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"Listen to the science!"—The role of scientific knowledge for the Fridays for Future movement

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The Fridays for Future movement (FfF) has drawn a lot of public and academic attention in recent years. So far, studies investigated the organization, mobilization, and motives of the movement from different perspectives as well as the relevance of science for FfF. Mostly from an external point of view researchers looked at the types of science communication and its reception by the audience (i.e., framing theory). In this paper, we combine theories of science communication with the resource mobilization approach in social movement studies and thereby develop a theoretical framework for the analysis of the use of scientific knowledge by climate movements. We focus on the resource mobilization theory (RMT) and the notion of activists as alternative science communicators. RMT emphasizes the role of resources and organization to explain the success of social movements. Specifically, we regard legitimacy as a moral resource and analyze the importance of communication of climate scientific knowledge for FfF as a political movement. We argue that a climate movement like FfF relies on climate scientific knowledge which serves as a moral resource when climate activists refer to it to legitimate their claims. Empirically, we draw on a survey of more than 500 FfF activists in Germany, that was conducted as a mixed method study in 2020 and 2021. Our objective is to close a gap on the relevance of science for FfF activists from the inner perspective. Following the research question "How and why is scientific knowledge being used by FfF activists to mobilize people?" the findings indicate a rather strategic use of scientific knowledge as an end in itself within the movement. Unsurprisingly, we see that individual strategic use of scientific knowledge within the movement corresponds with the belief that FfF should include scientific knowledge in the general communication strategy of FfF. Moreover, our data show that activists overwhelmingly derive their goals from scientific knowledge and reject the idea that science could be used imprecisely just as an instrument to attain their goals. These learnings shed light on the question of whether science is used as a moral resource within climate movements like FfF.

KEYWORDS

Fridays for Future, climate communication, scientific knowledge, science communication, social movement, climate movement, citizen science, youth participation

Introduction

The global climate movement Fridays for Future (FfF) began in 2018 as a single protest by the Swedish schoolgirl Greta Thunberg and initiated a huge media response and protests around the globe. These protests of young students with their demands to comply with the Paris Climate Protection Agreement attracted a lot of public awareness and support. Scientific observations followed as this case seemed to show some differences from other movements in the demographics, the motives, and the use of various media. In particular, studies focused on the development, mobilization, and framing of the social movement (Haunss, 2020; Sorce and Dumitrica, 2021; Von Zabern and Tulloch, 2021). Additional studies looked at the motives of the protesters on the streets and identified strong personal and social values as motivating factors (Huttunen, 2021; Wallis and Loy, 2021). The increased reactions of established organizations, like political parties and political actors but also the school system (Deisenrieder et al., 2020; Holfelder et al., 2021) as well as the scientific community (Kühne, 2019; Fopp et al., 2021) have been analyzed. A broad variety of reactions became visible since some actors supported the strong claims of FfF while others tried to harm the movement (Raisch and Zohlnhöfer, 2020; Berker and Pollex, 2021). The movement has also received some academic attention from the inner perspective to show how the activists operate within local groups (Haunss, 2020; Rucht and Rink, 2020) or how they managed to continue their activities during the Covid-19-Pandemic (Mucha et al., 2020; Hunger and Hutter, 2021). An intensively discussed slogan and a possible explanation for the success of the movement has been the movement's claim to "listen to the science" (De Moor et al., 2021; Rohden, 2021; Hanusch and Meisch, 2022). But what does that mean for the movement within the inner circles? How do the very activists respond to this claim in their activism? What differences are there in the relevance of scientific knowledge for the activists? It is of utmost interest to investigate how the activists themselves use science and scientific knowledge in the context of "their" movement. These considerations form the starting point of this paper and will guide the following chapters.

As the basis of our study, we draw on a novel survey of more than 500 Fridays for Future activists in Germany to investigate the use of scientific knowledge and attitudes toward science in the movement. With our survey design, we analyze the behavior of the core activists of the Fridays for Future movement who are engaged in the movement's planning, decision-making, and mobilization actions on an organizational basis. This is a rather novel approach since so far most of the studies on FfF focused mostly on the perceptions and opinions of the protesters on the streets who were joining the climate protests (Koos and Lauth, 2019; Wahlström et al., 2019). Moreover, we address already identified research gaps—which will be presented later in this paper—and involve further disciplines to broaden the view on climate science. As the renowned climate (natural) scientist Von Storch (2019) pointed out, there is a need for a social and cultural scientific climate science that deals "with the instrumentalization of climate knowledge" (p. VII). The following article feeds into that gap. We combine theories of science communication with the resource mobilization approach in social movement studies. Thereby, we develop a theoretical background for the analysis of the importance and use of scientific knowledge for climate movements like the FfF protests. We argue for an approach that interprets scientific knowledge as a source of moral legitimation used by the FfF movement.

In our empirical investigation, we follow the research question: How and why is scientific knowledge being used by FfF activists to mobilize people? Therefore, we developed a matrix of four opposing dimensions concerning the way scientific knowledge is being used on a scale between "strategically" and "spontaneously" as well as the purpose of the use in a range between "scientific knowledge as an instrument" and "scientific knowledge as self-purpose". This dimension concept derives from the theoretically built argument explained later in this paper, that FfF activists regard science as a moral resource and use it accordingly as a useful means to achieve their goals. To which degree and with what kind of variations they agree with this argumentation are the most interesting aspects of this work.

Our results suggest that the activists think that it is important to include scientific knowledge in the overall strategy of FfF in general, but at the same time individually tend to use scientific knowledge according to the occasion also more spontaneously. When it comes to the purpose of the use of scientific knowledge the data show significantly that the activists have a strong identification with scientific knowledge as the self-purpose and therefore use this knowledge accordingly. We, therefore, conclude that the FfF activists themselves regard and therefore apply scientific knowledge on climate change as a source of legitimacy.

In the following, we will unfold the relevant aspects of the topic's state of the art and explain how we combine the theoretical approaches needed to analyze the depicted problem (2). After that, we introduce the applied methodical research design (3). The focus of our paper lies in the presentation (4) and discussion (5) of the main findings.

Scientific knowledge within Fridays for Future

In this chapter, the main theoretical approaches, discussions, and empirical findings concerning FfF's use of scientific knowledge found in the existing literature will be summarized and finally pointed to the leading research interest of his paper.

Therefore, the following section is divided into three parts: First, a general overview of the activists participating in the movement and the relevant theoretical discussions will be given as well as an assessment on the FfF's findings on the communication. Second, based on these descriptions of the state of the art, the specific theoretical approach of this paper will be outlined. Finally, in a concluding section, the essence of these theoretical approaches is sharpened to support the logic of the research interest and the guiding research question.

Existing theoretical discussions and empirical findings

The Fridays for Future movement in Europe is mainly constituted by well-educated, female persons under the age of 25—especially in the beginning—and therefore differs from the traditional image of protesters (Wahlström et al., 2019; De Moor et al., 2020; Haunss, 2020; Gardner and Neuber, 2021). In that regard, two interconnected arguments have been emphasized in the literature: The ability of the movement to mobilize people who had not been involved in political activism before and the mobilization of young female protesters (De Moor et al., 2020; Wallis and Loy, 2021; Noth and Tonzer, 2022). Studies of the "core" activists who are involved in the inner organization and constitute the local groups show that these particularly engaged activists are even younger than those who mainly engage in protesting (Mucha et al., 2020). The main drivers to participate in the protests are, among others, interpersonal contacts, personal norms, identification with other activists, and trust in climate scientists (De Moor et al., 2020; Cologna et al., 2021; Wallis and Loy, 2021). In this respect, the role of young women as leaders of the movement has also been highlighted (Noth and Tonzer, 2022). Moreover, FfF protesters seem to adopt a more climate-neutral lifestyle compared to other people in their age group (Cologna et al., 2021). In terms of the movement's political goals, different opinions seem to exist. While the basic claim of the movement is to abide by the goals of the Paris Agreement (Wallis and Loy, 2021, p. 1), some want to pursue more fundamental societal change, others mainly emphasize the need for urgent political action in regard to climate policies (Marquardt, 2020; Huttunen, 2021; Svensson and Wahlström, 2021).

As to the role of social media as intensively used tools to mobilize protesters and for internal communication as well as organization, studies show, that FfF is highly involved and present on various social media platforms. Since their main group of followers is rather young and already active on social media, the strategy of motivating these supporters online to show up at the demonstrations seems obvious and is therefore successful (Wahlström et al., 2019; Boulianne et al., 2020; De Moor et al., 2020). According to their data on FfF Spain Soler-i-Martí et al. (2020) describe "a close and mutually-reinforcing relationship between the movement's activity on the street and on social networks" (p. 111). Especially the dominant role of Greta Thunberg and other mostly female leaders in social media is often explained by their iconic status that is possible because of the specifics of the "new social media ecology" (Olesen, 2022): "Social media communication is a path-breaking form of communication because it provides new degrees of co-performing reciprocity and intimacy in the relationship between iconic protagonist and audience" (Olesen, 2022, p. 15). Even during the first restrictions of the Covid-19-Pandemic the movement managed to shift its mobilization to the digital sphere and organized digital protests and other activities on social media which showed how resilient and already digital the movement operates (Mucha et al., 2020; Hunger and Hutter, 2021; Sorce and Dumitrica, 2021).

As mentioned above our objective in this paper is to have a closer look at the relationship between science communication (specifically the use of scientific knowledge) and the Fridays for Future movement. Therefore, we focus on the use of scientific knowledge by the very activists inside the organization rather than analyze how FfF's use and communication of scientific knowledge is picked up by the media or consumed by the audience. In recent research different wording occurred when the use of science is referred to. While some papers use the term *scientific evidence* (De Moor et al., 2021; Gardner and Neuber, 2021) or *scientific knowledge* (Marquardt, 2020) others synonymously switch between the related terms *scientific information*, *evidence,* or *knowledge* (Fähnrich, 2018; Fähnrich et al., 2020). Therefore, in this paper, we choose to use the term *scientific knowledge* and refer to the wider understanding of the empirically gathered state of knowledge concerning climate change. Nevertheless, we are aware of a deviating use in the various studies and therefore include those findings even if the wordings differ from our explicit definition.

Research gap

With the focus on scientific knowledge applied by the very activists, we try to close a research gap and enhance our knowledge on the relevance of science for Fridays for Future activists from the inner perspective. This approach derives from and also complements the existing literature on this topic. By now, some research has been undertaken to understand the relevance of science for the movement, since from the very beginning Fridays for Future has built its claims on scientific evidence and the opinions of experts within climate research. In one of her speeches the main figure, Greta Thunberg, asked the audience "to listen to the science" (Marquardt, 2020; Kern and Opitz, 2021; Olesen, 2022). Different research questions have been applied on this basis and the importance of science communication. Mostly from an external perspective researchers looked at the types of communication in the context of FfF and its reception by the

audience. Therefore, the climate movement has been examined by applying various theoretical and methodical approaches (Daniel et al., 2020; Holmberg, 2021; Von Zabern and Tulloch, 2021). In the following, we summarize the relevant theoretical approaches as well as findings on this topic to show that there is existing knowledge on which we can build our research. In doing so, we will only introduce the necessary perspectives and will later present them in a new combination suitable for our needs. Therefore, the very commonly applied framing theory in the context of climate communication and Fridays for Future will not be included in this introduction. Nevertheless, we want to mention the vast empirical studies on the relevance of media and communication processes as combinations of the framing theory and qualitative analysis of the existing media contents (press and social media). Most literature on FfF that applies framing concepts focuses on a content and audience-related perspective of the implemented science communication. In these studies it has been revealed that media coverage often emphasizes the movement's events and activities rather than the actual issue of climate change or the movement's demands (Daniel et al., 2020; Svensson and Wahlström, 2021; Von Zabern and Tulloch, 2021). The importance of science communication of the movement's activities remains unilluminated: "According to the protest paradigm, news frames of protests are more episodic than thematic, thus reducing protests to an event, rather than focusing 'on the issues the movement seeks to address" (Von Zabern and Tulloch, 2021, p. 27). When looking at the usage of scientific knowledge Daniel et al. (2020) show that there is a strong emphasis on science since solutions and possible ways out of climate change are publicly transported with a focus on arguments built on scientific knowledge (p. 11). Also, Han and Ahn (2020) agree on the huge relevance of scientific findings for the climate movement's communications strategies that have "influenced the narrative settings of the youth climate movement" (p. 9).

Agents of change

A promising research approach to the relevance of science for the movement is made by considering the activists as *agents of change* (Han and Ahn, 2020). Here, activists see their role as agents who pursue change with the argumentative power of climate science. It, therefore, functions as a fundamental pillar of the movement's narrative. Since the young activists can not yet be effective enough because they seem to lack a certain status, experience, and network they focus on the undeniable facts of climate science: Thunberg "therefore urged politicians to listen to scientists, if not the youth strikers themselves, in enacting drastic climate change policies" (Han and Ahn, 2020, p. 11). Also, Rödder (2020) agrees by showing that climate movements use scientific knowledge strategically for environmental communication and therefore strengthen their objectivity and so act simultaneously as agents for environmental issues and climate science (Maeseele, 2009). In this regard, Friberg (2022) describes the narratives of FfF as not focused on just one story, but rather parallel strings are being followed with the main goal to mobilize and create awareness for the issue of climate change. The author argues, that these young activists "offer a new kind of discourse, one that is non-postpolitical, nonpopulist, and non-postapocalyptic" (Friberg, 2022, p. 49).

Moderate approach and radical approach

Marquardt (2020) ideas point in a different direction by focusing on the various positions of the FfF activists regarding the relevance of science to the movement. He distinguishes between a *moderate approach* and a *radical approach* toward science within the inner circles of FfF. While from the former view climate science is seen as a neutral guiding concept to accompany climate policies and decisions the latter fraction is more radical. From this perspective, scientific knowledge-making cannot be seen without the dimensions of political and power dynamics and therefore has to become more political (Marquardt, 2020, p. 13). Marquardt (2020) shows that on the one hand FfF activists are highly orientated to and rely on scientific knowledge as their leading paradigm: "Leading figures of the movement [...] are unified by a strong belief in science and evidence-based climate politics, and they often refuse to take strong political positions" (p. 7). Also, the overall use of scientific knowledge is being estimated within a realistic scope, as they are seen as useful "cornerstones of societal progress and solution to current problems" (Marquardt, 2020, p. 12). At the same time, it seems clear that they cannot function as means to transform society at large. But on the other hand, the more radical forces within the movement demonstrate their strong notion for a massive political turn leaning on climate science in general and explicitly on the IPCC and the Paris Agreement as a common ground for their activism (Marquardt, 2020, p. 8).

It has been made clear that the promotion of scientific knowledge by Fridays for Future varies and scientific legitimation seems to play different roles for the activists. Therefore, it is an unresolved issue in which way exactly the movement uses scientific knowledge.

New theoretical framework to connect social movements with science communication

In the following, we will construct a theoretical framework based on theories of social movement and science communication to offer a new perspective on the subject. Building upon this, we will examine the relationship between scientific knowledge and the Fridays for Future movement in Germany empirically.

Social movement theory

The history of social movement theory has long been characterized by competing approaches and schools of thought (Koopmans, 1998). Classic social movement theories have focused on individual grievances as a precondition of social movements (e.g., Gurr, 1970) or questions of collective action (Olson, 1971; Saunders, 2013, p. 10). The resource mobilization theory (RMT) challenged this view in the 1970s and shifted the theoretical focus. For RMT scholars, grievances were secondary (Jenkins, 1983, p. 530). They emphasized the role of resources and organization to explain the success of social movements (McCarthy and Zald, 1977). In later years, further approaches in theoretic literature broadened our view on social movements, such as Framing (Snow et al., 1986; Benford and Snow, 2000), Political Opportunity Structures (Eisinger, 1973; Kitschelt, 1986), collective identity (Polletta and James, 2001) or connective action (Bennett and Segerberg, 2012).

Resource mobilization theory (RMT)

In this paper, we will focus on the resource mobilization theory, which has been increasingly used since the early 2000s (Edwards et al., 2018, p. 91f) and also as a theoretical framework in the context of Fridays for Future (Laux, 2021). "[W]hen compared to other key SM perspectives, [RM theory] remains a strong predictor of collective action and social movement involvement" (Edwards et al., 2018, p. 92). Edwards and Kane (2014) argue that the role of resources and therefore RM theory itself is often implicitly used as a core assumption in the literature. According to them, it even underlies studies that analyze social movements with different frameworks such as framing theory.

McCarthy and Zald (1977) have prominently theorized the RM approach. Their premise is the central importance of resources and organization. According to RM theory, the emergence and mobilization of a social movement depend on the societal resources available and how they can be organized. It is the task of Social Movement Organizations (SMOs) to aggregate and transfer resources into action "in order to work toward goal achievement" (McCarthy and Zald, 1977, p. 1220). However, the understanding and definition of resources differed significantly. Different authors have suggested different conceptualizations of resources (McCarthy and Zald, 1977; Freeman, 1979; Cress and Snow, 1996). McCarthy and Zald (1977) themselves use a rather unexplained concept of resources which includes time, money, and labor, but also legitimacy. "Later theorists moved beyond material resources to identify a less tangible set of resources, often referred to as cultural resources" (Bomberg and Hague, 2018, p. 583).

In our work, we draw on the reformulation of RM theory by Edwards and Kane (2014) which has already been laid out in earlier years (Edwards and McCarthy, 2004). Edwards and Kane criticize a narrowing of the concept of resources to money, time, and organization as three core resources. They suggest a differentiation into five categories of resource types. This categorization theorizes the concept of resources on the one hand more broadly than previous ones and on the other hand avoids defining almost everything as a resource (Edwards and Kane, 2014, p. 212). This newer approach to RM theory has been applied in several publications over the last few years (Khadse et al., 2018; Gillham et al., 2019; Reda et al., 2021).

The resource types conceptualized by Edwards and Kane are material, human, social-organizational, cultural, and moral, as can be seen in Table 1 (Edwards and Kane, 2014, p. 212–218). Material resources are needed for apparent reasons and have often been analyzed as they are easy to operationalize. Material resources are the kind that Freeman (1979) categorizes as tangible assets. The second resource type, human resources, are rather tangible as well: They include labor, time, skills but also expertise and leadership (Edwards and Kane, 2014, p. 213) and can for example help the emergence of movements, where finding support for niche interests becomes more likely (Fetner and Kush, 2008). Another type is social-organizational resources such as the formal organization and structuration of a movement—in the Fridays for Future case their grassroots organization (Fridays for Future Germany, 2021a). Social networks and infrastructure can also be subsumed as social-organizational resources and prove necessary to keep a movement like FfF going, especially in times of crisis (Mucha et al., 2020; Hunger and Hutter, 2021). Cultural resources are a type of resource that has received increasing attention in recent decades. Action groups socially construct frames that interpret their actions against the backdrop of the societal and political context, e.g., they combine civil rights concerns with environmental racism frames (Edwards, 1995). Last, and most importantly for our investigation, social movements

TABLE 1 Resource types as conceptualized by Edwards and Kane (2014).

Resource type	Material	Human	Social organizational	Cultural	Moral
Example	Money, property, equipment	Labor, experience, skills	Infrastructures, networds	Identity, values, beliefs	Legitimacy, authenticity, solidary support

mobilize moral resources that include among others legitimacy, authenticity, and solidary support. Moral resources "often originate outside of a social movement or SMO and are bestowed by an external source known to possess them" (Edwards and Kane, 2014, p. 217). Publicly respected figures or organizations can thereby strengthen a movement.

Since many approaches to measure the different types of resources and their influence on social movements are possible, and the need and use of resources for a particular movement depend on its specific goals (Opp, 1998, p. 96), one must necessarily focus on a particular type. A RM perspective has been applied to study the success of FfF as a global movement (Laux, 2021), but hardly any attention has been paid to moral resources so far. In the following chapter, we will therefore focus on legitimacy as a moral resource. To achieve this, we will integrate the RM perspective outlined above with theoretical approaches of communication science to argue that scientific knowledge can be an effective source of legitimacy as a moral resource for Fridays for Future. Despite these arguments, it has to be mentioned, that scientific knowledge as a moral resource is contradictory at a certain theoretical level. Since the nature of scientific knowledge is regarded as objective, it is questionable, how it can have a normative, in this context a moral dimension at the same time. Especially when used politically motivated as an instrument and resource within a movement, it certainly loses its objectivity. This contradiction will be addressed later in the methodological and empirical part when the explicit motives of the use of scientific knowledge as a resource will be analyzed.

Alternative science communicators and sense making theory

In line with Yearley (2014), our claim is that the communication of climate science knowledge is important for Fridays for Future—or the climate movement in general—as a political movement. This knowledge can serve as a moral resource when climate activists refer to it to legitimate their claims. Pezzullo and Cox (2017) illustrate that in the 20th century policymakers sought to strengthen their credibility in an increasingly complex and technical societal environment by relying on scientific criteria and experts' advice—a trend that was later supported by popular culture. They argue that science culturally has gained a significant kind of *symbolic legitimacy* since a certain authority and credibility have been associated with this source of knowledge. Especially when it comes to environmental science this observation of a source of legitimacy has been made (Pezzullo and Cox, 2017, p. 144).

Fähnrich (2018) builds on this perspective to theoretically construct the concept of activists as *alternative science communicators*. According to her observations they use scientific knowledge, implement this very moment of symbolic legitimacy of science to strengthen their claims, and strategically use science to influence political and economic decision processes as well as mobilization activities (Fähnrich et al., 2020, p. 2). From this theoretical perspective activism and science communication are interrelated and in need of each other. On the one hand, activists use and therefore rely on scientific knowledge to inform, educate and persuade the public. On the other hand, scientific knowledge depends on activism to spread messages and raise awareness of certain problems (Fähnrich et al., 2020, p. 2). There has been a close relationship between science communication and environmental communication, so "activists refer to and use scientific evidence to substantiate their argument" (Fähnrich, 2018, p. 2.). In the case of Fridays For Future, it can be stated that this movement's activists can be categorized as alternative science communicators. By now, numerous studies have emphasized the importance of claims like "Listen to the science!" (Daniel et al., 2020; De Moor et al., 2021). FfF uses science as argumentative power (Han and Ahn, 2020) and works closely together with spin-offs like Scientists for Future that publicly endorse the movement's claims (Fopp et al., 2021). Feldman's (2020) study on climate school strikes in Australia shows that the different campaigns organized by FfF activists made use of science to enhance the credibility and use pathos to address the young strikers emotions and values (Feldman, 2020; p. 4). Thereby, the scientists and their expertise legitimate the movement's claim.

Yet, the activists deal with scientific knowledge on a regular bases, but still, they are not scientists and therefore might not have the scientific literacy needed. Therefore, the concept of *sense making* (Weick, 1995; Dervin, 1998; Naumer et al., 2008) helps to understand how environmental activists interpret and make sense of and finally use scientific knowledge (Fähnrich, 2018, p. 4). "Sense-Making focuses on how messages are understood by receivers of information and communicated in their life contexts recognizing that there are differences in people's understandings, expertise, social positions, situations, and other factors that impact sense-making" (Naumer et al., 2008, p. 2). In the last decades, this approach focused on how "people make sense out of information" (Naumer et al., 2008, p. 1) shifting away from a transmission model which analyzes sent messages, senders, and receivers to an alternative model. Following this new model, messages are no longer fixed information sets to be sent and received but rather constructions that are being developed by the receiver and within the interaction between people. With this understanding, people are like designers, trying to make sense of the information they receive to complete their own reality instead of seeking information in an attempt to gain a complete and objective understanding of a shared reality (Weick et al., 2005; Klein et al., 2006; De Jaegher and Di Paolo, 2007 Naumer et al., 2008, p. 5; Holt and Cornelissen, 2014).

In her argumentation Fähnrich (2018) focuses on the way activists reflect on the importance of science for their work, as well as on the way they make sense of science, and finally how they use scientific knowledge to speak up. She argues that

in this way we gain an understanding of the "environmental activists' information systems" (Fähnrich, 2018, p. 2) and also get an idea of their strategic use of science as alternative science communicators. She, therefore, explores how scientific information is understood and made sense of. In this context, she points out that little research has been undertaken on the activist's motives and application of scientific information (Fähnrich, 2018, p. 2). Therefore, she emphasizes, that the actual value and relevance of scientific knowledge for the activists still need some illumination, because it is not clear if activists are actually following the "normative demands and value systems of science and science communication" and therefore lack neutrality and objectivity (Fähnrich, 2018, p.3). Also, on the one hand, recent studies show that activists apply a more utilitarian use of scientific knowledge which can be categorized as a tool of symbolic legitimacy. On the other hand, other studies reveal that they "use scientific information largely unconsciously and automatically" (Fähnrich, 2018, p. 12 f.). Therefore, this obvious interrelation between the use of scientific knowledge and activism as well as the role of alternative science communicators has thus far not been analyzed sufficiently (Fähnrich et al., 2020, S. 3).

Research focus: The role of scientific knowledge as a moral resource

This paper addresses a relevant research interest along three already mentioned aspects. *First*, following the idea of activists as *agents of change* (Han and Ahn, 2020) and also the work of Marquardt (2020) on the distinction between a *moderate approach* and a *radical approach*, our paper picks up the leads on the different handling of scientific knowledge within FfF to further elucidate this relationship:

> "Despite the group's focus on an effective implementation of the Paris Agreement and its translation into ambitious climate legislation, more critical protestors and subgroups envision a radically different future through power shifts, forms of democratization and social justice which goes far beyond a de-politicized understanding of climate change. Exploring these forms of fundamental contestation is needed to shed light on FfF's broader political and societal effects." (Marquardt, 2020, p. 15).

Second, from the theoretical perspective of the *alternative science communicators* (Fähnrich, 2018) our analysis feeds into research desiderata mentioned in previous works. Fähnrich (2018) states that it is not clear, how activists integrate scientific knowledge into their work, "which processes and practices they apply, and which strategies underlie these translation processes" (Fähnrich, 2018, p. 3). Understanding the movement's use of scientific knowledge and the motives behind it seems to still be unilluminated. Especially with the growing interest of the public and political actors in science communication, it is important to know more about the movement's position on the relevance of science and also the "instrumentalization of climate knowledge" (Von Storch, 2019, p. VII). *Third*, our paper picks up Fähnrich (2018) and Fähnrich et al. (2020) argumentation on the conceptual framework of *sense making* by extending her perspective on how activists seek, understand, and construct scientific knowledge on how they implement it in their movement's work.

These mentioned theoretical approaches are linked and enable us to have a closer look at the use of scientific knowledge from an RMT perspective. Based on the described relevance regarding the importance of the use of scientific knowledge in the activism of FfF, we composed the leading research question: How and why is scientific knowledge being used by FfF activists to mobilize people? Following a descriptive approach to this question, we first concentrate on the way scientific knowledge is implemented in a range between "strategically" and "spontaneously". Secondly, we also focus on the motives behind this behavior in a range between "use scientific knowledge as an instrument" and "use scientific knowledge as self purpose". Therefore we operationalize a matrix with two opposing characteristics for each part of the question ("how" and "why") to identify, where the majority of the activists situate themself. Additionally, we make a differentiation concerning the activists attitudes and their positions on the movement's use of scientific knowledge (see Figure 1).

Methodology

The data for this article originates from a citizen science research project that has been conducted in 2020 and 2021 (Mucha et al., 2020). All methodological considerations and empirical steps were based on a citizen science approach (Irwin, 1995; Hecker et al., 2018; Haklay et al., 2021). The main ideas of a citizen science approach are to involve so-called lay people as co-researchers in the research process, to include innovative ideas in the project, receive exclusive access to the field and promote participation in science in general in society. Both sides benefit, as citizen scientists contribute to the research project with an open perspective and at the same time gain new insights and expertise in terms of scientific literacy (Hecker et al., 2018; Haklay et al., 2021).

In this project, ten Fridays for Future activists from the Düsseldorf area were involved as co-researchers in a multi-step research process over 12 months. To recruit these co-researchers the research team at the University of Düsseldorf contacted the local FfF group via official channels (Website and Telegram group), presented the project and offered the activists the opportunity to join the project as a citizen scientist in one of the weekly meetings before the official start of the project. In the

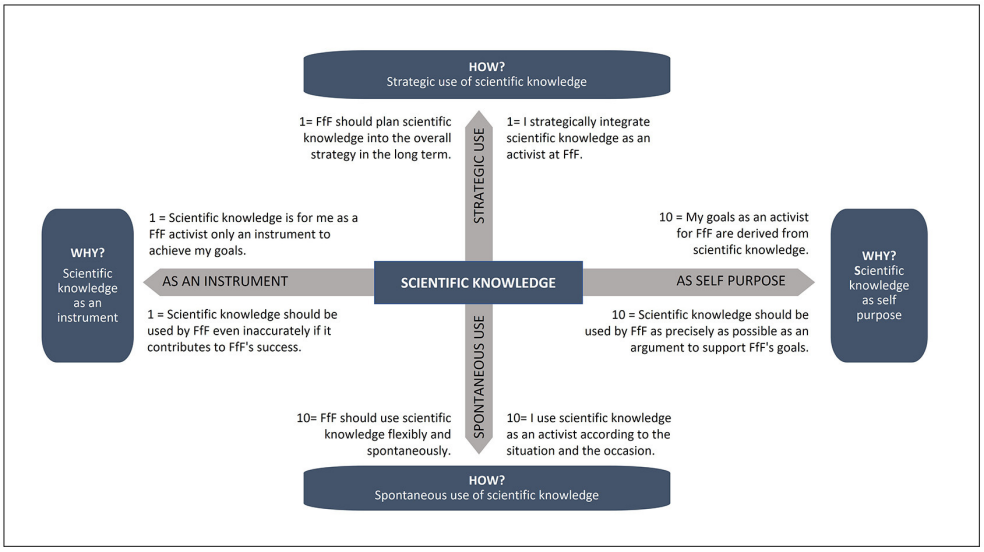

FIGURE 1
Four main complementary dimensions and their items along the research question "How and why is scientific knowledge being used by FfF activists to mobilize people?".

end, ten of the interested twenty participants were selected as co-researchers with a focus on diversity in terms of age, gender, and experience. Within five workshops and an accompanying online collaboration, the established researchers and the selected co-researchers developed the research project. Each workshop was dedicated to a different research phase (research question, survey design, survey, evaluation, publication) and always started with a brief insight into the procedures of social science research and led to the mutual development of new ideas and impulses for the upcoming research phases.

This way, the co-researchers from outside of academia contributed a wide knowledge of the structures and peculiarities of FfF as well as unexpected, creative, and innovative ideas for all research phases. Without explicitly pointing to a specific research gap, the co-researchers developed a research question concerning the decision making process of the movement. Similarly, qualitative methods such as participant observation were derived from the co-researcher's perspective. Another valuable aspect of the collaboration with the activists was the access to the local group meetings, interview partners, and the network structures for distribution of the online surveys.

Finally, the mixed-method design consisted of observations, interviews, and a quantitative online survey. Although the theoretical research literature allowed for a deductively generated category development, inductive insights gained within the qualitative phase (observations and interviews) complemented this category structure. These new impulses for items were included in the following online survey. This *between-method triangulation* (Flick, 2020) enabled exploratory in-depth research on the experiences of the interviewed and observed FfF activists while the findings from the standardized online questionnaire verified the findings on a broader comparative scale. At all stages, the established researchers ensured that scientific standards were met. Therefore, it was important to communicate to the co-researchers in great detail why decisions were made and certain steps were taken. In addition, there was always enough time for reflection and explanation to emphasize the importance of scientific rules and procedures.

Specifically, seven participant observations in local groups and delegates' conferences as well as twelve interviews with activists from different local groups and functions were conducted. Since the project followed a greater research interest [concerning decision-making processes], the items concerning the relevance of science within the movement just played a smaller role in the whole study. In addition, questions about possible influencing factors and demographics (age, competencies, degree of activity) were designed. To apply a variety of descriptive as well as bi- and multivariate statistical analysis methods, the final 22 questions and sub-questions were composed in different item batteries and scale levels.

At the time of the sampling in April 2021, FfF had listed 676 groups across Germany on its official website (Fridays for Future Germany, 2021b). This list included not only messenger channels of local groups but also regional or supra-regional FfF groups. Of these groups, 500 were randomly selected. The randomly drawn groups were joined via the messenger app Whatsapp; if this contact channel was not accessible,

alternatively via Telegram. In some cases, it was not possible to join the groups via both channels, so contacting 58 groups was not possible. Thus, the survey could finally be sent to 442 (local) groups via Whatsapp or Telegram. In addition, the co-researchers of the citizen science project distributed the survey internally. 507 participants completed the survey and the completion rate was 65%. The survey period ran from 04/16/2021 to 05/23/2021.

The research interest in the relevance of science, which is the focus of this paper, arose only after the qualitative phases were completed and emerged as an unintended outcome during the interviews. We had the impression that some of the interviewees were guided by a strong ideological identification with scientific knowledge and at the same time had to decide in their engagement how to effectively use scientific knowledge to mobilize people. It became visible to us that the activists constantly had to make practical decisions concerning different activities. Also, the interviews revealed that the activists have very diverse skills, and (time) resources, and therefore also their commitment to the topic and the claim of FfF varied. One activist describes: "So the movement is definitely very diverse. We are all fighting for the same things concerning the climate. But we are actually very different people" (Interview 1). We learned that within FfF different informal hierarchies and personal factors like skills, networks, and specific knowledge had a high influence on how decisions were being made. However, because the role of scientific knowledge was not consistently addressed in the qualitative phase, we cannot draw any reliable conclusions from this qualitative data, other than some insights at an exploratory level. Nevertheless, these few insights led us to the conclusion, that also there must be conflicts about the motives of how scientific knowledge is implemented in daily activism. This assumed ambivalence led to the idea of exploring this further in the online survey.

Based on these explorative impressions four, main complementary dimensions were constructed to answer the question about the role of science for Fridays for Future. To gain knowledge about to which degree the activists find scientific knowledge relevant against the backdrop of these four dimensions—for themselves and the movement—we applied a scale from 1 to 10 and placed opposing statements on each end of the scale. The following figure illustrates the question concept (Figure 1).

By forcing the activists in the survey to choose between the opposing poles, we were hoping to get some ideas on how these characteristics relate to each other. But, of course, it has to be made clear, that the items are selected in such a way that bias is likely. It is kind of expected that the activists might have a hard time choosing between the item of using scientific knowledge "only as an instrument" and "as leading for the goals as an activist". Also, it might be unlikely to expect anyone to agree to using scientific knowledge "inaccurately if it contributes to the success". Nevertheless, we think that it was worth looking into these contradicting dimensions to find out more about the motives of activists in terms of the use of scientific knowledge.

Main findings

In the following chapter the main results from the quantitative online survey will be presented along the four opposing characteristics (1) "strategic use of scientific knowledge" vs. (2) "spontaneous use of scientific knowledge" and (3) "use of scientific knowledge as an instrument" vs. (4) "use of scientific knowledge as self-purpose" against the backdrop of the theoretical foundation as well as the presented state of research.

Beforehand, the participants were asked to rate how important it is to them that arguments in discussions at FfF are based on scientific knowledge. The results clearly show that scientific knowledge is very important to the activists: Almost two-thirds of the activists rate the scientific basis of an argument as "very important". This also shows in the high mean ($m = 6.42$; ranging from 1 to 7) and the low standard deviation (sd $= 0.97$). These findings corroborate the existing literature on the high trust in climate science among FfF activists (Cologna et al., 2021) and the aforementioned assumption that the reference to science and scientific knowledge is important to them in general.

The results presented in the following are focusing on the already mentioned dimensions along the diametral opposing poles of the question "How and why is scientific knowledge being used by FfF activists to mobilize people?" First, we look at the results concerning the way scientific knowledge is being implemented by the activists. Our data show that according to the majority of the activists "FfF should plan scientific findings into the overall strategy in the long term" rather than "FfF should use scientific knowledge flexibly and spontaneously". On a scale from 1 (strategically) to 10 (spontaneously), the mean here was $m = 4.18$. The picture is different though when it comes to the individual use of scientific knowledge within the movement. Here the mean ($m = 5.46$) is only slightly in favor of a strategic use against a more flexible implementation "according to the situation and occasion" (Figure 2).

It becomes visible that if forced to decide between a strategic and spontaneous application of scientific knowledge it seems easier to make general statements on how the movement should act in this matter. But the opinions are more diverse within the movement when it comes to personal behavior and beliefs. Even though the data shows a slight majority that tends to use scientific knowledge rather strategically, a quarter of the activists decide to locate themselves almost in the middle of the scale (5 out of 10).

Regarding the use of scientific knowledge, the answers on the level of the whole movement and the individual level clearly

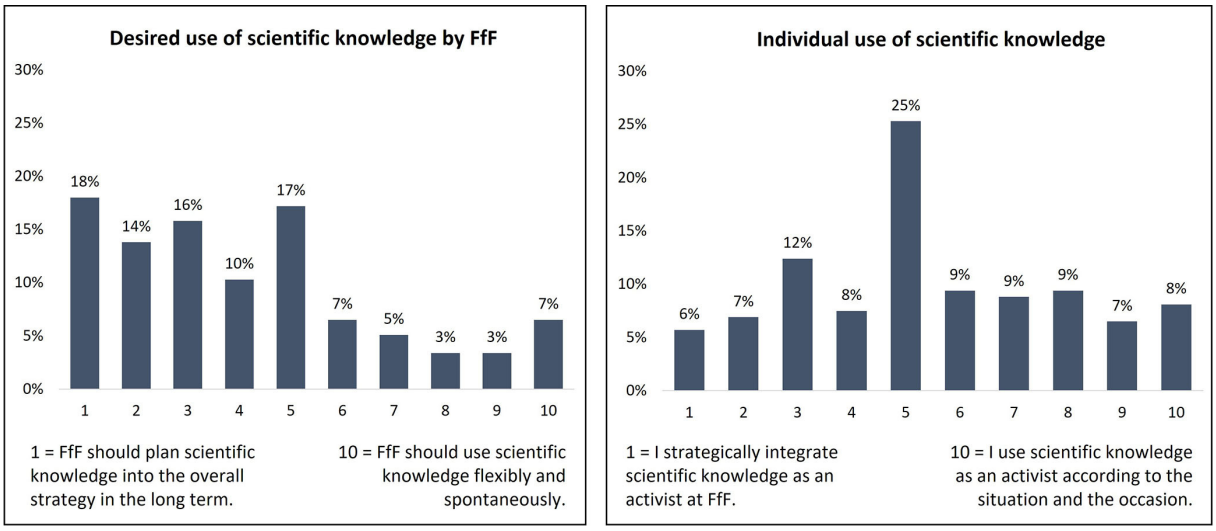

FIGURE 2
Use of scientific knowledge by Fridays for Future activists on the movement and individual level in the range between "strategic" and "spontaneous".

correlate ($r = 0.36$; Figure 3). This shows that the ideas about the use of scientific knowledge are generally consistent on both levels, concerning the movement as a whole and the individual. Yet, opinions on the use of knowledge diverge more than on the other two variables. The standard deviations for both variables regarding the use of scientific knowledge (2.51 and 2.63) are higher than for the variables regarding motives and precision (1.98 and 2.09). In summary, more than 50% of the surveyed activists can be allocated in the bottom left quadrant which implies a rather long-term and strategic use of scientific knowledge on both levels. Almost a fourth use scientific knowledge rather flexibly and spontaneously individually but they desire rather a long-term and strategic action from their movement (Figure 3). This may well be because it is hard for the individual to adopt a strategic use for themselves especially as they may not be knowledgeable enough to feel like doing so. However, this can be desired from FfF which does not come as a surprise since they have specialized working groups, e.g., on communication and social media.

When looking at the data concerning the purpose of the implementation of scientific knowledge it becomes visible that activists overwhelmingly derive their goals from scientific knowledge and rather reject the idea that science should be used imprecisely to attain their goals (Figure 4). Therefore, the majority stated that on the movement level knowledge should be used "as precisely as possible as an argument to support FfF's goals" (Scale 1 to 10; $m = 8.54$). Likewise, on the individual level, most activists stated that scientific findings are not used exclusively as an instrument but that they rather overwhelmingly derive their goals from scientific knowledge for their activism ($m = 8.53$).

Interestingly the views on both levels strongly correlate, with Pearson's r being 0.45. Additionally, the standard deviations for both variables are quite low (as self-purpose: 1.98; precision: 2.09). The overwhelming majority of activists is allocated in the upper right quadrant, implying a rather precise use and use as self-purpose. Therefore, it can clearly be stated that most activists dislike an imprecise and instrumental use of scientific knowledge that favors political or societal goals over goals that can directly be derived from scientific knowledge. These results, therefore, suggest that when it comes to the motives behind the activities, activists seem to identify strongly with the movement's ideological principles (Figure 3).

Discussion

We have shown that the Fridays for Future activists regard scientific knowledge as relevant for their engagement within the movement in general and favor arguments that are based on scientific knowledge. This overall finding feeds into the existing studies on the movement presented in this paper, e.g., the higher trust in climate scientists among FfF activists (Cologna et al., 2021). In this context, Daniel et al. (2020) already pointed out that scientific knowledge is used from the *diagnostic framing* perspective, and also Han and Ahn (2020) observed the orientation of FfF activists on science as *agents of change*. So far, it was already stated that the movement sways between

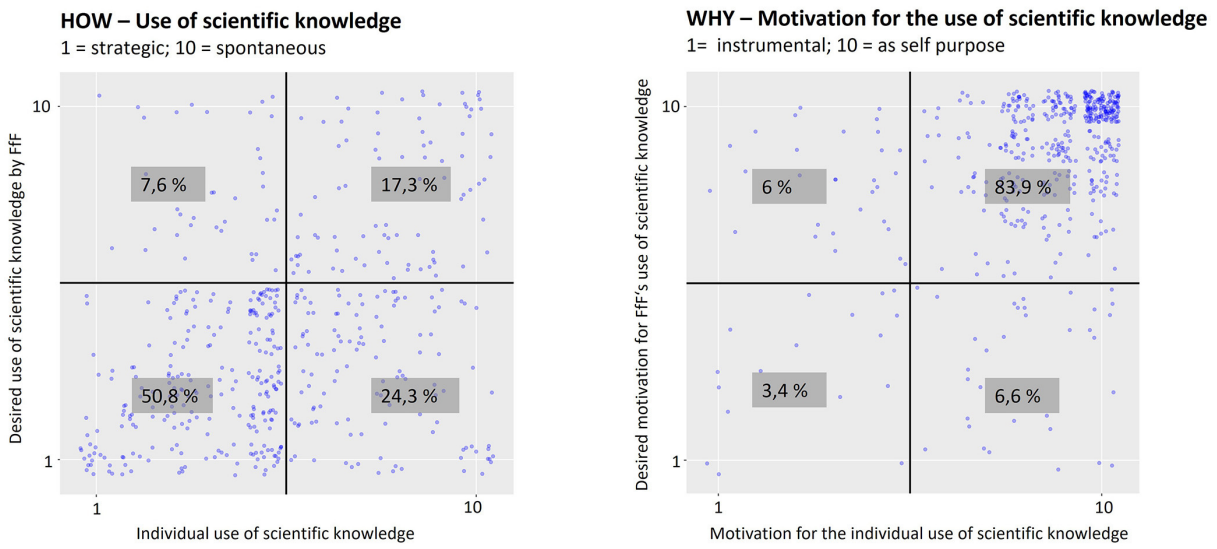

FIGURE 3
Use and motivation for the use of scientific knowledge by Fridays for Future activists on the movement and individual level.

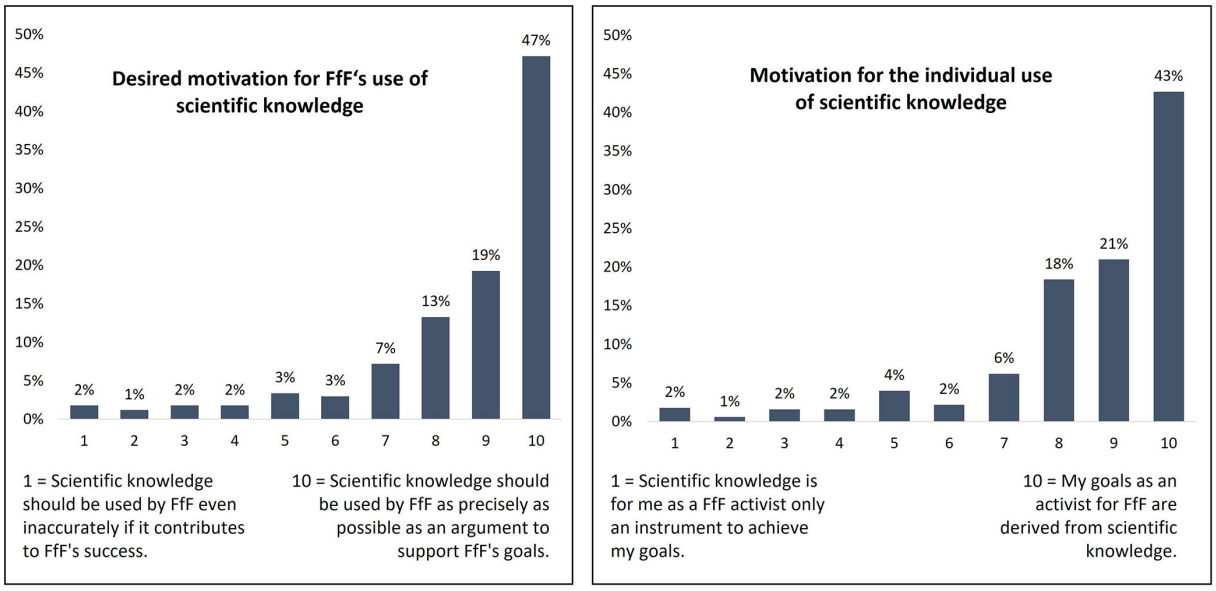

FIGURE 4
Motivations for the use of scientific knowledge by Fridays for Future activists on the movement and individual level in the range between "as an instrument" and "as self-purpose".

a *moderate* and a *radical approach* to scientific knowledge (Marquardt, 2020). Also, it was already claimed to illuminate the relevance of scientific knowledge for climate movements from a *sense making perspective* (Fähnrich, 2018; Fähnrich et al., 2020).

The objective of this paper was to shed light on the relationship between the Fridays for Future movement and scientific knowledge. Therefore, we built a theoretical framework to understand the importance of the use of science for Fridays for Future. It seems that resource mobilization theory (RMT) is a fruitful approach to achieving this goal after all. In short, we argued that parts of the movement's success can be explained by focusing on the use of scientific

knowledge: Generally, social movements use different resources to attain their goals. While different resource types exist, moral resources seem to be key to understanding the case of Fridays for Future. Legitimation can be one of those moral resources and science and scientific knowledge can provide this legitimation. Therefore, the movement uses scientific knowledge to legitimate its claims and actions.

However, this notion remains strictly theoretical as we have not investigated empirically to what extent the reference to and use of scientific knowledge provides legitimation for the movement in the population (e.g., Koos and Naumann, 2019)—and could therefore partly explain its success. Nevertheless, this approach of analyzing the support of the movement in the population could be a promising avenue for future research and needs more investigation. Yet, our theoretical and methodical approach can be considered successful as with our findings we gather new insights, and the understanding of the actual use of scientific knowledge and its motives is deepened with this paper.

First, our findings showed that the activists highly respond to the idea to base the overall strategy of FfF on scientific knowledge in the long-term. At the same time, on the individual level, they implement scientific knowledge strategically as well as spontaneously. While this distinction has not been applied in former studies we can draw some new theoretically focused conclusions from this comparison. When connected to the theoretical argumentation mentioned before, it can be concluded that the movement seems to draw some kind of legitimacy from scientific knowledge in general. In their practical activism, scientific knowledge seems to come in handy as a strategic blueprint but also as useful content to enhance various activities. Concerning the strategical or flexible use of scientific knowledge, scientific knowledge as a leading and legitimating resource does not seem to be such a fixed concept, but is expected to be implemented strategically on the movement level and rather spontaneously at the individual level at the same time. Some of the differences between the movement and the individual level can be explained by the fact that strategy and spontaneity are concepts that rather contradict a long-term logic. In the daily business of a movement though strategic and spontaneous elements can be combined and can also enrich each other.

Second, concerning the second part of the question about the motives of the use of scientific knowledge we recognize high support for the motive of self-purpose rather than as an instrument. Here our data shows that activists overwhelmingly derive their goals from scientific knowledge and reject the idea that science could be used imprecisely to attain their goals. A clear majority of activists consider scientifically based arguments as very relevant, want them to be used precisely, and prefer that the movement's goals are derived from scientific knowledge.

Third, our learnings from possible correlations between the statements regarding the movement and the individual level also support the elaborated theoretical concept. According to our data, we see that regarding the use and also concerning the motives there is a majority of activists, whose individual and movement positions correlate. These findings indicate that while activists find it very important that FfF derives its goals from and bases its activities on scientific knowledge, their individual positions show in the same direction. Therefore, conclusions regarding the theoretical implications can be formulated. Again we state that scientific knowledge can be regarded as legitimate and therefore a moral resource since the majority of the activists identify themself with the movement's positions based on a strategic and long-term focus on scientific knowledge as a self-purpose.

These results support the theoretically developed concept of legitimacy as a moral resource as explained above. We argued theoretically based, that scientific knowledge can be an effective source of legitimacy as a moral resource for the Fridays for Future movement. Following this line of thought, the activists draw on legitimacy provided by science: They use scientific knowledge to back their claims and integrate this knowledge into their work as activists. Therefore, we argue that they can indeed be called *alternative science communicators* (Maeseele, 2009; Fähnrich et al., 2020).

This implies that their use of science seems to be based on "the normative demands and value systems of science and science communication" (Fähnrich, 2018, p. 3). On the one hand, this is surprising in its clarity: It is an area of conflict whether the activists strictly stick to scientifically based knowledge for their goals—which necessarily implies openness to new insights and potentially changing positions—or pursue their interests and only use scientific knowledge if it comes handy for their "own" goals. It is far from clear that the activists choose the value system of science—as our results suggest—and not their own in this conflict of goals. On the other hand, one could argue that they locate themselves closer to the scientific value system when theoretically asked but their actual behavior is different when looking at their communication and actions empirically.

In addition, several other limitations related to this study became apparent: Social desirability could have led to the answers given as the activists may well know that their reputation could suffer if they were accused of only using scientific arguments in a superficial way to reach other, politically radical goals (Marquardt, 2020). Additionally, the wording of the items in the questionnaire may not necessarily oppose the two dimensions enough to stress the tension between the described poles. Generally, it should be said that the applied citizen science approach comes with advantages and disadvantages. On the one hand, the citizen scientists provided deep insights into the movement's structures and therefore enabled us to gain knowledge more

precisely. Their connections gave the researchers access to interviewees and observations of group meetings for the qualitative part of the research. Moreover, they could help with the survey and also pretest it from the point of view of an FfF activist. On the other hand, the citizen scientists working on the process are biased because they are part of the movement under investigation. They could have tried to present FfF in a good light and their specific insights on the process could potentially have influenced the researchers' judgment. Yet, the university researchers had the last words in every part of the research process to guarantee scientific standards. Potential challenges of the citizen science approach were constantly reflected upon. Furthermore, about the research question in this paper, the aspect seems to be rather neglectable as the questioning and distribution of the survey was mainly conducted by the researchers and not by the citizen scientists. As the survey was only distributed digitally, it should generally be said that activists who do not use messenger apps at all could not participate. However, the estimated number of this group of activists seems to be insignificant because Whatsapp and Telegram are the most important channels of communication and organization (Mucha et al., 2020).

All in all, our paper presents a few new approaches to analyzing social movements like Fridays for Future. Nevertheless, this single case study focuses only on Fridays for Future. It would be interesting to relate these findings to the role of climate science in the campaigning strategies of other organizations (e.g., Greenpeace). With the suggested theoretical concept, we have elaborated a combination of perspectives that might be useful to look closely at the specific motives and origins of the actual behavior of activists. Following this notion, future studies might investigate whether typologies of behavior and motives become visible within FfF or other movements. Also, the matrix of the four opposing poles along the question of how and why scientific knowledge is being used can only be a foundation. A more in-depth investigation of these basic findings in the form of narrative explanations of the detailed sense making, structuring, negotiating, and finally implementing processes might draw a more abundant picture of how activists deal with scientific knowledge. Another focus might be laid on the (learning) impacts in terms of the scientific literacy of the activists. Here, it might be interesting to analyze, how the activists gain more knowledge during their discussions and negotiations or what kind of knowledge they identify as important and useful for their activism.

In this way, the added value of the citizen science approach could promise to gain exclusive knowledge and thus could reveal exciting insights into the structures and processes of various movements in the context of new research. Finally, when observing the fast development of Fridays for Future, academic research should continuously analyze how the movement's internal structures change over time, which factors enable it to continue to successfully mobilize people, or whether conflicts and divergent demands might eventually lead to erosion and fragmentation.

Data availability statement

The raw data supporting the conclusions of this article can be provided by the authors upon request.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

Author contributions

AS and VB designed and implemented this research, conducted the analysis, and wrote the manuscript. Both authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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