with you will take place in X on x x and will last around one and a half hours.

I would appreciate if you would let me know whether you have the desire and opportunity to participate in the focus group. Please let me know either via phone (40863987) or email (pbn@ps.au.dk). If you have any questions about the study or the project in general, you are very welcome to contact me.

Kind regards,
Peter Nicolaisen, PhD student at the Danish Centre for Studies in Research and Research Policy at Aarhus University

Original invitation letter for homogeneous focus groups with citizens

Invitation til fokusgruppeinterview om klimaforskningskommunikation

Kære X

Jeg vil gerne invitere dig til at deltage i en fokusgruppe, der kommer til at indgå som en del af dataindsamlingen i mit ph.d.-projekt ved Dansk Center for Forskningsanalyse på Aarhus Universitet.

I min ph.d. beskæftiger jeg mig med klimaforskningskommunikation, hvor jeg undersøger samspillet mellem klimaforskere, klima- og videnskabsjournalister og borgere. Fokusgrupperne vil derfor handle om den ideelle rollefordeling mellem disse tre aktørtyper i den offentlige samtale om klimaet.

Mit studie kommer til at hvile på tolv fokusgrupper med klimaforskere fra danske universiteter, danske journalister, der dækker klimastoffet, samt borgere, der repræsenterer et bredt udsnit af den danske befolkning. Ni grupper vil bestå af udelukkende én aktørtype, mens forskere, journalister og borgere vil blive blandet i de resterende tre.

Du er inviteret til en fokusgruppe bestående udelukkende af borgere. Fokusgruppen skal afspejle et bredt udsnit af den danske befolkning. Du er blevet udvalgt, fordi du har en profil, jeg gerne vil have repræsenteret blandt deltagerne. I fokusgruppen skal du sammen med de andre deltagere diskutere, hvilke roller klimaforskere, klimajournalister og borgere hver især bør have i kommunikationen af klimaforskningen.

Hensigten med fokusgrupperne er at generere ny viden om de tre aktørers rolleopfattelser. Denne viden vil efterfølgende blive formidlet i videnskabelige artikler rettet mod internationale tidsskrifter. Dine personlige oplysninger vil blive behandlet strengt fortroligt, og uddrag af interviewmaterialet vil blive udgivet i pseudonymiseret form. Det betyder, at der ikke vil blive offentliggjort oplysninger, der henviser direkte tilbage til dig som person.

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Translated invitation letter for homogeneous focus groups with citizens

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My PhD focuses on climate science communication as I investigate the interplay between climate scientists, climate journalists, and citizens. The focus groups will thus concentrate on the ideal role delegation between these three types of actors in the public discussion of the climate.

My study will rest on twelve focus groups with climate scientists from Danish universities, Danish journalists covering the climate, and citizens who represent a diverse sample of the Danish population. Nine groups will be comprised of only one type of actor, while scientists, journalists, and citizens will be mixed in the remaining three.

You are invited to participate in a focus group consisting solely of citizens. The focus group shall reflect a wide cross-section of the Danish population. Because you have a profile that I would like to have represented in this study, I would like to invite you to take part in a focus group. Together with the other participants, you will discuss which roles scientists, citizens, and journalists should have in the communication of climate science.

The aim of the focus groups is to generate new knowledge about the role perceptions of the three actors. This knowledge will subsequently be communicated in scientific articles to be published in international journals. Your personal information will be handled confidentially, and excerpts of the interview material will be published in a pseudonymised state. This means that no information that refers directly to you as a person will be published.

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Invitation til fokusgruppeinterview om klimaforskningskommunikation

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Mit studie kommer til at hvile på tolv fokusgrupper med klimaforskere fra danske universiteter, danske journalister, der dækker klimastoffet, samt borgere, der repræsenterer et bredt udsnit af den danske befolkning. Ni grupper vil bestå af udelukkende én aktørtype, mens forskere, journalister og borgere vil blive blandet i de resterende tre.

Fordi du beskæftiger dig med klimaet i dit journalistiske virke, vil jeg gerne invitere dig til at indgå i en fokusgruppe. Her skal du sammen med andre journalister med et lignende fokus diskutere, hvilke roller forskere, borgere og journalister hver især bør have i kommunikationen af klimaforskningen.

Hensigten med fokusgrupperne er at generere ny viden om de tre aktørers rolleopfattelser. Denne viden vil efterfølgende blive formidlet i videnskabelige artikler rettet mod internationale tidsskrifter. Dine personlige oplysninger vil blive behandlet strengt fortroligt, og uddrag af interviewmaterialet vil blive udgivet i pseudonymiseret form. Det betyder, at der ikke vil blive offentliggjort oplysninger, der henviser direkte tilbage til dig som person.

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Because you cover the climate beat, I would like to invite you to take part in a focus group. Together with other journalists with a similar focus, you will discuss which roles scientists, citizens, and journalists should have in the communication of climate science.

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Original invitation letter for heterogeneous focus groups to climate scientists

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Fordi din forskning er relateret til klimaet, vil jeg gerne invitere dig til at indgå i en fokusgruppe. Her skal du sammen med klimajournalister, borgere og andre forskere med et lignende fokus diskutere, hvilke roller forskere, borgere og journalister hver især bør have i kommunikationen af klimaforskningen. Jeg stræber efter at have to repræsentanter for hver aktørtype i gruppen.

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My study will rest on twelve focus groups with climate scientists from Danish universities, Danish journalists covering the climate, and citizens who represent a diverse sample of the Danish population. Nine groups will be comprised of only one type of actor, while scientists, journalists, and citizens will be mixed in the remaining three.

Because your research is related to the climate, I would like to invite you to take part in a focus group. Together with journalists, citizens, and other scientists with a similar focus, you will discuss which roles scientists, citizens, and journalists should have in the communication of climate science. I strive for two representatives from each segment in the group.

The aim with the focus groups is to generate new knowledge about the role perceptions of the three actors. This knowledge will subsequently be communicated in scientific articles to be published in international journals. Your personal information will be handled confidentially, and excerpts of the interview material will be published in a pseudonymised state. This means that no information that refers directly to you as a person will be published.

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Fordi du har en profil, jeg søger at få repræsenteret i studiet, vil jeg gerne invitere dig til at indgå i en fokusgruppe. Her skal du sammen med klimaforskere, journalister og en anden borger diskutere, hvilke roller forskere, borgere og journalister hver især bør have i kommunikationen af klimaforskningen. Jeg stræber efter at have to repræsentanter for hver aktørtype i gruppen.

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Translated invitation letter for heterogeneous focus groups with citizens

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My study will rest on twelve focus groups with climate scientists from Danish universities, Danish journalists covering the climate, and citizens who represent a diverse sample of the Danish population. Nine groups will be comprised of only one type of actor, while scientists, journalists, and citizens will be mixed in the remaining three.

Because you have a profile I would like to have represented in this study, I would like to invite you to take part in a focus group. Together with climate scientists, journalists, and another citizen, you will discuss which roles scientists, citizens, and journalists should have in the communication of climate science. I strive for two representatives from each segment in the group.

The aim with the focus groups is to generate new knowledge about the role perceptions of the three actors. This knowledge will subsequently be communicated in scientific articles to be published in international journals. Your personal information will be handled confidentially, and excerpts of the interview material will be published in a pseudonymised state. This means that no information that refers directly to you as a person will be published.

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Venlig hilsen
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Translated invitation letter for heterogeneous focus groups with climate journalists

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Appendix VIII: Information letter

Original information letter

Informationsbrev

Baggrund

Fokusgrupperne indgår som en del af min ph.d.-afhandling, der undersøger samspillet mellem klimaforskere, klimajournalister og borgere. Projektet skal belyse, hvordan de tre aktører opfatter deres egen og de andres rolle i den offentlige debat om klimaforskningen. Formålet med fokusgrupperne er derfor at søge svar på en række bør-spørgsmål: Hvordan bør klimaforskere agere, når de kommunikerer deres forskning offentligt? Hvordan bør medierne dække klimaforskningen? Hvordan bør borgere indgå i den offentlige diskussion af klimaforskningen?

Det praktiske

Fokusgruppen bliver afholdt i X. Der er mulighed for at parkere sin bil ved X. Hvis man kommer med offentlig transport, skal man stå af ved X. Der vil blive serveret te, kaffe og vand samt sandwich og kage undervejs.

Fokusgruppen som metode

I dette studie vil der være omkring seks deltagere i hver gruppe. Modsat gruppeinterview er det i fokusgruppeinterview den indbyrdes diskussion mellem deltagerne, der er i højsædet. Det betyder, at intervieweren har en mere tilbagetrukket rolle end i almindelige interviews. Intervieweren i en fokusgruppe har derfor karakter af en moderator, der med spørgsmål og øvelser igangsætter en diskussion mellem deltagerne.

Dagens program

Forud for fokusgruppen skal jeg indsamle jeres samtykkeerklæringer, som I meget gerne må læse og underskrive på forhånd samt medbringe. Fokusgruppen vil blive bygget op omkring tre temaer, der knytter sig til henholdsvis borgernes, klimaforskernes og klimajournalisternes rolle i kommunikationen af klimaforskningen. Temaerne vil blive udforsket ved hjælp af en række spørgsmål og to øvelser, mens der også vil blive indlagt en kort pause undervejs. Fokusgruppen vil blive afsluttet med en kort opsummering, hvor hovedpunkterne fra dagens diskussion vil blive gennemgået.

Det formelle

Fokusgruppediskussionen er fortrolig, så I bedes venligst ikke afsløre noget af indholdet til udenforstående. Samtalen vil blive optaget og udskrevet efterfølgende. Her vil alle identificerende oplysninger blive pseudonymiserede. Det betyder, at der ikke vil fremgå oplysninger, der fører direkte tilbage til den enkelte deltager. Alle data vil blive behandlet i overensstemmelse med GDPR, EU's lovgivning om databeskyttelse, som det også fremgår af samtykkeerklæringen og studiets privatlivspolitik.

Jeg glæder mig til at se dig.

Venlig hilsen

Peter Nicolaisen, ph.d.-studerende ved Dansk Center for Forskningsanalyse, Aarhus Universitet

Translated information letter

Background

The focus group will be a part of my PhD thesis, which investigates the interaction between climate scientists, climate journalists, and citizens. The project will examine how the three actors perceive their own and each other's roles in the public debate about climate science. The aim of the focus groups is therefore to seek answers to a range of normative questions: How should climate scientists communicate their science publicly? How should the media cover climate science? How should citizens participate in the public discussion of climate science?

Practicalities

The focus group will be held at X Avenue, Y City. During the session, tea, coffee, and water will be served along with sandwiches and cake.

The focus group as a method

In this study, there will be around six participants in each group. Contrary to group interviews, it is the discussion among the participants that is central to focus groups. This means that the interviewer has a more detached role than in ordinary interviews. The interviewer in a focus group therefore functions as a moderator who uses questions and exercises to stimulate a discussion between the participants.

The programme of the day

Prior to starting up the focus group, I will collect your informed consent forms, which you are supposed to have read and signed beforehand and bring to the session. The focus group will be structured around three themes that revolve around the role of climate scientists, climate journalists, and citizens, respectively, in climate science communication. The themes will be explored by way of a range of questions and two exercises. There will be a short break midway through the session. The focus group will finish with a short summary of the main points from the discussion.

Formal matters

The focus group discussion is confidential, so you are not allowed to reveal any of the content to outsiders. The conversation will be recorded and subsequently transcribed. All identifying information will be pseudonymised. This means that no information leading directly back to the individual participant will appear. All data will be treated in accordance with GDPR, the European Union's legislation regarding data protection, as stated in the informed consent form and the study's privacy policy.

I look forward to seeing you.

Kind regards,
Peter Nicolaisen, PhD student at the Danish Centre for Studies in Research and Research Policy at Aarhus University

Appendix IX: Consent form

Original consent form

Samtykkeerklæring for deltagelse i fokusgruppestudie om klimaforskningskommunikation

Beskrivelse af projektet
I mit ph.d.-projekt ved Dansk Center for Forskningsanalyse på Aarhus Universitet undersøger jeg rolleopfattelser blandt klimaforskere, journalister og borgere i kommunikationen af klimaforskningen. Intentionen med projektet er at afdække graden af overensstemmelse mellem de tre aktørers gensidige forventninger. Projektet er finansieret af Aarhus Universitet under programmet "Social Science and Business".

Formål med fokusgruppeinterviewet
Sigtet med fokusgrupperne er at få belyst, hvordan tre centrale aktører i den offentlige samtale om klimaet, klimaforskere, journalister og borgere opfatter den ideelle rollefordeling i denne interaktion. Hidtil har de tre gruppers rolleopfattelser været studeret særskilt, men en central antagelse i dette ph.d.-projekt er, at det vil være frugtbart at anskue dem i en sammenhæng. Ved at sammensætte tolv fokusgrupper med danske klimaforskere, klimajournalister og borgere vil jeg facilitere en udforskning af aktørernes forventninger til sig selv og hinanden. Deltagernes refleksioner om deres egen og andres roller vil sidenhen komme til at tjene som det centrale datamateriale i min ph.d.-afhandling.

Databrug og formidling af resultater
Fokusgruppeinterviewet vil blive optaget med diktafon og derefter transskriberet i anonymiseret form.

Hver deltager i fokusgruppeinterviewet må på ethvert tidspunkt kræve, at vedkommendes interviewdata bliver fjernet med en enkelt forespørgsel til Peter Nicolaisen (pbn@ps.au.dk). Data, der allerede er blevet udgivet, kan ikke fjernes. Desuden kan deltagere også bede om at få lov til at læse interviewudskrifterne igennem.

Resultaterne fra fokusgrupperne vil blive analyseret, udgivet og gjort offentligt tilgængelige i et eller flere videnskabelige tidsskrifter. Ingen personlige informationer vil blive nævnt eller afsløret på noget tidspunkt.

Brud på datasikkerhed
I tilfælde af at datasikkerheden bliver brudt, vil de berørte deltagere blive kontaktet, og data vil midlertidigt blive fjernet fra det berørte opbevaringssted.

Dataansvarlig
Spørgsmål om databeskyttelse kan rettes til Peter Nicolaisen (pbn@ps.au.dk).

Samtykke
Deltagelse i studiet er frivillig, og deltagerne kan på ethvert tidspunkt trække sig fra studiet uden yderligere begrundelse ved at kontakte Peter Nicolaisen (pbn@ps.au.dk).

Ved at underskrive samtykkeerklæringen indikerer du, at du er enig i alle nedenstående punkter:

- Jeg har læst den givne information om studiet. Jeg har haft muligheden for at stille spørgsmål, og mine spørgsmål er blevet fyldestgørende besvaret. Jeg har haft tilstrækkelig tid til at beslutte, hvorvidt jeg vil deltage.
- Jeg ved, at deltagelse i studiet er frivillig. Jeg ved også, at jeg på ethvert tidspunkt kan beslutte ikke at deltage eller trække mig fra studiet. Det er ikke nødvendigt for mig at begrunde min udtrædelse.
- Jeg ved, at jeg har mulighed for at læse interviewudskrifterne igennem, hvis jeg beder om det. Dette gælder også for de andre deltagere, som dermed får mulighed for at genlæse, hvad jeg har sagt.
- Jeg giver samtykke til, at fokusgruppeinterviewet må optages på bånd.
- Jeg giver samtykke til, at indsamlingen og brugen af mine interviewdata foregår i tråd med etablerede retningslinjer for databeskyttelse (GDPR).
- Jeg er indforstået med, at formålet med fokusgrupperne er at genere ny videnskabelig viden.
- Jeg er bekendt med, at deltagelsen i en fokusgruppe potentielt kan opleves som en følelsesmæssig belastning.
- Jeg lover at bevare fortroligheden af den information, der bliver delt mellem deltagere og forskeren i fokusgruppeinterviewet.
- Jeg lover at have et gyldigt coronapas ved tidspunktet for afholdelsen af fokusgrupperne.
- Jeg vil gerne deltage i dette studie.

Deltagerens underskrift: Kontaktpersons underskrift:

Navn med blokbogstaver:
Dato:

Translated consent form

Informed consent form for participation in focus group study on climate science communication

Description of the project

In my PhD project at the Danish Centre for Studies in Research and Research Policy at Aarhus University, I examine role perceptions among climate scientists, journalists, and citizens in climate science communication. The aim of the project is to cover the degree of agreement in the expectations of the three actors. The project is financed by Aarhus University under the programme 'Social Science and Business'.

The purpose of the focus group

The aim of the focus group is to examine how three central actors in the public climate discussion – climate scientists, journalists, and citizens – perceive the ideal delegation of roles in their interaction. The role perceptions of the three segments have hitherto been studied individually, but a central assumption of this PhD project is that it would be fruitful to examine them alongside each other. By putting together fifteen focus groups comprising Danish climate scientists, climate journalists, and citizens, I will facilitate an exploration of the actors' expectations for themselves and one another. The participants' reflections regarding their own and others' roles will later serve as the primary data material of my PhD dissertation.

Use of data and communication of results

The focus group interview will be recorded with a digital voice recorder and subsequently transcribed in a pseudonymised manner.

Each participant in the focus group interview can demand to have his or her interview data removed at any time by a simple request to Author (pbn@ps.au.dk). Data that have already been published cannot be retracted. Further, participants can ask to see the interview transcripts.

The results from the focus groups will be analysed, published, and made publicly available in one or more scientific journals. No personal information will be revealed at any point.

Breach of data security

In case of a breach of the data security, the affected participants will be contacted, and the data will be removed temporarily from the compromised storage location.

Data protection officer

Questions regarding data protection can be directed to Author (pbn@ps.au.dk).

Consent
Participation is voluntary, and the participants can withdraw from the study at any point without further justification by contacting Author (pbn@ps.au.dk).

By signing the informed consent form, you confirm that you agree to all the following points:

- I have read the provided information about the study. I have had the possibility to ask questions, and my questions have been exhaustively answered. I have had sufficient time to decide whether I want to participate.
- I am aware that participation is voluntary. I am also aware that I can decide not to participate or withdraw from the study at any point. It is not necessary for me to justify my withdrawal.
- I know that I have the possibility to read the interview transcripts if I ask. This also applies to the other participants, who will then have the possibility to read what I have said.
- I give consent to the focus group interview being recorded on tape.
- I give consent to the collection and use of my interview data taking place in accordance with the established guidelines for data protection (GDPR).
- I know that the purpose of the focus groups is to generate new scientific knowledge.
- I am aware that participation in a focus group can potentially be an emotionally distressing experience.
- I promise to keep the confidentiality of the information that is shared among the participants and the researcher in the focus group interview.
- I promise to have a valid corona passport at the time the focus group is conducted.
- I would like to participate in this study.

The participant's signature: The contact person's signature:

Name in capital letters:
Date:

Appendix X: Privacy policy

Original privacy policy

Privatlivspolitik

Indsamling, bearbejdning og brug af data

Datahåndteringen vil i hele forskningsprocessen (indsamling, bearbejdning og efterfølgende brug) ske i overensstemmelse med GDPR, EU's lovgivning vedrørende persondata samt Uddannelses- og Forskningsministeriets anbefaling om forskningsintegritet.

Den etiske godkendelse af studiet vil blive foretaget af Forskningsetisk Komité på Aarhus Universitet.

Alle deltagere vil blive præsenteret for en samtykkeerklæring forud for fokusgruppeinterviewet.

For at kunne analysere interviewdataene efterfølgende, vil fokusgruppesessionerne blive optaget med diktafon. De efterfølgende interviewudskrifter vil blive anonymiserede. Samtykkeerklæringerne vil blive opbevaret separat fra lydfilerne og udskrifterne. Fundene fra fokusgruppeinterviewene vil blive analyseret, udgivet og gjort offentligt tilgængelige. Ingen personlige oplysninger af afslørende karakter vil blive nævnt på noget tidspunkt. Dataopbevaring vil ske i overensstemmelse med GDPR-reguleringen, og det er som forskningsansvarlig Peter Nicolaisens ansvar at sikre, at følsomme data bliver beskyttet og slettet i tråd med GDPR-reguleringen.

Hver deltager i fokusgruppeinterviewet må på ethvert tidspunkt kræve, at vedkommendes interviewdata bliver fjernet med en enkelt forespørgsel til Peter Nicolaisen (pbn@ps.au.dk). Data, der allerede er blevet udgivet, kan ikke fjernes.

I tilfælde af at datasikkerheden bliver brudt, vil de berørte deltagere blive kontaktet, og data vil midlertidigt blive fjernet fra det berørte opbevaringssted.

Spørgsmål om databeskyttelse

Henvendelser vedrørende databeskyttelse kan rettes til Peter Nicolaisen (pbn@ps.au.dk).

Translated privacy policy

Privacy policy

Data collection, processing, storage, and usage

Collection, storage, and use of the data collected during the focus groups interviews will be in alignment with the European Union's General Data Protection Regulation and the Danish Ministry of Higher Education and Science's recommendation in the Danish Code of Conduct for Research Integrity.

The ethical approval of the focus group study will be obtained from the Research Ethics Committee at Aarhus University.

Before the interview, all participants in the focus group interview will be presented with an informed consent form.

In order to be able to transcribe and analyse the interviews, the focus group interviews will be audio recorded. The subsequent interview transcriptions will be anonymised. Informed consent forms will be stored separately from the audio files and transcripts.

The findings from the focus group interviews will be analysed, published, and made publicly available. No personal identifiable information will be mentioned or disclosed at any point. Data storage will comply with GDPR regulations, and it is the responsibility of the researcher, Peter Nicolaisen (pbn@ps.au.dk), to ensure that sensitive data is secured and deleted in accordance with the GDPR regulations.

Each participant in the focus group interviews may at any time demand removal of his/her interview data by a simple request to the coordinator of the study, Peter Nicolaisen (pbn@ps.au.dk).

In case of a data breach, affected participants will be contacted, and data will be temporarily removed from the compromised storage.

Questions about the privacy policy

PhD student Peter Nicolaisen (pbn@ps.au.dk) can be contacted for questions regarding data protection in the study.

Appendix XI: Ethical approval

AARHUS UNIVERSITY

To
PhD Student Peter Busch Nicolaisen
Department of Political Science
Aarhus University

Re the 'Ideal role perceptions in the triangle of climate science communication' research project
Person in charge of the project: PhD Student Peter Busch Nicolaisen
Contact/project manager: -
Project period: September 2021 – October 2021

The Research Ethics Committee

Date: 31 August 2021

Direct Tel.: +45 2899 2554E-mail: tbj@au.dk

Journal no.: 2021-0275937
Approval number: 2021-81

Sender's CVR no.: 31119103

Aarhus University's Research Ethics Committee (Institutional Review Board) discussed the project at its meeting on 31 August 2021 and came to the following decision:

Decision

The project *is approved* in accordance with Aarhus University's guidelines for the university's Research Ethics Committee (IRB) and the considerations listed in the guidelines.

The approval is granted with reference to the following documents:

- Information sheet with appendices:
  - Project description/protocol
  - Recruitment material
  - Declaration of consent
  - Timetable
  - Project manager's CV

The person or persons identified as being in charge of the project guarantee that the project is carried out as described in the referenced documents and is otherwise in compliance with applicable research ethics and data protection regulations.

Legal Support
Aarhus University
Nordre Ringgade 1
DK-8000 Aarhus C
Denmark

Tel.: +45 8715 0000
E-mail: legal@au.dk
Web: www.au.dk/en

AARHUS UNIVERSITY

As a result of the approval, subsequent academic publications which are based on the findings of the project may be provided with the endorsement that 'the project was approved by the Institutional Review Board at Aarhus University' (indicating the approval number).

The following Committee members participated in the discussion of the project:

- Palle Bo Madsen, professor (chair)
- Claus Højbjerg Gravholt, clinical professor (HE)
- Karsten Riisager, associate professor (NAT)
- Jesper Wiborg Schneider, professor (BSS)
- Erik Reimer Larsen, professor (BSS)
- Jette Kofoed, associate professor (AR)
- Nina Javette Koefoed, associate professor (AR)
- Preben Kidmose, professor (TECH)

Kind regards,

Tove Bæk Jensen
Chief consultant