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Is There a Medialization of Climate Science? Results From a Survey of German Climate Scientists

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Abstract

The relation between science and the media has recently been termed a *medialization of science*. The respective literature argues that interaction of scientists with the media and journalists as well as scientists' adaptation to media criteria has increased. This article analyzes whether German climate scientists are indeed "medialized." The results of a survey among 1,130 scientists suggest that medialization phenomena exist in climate science but that they differ significantly among different subgroups. While media interactions are more common for high-ranking scientists, an adaptation to media criteria is more typical for scientists with less experience.

Keywords

medialization, science communication, climate change, survey, Germany

Climate change has been on the political agenda for more than two decades, and it is an issue of intense public debate. A broad range of aspects, from the certainty of scientific knowledge to the justification of state regulation of greenhouse gas emissions, is disputed. Climate change has become "a deeply

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contested area [with] considerable competition among (and between) scientists, industry, policymakers and non-governmental organizations (NGOs), each of whom is likely to be actively seeking to establish their particular perspectives on the issues" (Anderson, 2009, p. 166).

One important aspect in this regard have been scientific issues, as they constitute the basis for potential political action and societal adaptation. Prominent controversies include the (in)famous "hockey stick" graph and its statistical foundations (Krauss, Schäfer, & von Storch, 2012, p. 125); the claims made in Al Gore's movie *An Inconvenient Truth* and subsequent responses such as *The Great Global Warming Swindle* documentary; the aftermath of "ClimateGate," that is, the hacking of e-mails from leading British climate scientists, which seemed to indicate that they were "hid[ing] the decline" in temperatures in their data (Grundmann, 2012); and the various mistakes in the fourth assessment report of the Intergovernmental Panel on Climate Change and the handling of those by the IPCC (Beck, 2012).

The field of climate science consists of various disciplines, from meteorology, oceanography, and biogeochemistry to geography, economics, and communications. They all contribute to the description of climate change and its (potential) causes and consequences and are therefore particularly interesting for analyses of a "societalization" (Weingart, 2001, 14ff) or, more specifically, a "medialization" of science. Whereas societalization entails close connections between science and various other realms of society, such as politics and the economy, the latter concept deals specifically with the nexus between climate science and the news media.

This study analyzes the medialization of climate science by examining to what extent it occurs among German climate scientists and which scientists are most susceptible to it. The German context is particularly interesting in this respect. In contrast to the United States (Boykoff & Boykoff, 2004), Australia (Speck, 2010), and other countries, the relation between climate science and the news media in Germany has been very close and less confrontational; public debate about a "Climate Catastrophe" (*Klimakatastrophe*) emerged in the early 1980s after the Energy Working Group of the German Physical Society actively approached the news media (Weingart, Engels, & Pansegrau, 2000). Since then, climate scientists have repeatedly and systematically found resonance in German news media (Schäfer, Ivanova, & Schmidt, 2012). Some of them have actively engaged in strategic communication to the public (Lederbogen & Trebbe, 2003) and put forward policy recommendations like the two-degree goal (Schwägerl, 2009), and, at times, have even attempted to silence journalists for writing articles that they deemed to contain incorrect information (Lehmkuhl, 2012). Furthermore,

many of them are convinced that news media shape decision makers' views on what kind of climate science should be conducted, and accordingly, that they influence the distribution of research funding (Post, 2009).

These examples hint at a close relation between German climate scientists and the news media. However, they are merely anecdotal evidence, and it is not clear how frequent, intensive, and influential media interactions of German climate scientists really are and to what they amount—or, in other words, how medialized German climate scientists are. The article at hand analyzes these questions. After presenting the concept of medialization in the first section, it introduces the data and measurements that are used in the next section. The results of the analysis are presented in the following two sections and discussed in the concluding section.

Medialization of Climate Science as a Conceptual Framework

What Is Medialization?

The concept of medialization has gained prominence in the social sciences and in communications in recent years, particularly in Europe, and a large number of theoretical and empirical contributions have been published (for general overviews, see Lundby, 2009; Meyen, 2009).[1]

Like many other widely used concepts, however, "medialization" is not easily defined. Even though various phenomena have been subsumed under this label from different theoretical backgrounds, there seems to be a smallest common denominator for all understandings of medialization: Scholars argue that currently, and increasingly, a process is taking place in which media are getting closer to various professional and private spheres, influencing them and leading to changes and adaptations in these spheres (Peters, Heinrichs, Jung, Kallfass, & Petersen, 2008; Schulz, 2004). Thus, medialization entails a closer connection between media and other spheres over time as well as the assumption of a causal change the media bring about in these other spheres (Dohle & Vowe, 2006).

Strands of Medialization Research

Two main strands of medialization research can be identified. The first has its theoretical roots in cultural studies and symbolic interactionism (Hartmann & Hepp, 2010; Krotz, 2009). It uses mainly qualitative and ethnographic research to analyze how interpersonal media such as cell phones, tablets, or

social networks permeate everyday life and induce cultural and social change. Although there are examples of scientists using social networks, weblogs, or Twitter (Bonetta, 2007, 2009), and although many effects of this use have been speculated on (Nentwich, 2003; Waldrop, 2008), this research strand has not been applied to the analysis of climate science yet (Schäfer, 2012).

The second strand is rooted in differentiation and general systems theory (Marcinkowski & Steiner, 2009; Meyen, 2009). It focuses on the effects of mass or news media on other social systems, such as politics (Kepplinger, 2002; Marcinkowski, 2005; Marcinkowski & Steiner, 2009; Vowe, 2006), law (Kepplinger & Zerback, 2009), or sports (Dohle & Vowe, 2006; Marr & Marcinkowski, 2006).

Dimensions of the Medialization of Science

The latter strand is the theoretical perspective of almost all existing studies on the medialization of science (for an overview, see Franzen, Weingart, & Rödder, 2011). It focuses on the effects of news media on science as a social system, scientific institutions, and, at the micro level, individual scientists. In their analyses of science-media interactions, the respective studies have often diagnosed two general changes:

- The first alleged change is that interactions between science and news media are becoming more frequent. This mirrors the closer connection between both sides, which is part of many definitions of medialization. For the case of science, authors argue that exchanges between science and news media have intensified (Weingart, 2001, 2005a) and that after a phase of segregation, both have recently become "more tightly coupled" (Franzen et al., 2011; Weingart, 2001, 2002, 2011). Weingart and others argue that scientists nowadays have more contact with the media and operate under "constant mass media observation" (Neidhardt, 2002; Rödder, Weingart, & Franzen, 2011; Weingart, 2005b).
- Presumably, this is accompanied by a change in science that is caused by the news media. Scientists are described as adapting to news media demands (Bucchi, 1998; Franzen et al., 2011; Rödder et al., 2011; Valiverronen, 2001). They have been said to alter their behavior to better accommodate the media. In other words, they are more willing to present their research in the media and to contact journalists proactively (Rödder, 2009), to adapt to the semantic and sometimes hyperbolic preferences of media language (Nelkin, 1994;

Weingart et al., 2000), or to use the media as an additional, quicker outlet to publish results of their research before they appear in peer-reviewed scientific journals (Bucchi, 1998; Lewenstein, 1995). The most profound of these adaptations, which Weingart (2001) considers a change in the "core of knowledge production" (p. 249), would be that scientists make research decisions—what topic to choose for research, where to publish the results, and so on—based on potential news media interest.

Gaps in Medialization Research and Our Research Questions

Nonetheless, both diagnoses do not stand on firm ground. Theoretically, differentiation theory has led many scholars to assume more news media interactions and a resulting adaptation of scientists. In contrast, however, it also may be used to deduce the exact opposite, namely, that science is becoming ever more specialized and complex, drifting further away from the rest of society, including the news media (Schäfer, 2007; Stichweh, 1988, 1994a, 1994b). Empirically, many of the studies that have assembled empirical evidence for these assumptions have analyzed research fields, such as stem cell research (Yoon, 2005) or human genome sequencing (Rödder, 2009), or specific social groups, such as professors (Post, 2009) or Nobel Laureates (Goodell, 1977), precisely because these fields or groups had intensive news media relations. However, they failed to compare them to other potentially less medialized sections of science. Both on theoretical and empirical grounds, it is therefore still impossible to confirm or disprove far-reaching claims of a medialization of science.

Indeed, there are indications to be found in recent research that the medialization of science is not a general, all-encompassing phenomenon. It has been hypothesized that a medialization of science might appear only in specific temporal, topical, and social settings (Rödder & Schäfer, 2010). Regarding the temporal dimension, this assumption seems to be comparatively robust; the medialization of science has been shown to peak significantly in "hot" phases around particular events (Brossard, Shanahan, & McComas, 2004; Rödder, 2009; Schäfer, 2009). Topically, it has been assumed that medialization might be restricted to certain research areas such as the life sciences or climate science. First indications from current research seem to support this assumption (L.I.S.A., 2011). Socially, it has been assumed that medialization applies only to a small number of "visible scientists" (Goodell, 1977). However, this has hardly been tested empirically.

This study focuses on the latter research gap—the social dimension of the alleged medialization of science. To do so, the dimensions "topic" and "time" are kept constant. We use climate science as the only topic, as it is a particularly suitable area to seek medialized science and differences among individual scientists. Furthermore, we limit the research to a short time period.

Against this backdrop, the first question is the following:

Research Question 1: How medialized are individual scientists?

In the second step, we intend to answer the following question:

Research Question 2: How can different degrees of individual medialization be explained?

The search for the causes of medialization among individual scientists employs two groups of explanatory factors. The first group refers to the inner-scientific position of individual scientists. It has been assumed that researchers' career progress is pivotal for the extent of their medialization, although with different effects. Some argue that academic careers, further specialization, and an increasing commitment to scientific criteria might lead to less medialization (Stichweh, 1988). However, others argue that advancement in scientific careers leads to opportunities to communicate scientific results and, potentially, more medialization (Rödder, 2009). Against these contradictory arguments, this study will empirically test which of these groups of scientists is more medialized.

It has also been argued that scientists' personal or institutional dependence on external funding might trigger attempts to enhance their societal relevance via increased media presence (Weingart, 2005a). Hence, one can assume that the more dependent scientists are on external funding, the more medialized they are.

Furthermore, a higher degree of medialization can be expected among researchers whose work mainly focuses on climate change. Due to the topic's increased societal relevance, these researchers are more likely to be confronted with media interaction. In addition, Peters (L.I.S.A., 2011) points out that social scientists are more medialized than others, possibly because their work entails greater proximity to society at large. Thus, social scientists can be expected to show a higher degree of medialization than natural scientists.

The second group of factors refers to scientists' individual expectations and experiences, and it has been derived from sociopsychological theories. The sociocognitive theory of learning (e.g., Pajares, Prestin, Chen, & Nabi,

2009) emphasizes that human action is influenced by the consequences a person has previously experienced with similar actions; positive experiences are more conducive to conduct an action. Accordingly, the more positive the previous experiences with media/journalists are, the more medialized scientists are expected to be.

The theory of reasoned action (e.g., Rossmann, 2011) points out that actions are also influenced by their consequences, by the acting individual, and by the evaluation of the action by his or her relevant social groups. Therefore, positive expectations and evaluations make action more likely. One assumes that scientists who have more positive expectations toward media interactions, and/or whose relevant social groups evaluate medialization favorably, will be more medialized.

In addition, the theory of planned behavior states that the "perceived behavioral control" (Rossmann, 2011, p. 23) of an action matters, that is, as how controllable—or conversely, how uncertain—a person perceives an action and its results. Accordingly, the higher the perceived behavioral control is when interacting with the media or adapting to media criteria, the more medialized a scientist is expected to be.

To answer the second research question, we will test the explanatory power of these factors in multivariate regression models.

Method

Sample

The basic population of this analysis, which was surveyed with a standardized questionnaire, was defined as all German climate scientists. It includes all natural and social scientists currently working in Germany whose research is related, to some extent, to the description of the characteristics, causes, and consequences of climate change.

Given that this basic population consists of multiple disciplines, which do not share a common scientific organization, joint journals, or shared conferences, it is difficult to sample and grasp it in its entirety.[2] To ensure that the sample was as representative and accurate as possible, we defined two criteria to delineate the population more precisely. Referring to Post (2009, p. 265), the term *climate scientists* is used when a researcher's professional work is connected to climate or climate change (which Post labels the "object criterion," p. 42) and when the researcher's community considers him or her as someone who works on the topic (which Post calls the "group criterion").

The group criterion served as the starting point for the sampling. First, representatives from Hamburg's Federal Cluster of Excellence on Climate Research were asked to list all relevant natural and social science disciplines that contribute to climate research, and to name three German experts for each discipline. Next, we contacted these experts and asked them to list institutions and working groups related to climate change in their disciplines. In addition, we gathered names through professional organizations' membership lists, the bibliographies of overview publications, the lineup of large conferences, and so on.

The result was a list of relevant institutions, research groups, and individual researchers, which was handed over to the German market research institution GfK (Gesellschaft für Konsumforschung). GfK compiled a list consisting of the entire personnel for all mentioned institutions and working groups and added all mentioned individual scientists. This list contained 5,500 scientists working in Germany who conduct research on climate change or who work in working groups or institutions in which research on climate change is being conducted.

Based on the conceptual considerations and the research questions, a questionnaire was designed with a total of 40 questions on different aspects of medialization, on the scientists' research contexts and sociodemographics. Some of these questions were taken from Peters (2009) in order to ensure comparability. After a pretest in a small sample, a link to the questionnaire was sent via e-mail to the 5,500 researchers between November 2010 and January 2011.[3] Respondents could choose between an English version and a German version of the survey.[4] To screen out off-topic scientists, the first question asked whether and to what degree the respective scientists' research was related to the climate change topic.[5] Researchers ($n = 119$) who answered "not a topic of research" were excluded from the sample.

With 1,130 remaining participants, the survey is the most comprehensive study of climate scientists in Germany so far (Bray & von Storch, 2007, 2010; Post, 2009). The final response rate is 21%, calculated on the 5,500 individuals who were initially addressed. This is a respectable number compared to other surveys among economists, engineers, philosophers, and law scholars (Schützenmeister & Bußmann, 2009).

The survey achieved its objective of representing different academic strata and sociodemographic groups (see Table 1). The typical climate researcher in the sample is male (66.2%), between 31 and 40 years old (29.3%), and a German citizen (85%). Younger researchers are also well represented, with 20- to 30-year-olds accounting for 26% of the participants. Many researchers have postdoctoral appointments (38.5%) or are PhD students (31.4%). 13.7% of the researchers are professors. Approximately 50% work at universities,

Table 1. Sociodemographic Information About the Respondents (n = 1,130).

	N	%
Gender		
Male	748	66.2
Female	372	32.9
Age, years		
20-29	249	26.0
30-39	350	29.3
40-49	252	21.7
50-59	138	11.8
60-79	81	5.9
Discipline		
Meteorology	202	17.9
Biology	106	9.4
Geography	103	9.1
Other natural sciences	571	50.6
Social sciences	148	13.1
Academic rank		
Professor	155	13.7
Postdocorate	435	38.5
PhD	355	31.4
Other	179	15.8
Institution		
University	532	47.1
Nonuniversity, publicly funded research institution, for example, Max Planck	564	49.9
Nonuniversity, privately funded institution	26	2.3

whereas the other half works at publicly funded research institutes such as Max Planck, Helmholtz, or Leibniz Institutes.

Measurement

The two dimensions of medialization that have been introduced above are crucial for this article: media interactions and media adaptation. In the first step, they are used to describe the degree of medialization of different scientists. In the second step—the explanatory part of the analysis—they serve as dependent variables (for all questions and scales as well as further information on all variables, see Table 2).

To measure media interactions, we asked researchers the question: "In the past 12 months, with which of the following types of media have you had professional contact?" Respondents were asked to answer this question separately for various types of media, including many kinds of news media such as "television," "radio," "tabloids," and "other newspapers" (see Table 3). For each media type, respondents could indicate how often they had professional contact with it, from "none" or "once" to "2 to 5 times" or "more than 25 times." The number and frequency of contacts with news media were determined by calculating an additive index consisting of contact with (journalists of) television, radio, tabloids, other newspapers, popular science magazines, other print media, news agencies, or news portals on the Internet.

Regarding media adaptation, many authors expect scientists to consider news media or presumed news media criteria (Tsfati, Cohen, & Gunther, 2011). This may affect actual research decisions, which have been empirically described via qualitative analysis for some research fields (Rödder & Schäfer, 2010; Shinn & Whitley, 1985), and is considered a change in the "core of knowledge production" (Weingart, 2001, p. 249). To survey this dimension, respondents were asked, "How important is possible media interest for you when making scientific decisions, such as considering research questions or publishing strategies?" They could indicate if such interest was "not important at all" for them, "fairly unimportant," "not very important," "important," or "very important." Posing a question like this that inquires directly about such behavior has the following advantages: For example, one does not have to rely on the attitudes or norms of the respondents but rather on, albeit reported, behavior.

As outlined, two groups of explanatory factors will be used as independent variables for the multivariate explanation:[6]

1. The inner-scientific position of the respondents consists of three measures: Respondents' career progress was measured in terms of their number of peer-reviewed publications as well as their academic rank and leadership positions in the scientific community. Since these variables are strongly correlated, they were summarized in one factor. Respondents' individual dependence on external funding, as well as the funding source of their institution, was directly asked for in the survey, as was the degree to which the respective researchers' work focuses on climate change and whether they are social or natural scientists.
2. The various individual expectations and experiences we derived from sociopsychological theories were operationalized as follows: Past experiences with similar actions were measured by two

Table 2. Overview of the Variables Used in the Analysis.

Name	Description
Media interactions	Factor comprising responses for contacts to various types of news media[a] Question: *In the past 12 months, with which of the following types of media have you had professional contact?* Items/Scale: See Table 3
Media adaptation	Question: *How important is possible media interest to you when making scientific decisions, such as considering research questions or publishing strategies?* Items/Scale: See Table 5
Gender	Dichotomous variable; 1 = male
Age in years	Metric variable
Career advancement	Factor from the number of publications, academic rank, position of leadership[b] Questions: *What is your current academic rank?* Items: *Professor* (4), *Postdoc* (3), *Doctoral student* (2), *Other* (1) *Do you currently occupy a management position in your institution? Please check all of the following that apply*: *Department Head, Dean, Director, CEO* (1/0); *Group leader, Principal Investigator* (1/0); *Other management position* (1/0) *So far in your career, how many peer-reviewed publications have you authored or coauthored?* *None* (0); *1-10* (1); *10-25* (2); *26-50* (3); *51-100* (4); *>100* (5)
Degree of climate focus	Question: *To what degree does your research deal with climate change, its reasons, and itsconsequences?* Scale: *Is not a topic of my research* (0 → exclusion); *Is only a peripheral topic of my research* (1); *Is one of several research topics for me* (2); *Is an integral topic of my research* (3); *Is my only research topic* (4)
Dependence on external funding	Question: *Considering the basic funding you receive from your institution, how necessary is it for you to apply for external funds?* Scale: *not at all necessary* (1) to *absolutely necessary* (5)
Employment in a private institution	Dichotomous variable; 0 = public institution, 1 = private institution
Discipline	Dichotomous variable; 0 = natural sciences, 1 = social sciences
Knowledge of methods of operation for media	Question: *What do you think: How well do you know how the mass media work?* Scale: *very bad* (1) to *very good* (5)
Evaluation of reporting on own research field	Composite index of six components relating to completeness, neutrality and accuracy of reporting in research field (Cronbach's $\alpha = .67$) Question: *In general, how would you evaluate media coverage of your research area*? Items: The media coverage *Contains errors; Uses credible scientific sources; Is hostile to science; Is sufficiently comprehensive; Is often exaggerating; concentrates on aspects that are scientifically irrelevant* Scale: *totally disagree* (1) to *totally agree* (5); negatively formulated items were recoded

(continued)

Table 2. (continued)

Name	Description
Prior reactions from colleagues to media presence	Question: *How did your scientific colleagues react to your presence in the media?* Scale: *Mostly negatively* (0); *In a relatively balanced manner/no reaction* (1); *Mostly positively* (2)
Experience with journalists	Composite index of four components relating to experience with journalists (Cronbach's $\alpha = .72$) Question: *Scientists have a variety of experiences when serving as media sources. To what extent do you agree with the following statements?* Items: *I was able to convey my message to the public; The information I provided was distorted; The journalists really listened to what I had to say; The journalists asked biased or unfair questions* Scale: *do not agree at all* (1) to *agree completely* (5); *neither agree nor disagree/no experience* (3)
Expected positive effects on one's scientific reputation due to media presence	Question: *In your experience, how important are the following factors for a scientists' reputation in the scientific community?* *. . . is often covered in the media* Scale: *not important at all* (1) to *very important* (4)

[a]To measure the latent concept "interactions with the media," the items were factor analyzed using principal axis factoring, extracting factors with an eigenvalue greater than 1 (Kaiser criterion). The analysis yielded a solution of one factor (eigenvalue 3.7), which explained 46% of the initial variance (Cronbach's $\alpha = .83$). Factor loadings ranged between .46 and .77. The factor score coefficients of the solution were used to compute the weighted sum of the items, which represent the dependent variable "media interactions."

[b]The three items were factor analyzed prior to the regression analysis using principal axis factoring, which yielded one factor (eigenvalue 1.92) and explained 64% of the initial variance. Factor loadings range between .56 and .82 (Cronbach's $\alpha = .72$). Since all of the initial items point to a high level of scientific achievement, one can interpret the factor as a measure of the latent dimension "career advancement." The standardized factor scores were saved und used in the regression analysis.

indices—one based on the respondents' experiences with journalists (e.g., whether the journalist posed unbalanced questions or if information was recounted in a distorted manner) and one based on their evaluation of media coverage about their own research field (whether it is portrayed correctly, in a comprehensible fashion, neutrally, etc.). To measure the consequences an individual expects from an action, respondents were asked whether they expected media exposure to have positive effects on scientific reputation. Evaluations of the social environment were assessed with a question regarding the reactions to previous media contact that the respondents have received from scientific peers. Finally, to measure the

Table 3. External Contacts of Scientists in the 12 Months Prior to the Survey (n = 1,130).

	None	Once	2-5	6-10	11-25	>25
All media, %	27.7	Together: 67.3				
All news media, %	34.0	Together: 62.3				
Television	65.7	22.2	9.6	1.3	0.4	0.2
Radio	66.7	18.3	12.0	1.5	0.5	0.2
Tabloids	91.5	5.0	1.4	0.4	0.1	0.4
Other newspapers	58.8	18.6	18.9	1.5	0.9	0.4
Popular science magazines	79.3	12.3	5.6	0.8	0.1	0.2
Other print media	62.4	15.8	16.9	2.4	0.4	0.6
News agencies	81.8	9.9	5.6	1.1	0.1	0.1
Web news portals	81.4	9.2	5.8	1.4	0.4	0.5
Fora, blogs, wikis	77.9	7.4	7.7	1.8	1.2	2.6
Other online media	74.2	9.8	9.2	2.2	0.5	2.6
Political actors, %	52.4	12.8	22.4	6.6	2.8	2.4
Economy representatives, %	58.0	13.7	18.8	5.3	2.4	1.2
Nongovernmental organizations, %	45.3	15.7	25.5	7.1	3.5	2.2

Note: The category "all media" includes all of the listed types of media, whereas "all news media" comprises television, radio, tabloids, other newspapers, popular science magazines, other print media, news agencies, and web news portals.

perceived behavioral control over their actions, scientists were asked whether they think they understand how the mass media operates.

How Medialized Are Climate Scientists? Descriptive Results

This section will present the results on Research Question 1: "How medialized are individual scientists?" In answering this question, the two aforementioned focal dimensions of medialization are used: the intensity of exchanges between climate scientists and news media—scientists' news media interactions—as well as their adaptation toward the news media.

Media Interactions

The medialization literature commonly hypothesizes that science and the news media are closely tied together, and getting even closer (Weingart,

2001). In this study, two thirds (67%) of German climate scientists reported that they had professional contact with news media at least once in the past year. News media were particularly important in this regard, with 62% of the scientists reporting at least one contact with a newspaper, television, or radio program or an Internet news portal.[7] This number corresponds to two smaller German surveys that asked climate scientists, "How often are you contacted by the media for information pertaining to climate change?" The results revealed that 72% had been contacted (Bray & von Storch, 2007, 2010). This shows that German climate scientists seem to have a large number of news media contacts, particularly when compared to other disciplines.

In a similar survey, Peters and colleagues (Peters, 2009; Peters, Heinrichs, et al., 2008) asked biomedical and epidemiological researchers in several countries, including the United States and Germany, about their "contacts to journalists from mass media" over the past three years. The results revealed a similar rate of news media contacts for the included German scientists (70%) as in this study, even though it included a longer time period and only scientists who had published at least once in a peer-reviewed journal, that is, on average, a more experienced group of scientists than the one surveyed.[8]

Only a small number of scientists in this study, however, have very frequent interactions with the media. Less than 1% had more than 10 contacts with television, radio, or newspapers during the past 12 months. Furthermore, in most cases, the scientists themselves did not initiate interactions between journalists and scientists (see Table 4). Rather, journalists or the PR departments of their institutions initiated the contact. More than 61% of the scientists reported that they never establish the contact themselves, and less than 5% reported that they do so often or very often.

In addition to professional contact with news media, other kinds of external contact were also common: A total of 54% of all respondents had at least one professional contact with a nongovernmental organization in the past 12 months, 47% with a political actor, and 41% with an economic actor. In turn, only 16% of the surveyed climate scientists had no contact with the news media, a nongovernmental organization, or political or economic actor during the past year.

Media Adaptation

But, are media contacts accompanied by an adaptation of scientists to news media demands, maybe even by one that concerns the "core of knowledge production" (Weingart, 2001, p. 249) in the sense that it influences research decisions? In this survey, 18% of the respondents claimed that media interest

Table 4. How Is Contact Initiated Between Media Actors and Scientists? ($n = 817$; Scientists With at Least One Professional Contact With the Media).

	Never	Seldom	Often	Very often
Journalists ask me for information or for my opinion	18.7	43.3	24.5	9.2
The PR department of my institution asks me for a public statement	30.0	41.0	21.3	3.3
I ask the PR department of my institution to contact journalists	61.1	27.8	5.6	0.5
I contact the journalists myself	61.6	29.0	4.4	0.5

Table 5. Importance of Potential Media Interest for Scientists When Making Research Decisions ($n = 1,130$).

	n	%
Not at all important	200	17.7
Fairly unimportant	311	27.5
Not very important	411	36.4
Important	185	16.4
Very important	19	1.7

is "not important at all" when making research decisions. A total of 82%, in turn, indicated that media interest does play some role in their scientific decision making (see Table 5).

On average, however, the importance of news media for most scientists' decision making is relatively low: Approximately 64% claim that media interest was "fairly unimportant" or "not very important" to them. Only 16% said that media interest was "important" to them when making scientific decisions, and less than 2% claimed media interest is "very important." The latter are the groups showing a high degree of medialization in this dimension.[9]

How Can Individual Scientists' Medialization Be Explained?

The descriptive analysis indicates that medialization does exist among German climate scientists. However, the data also reveal that it is not an

all-encompassing phenomenon in which all scientists are equally involved. Rather, it seems to be a differentiated phenomenon. Therefore, the second step of this analysis examines which scientists are medialized and to what extent. First, it investigates whether extensive media interactions and a pronounced media adaptation can be found for the same scientists. The results reveal that medialization seems to be composed of subdimensions, which occur independently from each other. Most notably, there is only a weak, although statistically significant ($p > .01$), correlation of .11 between scientists' media interactions and media adaptation. In other words, scientists with many media contacts are not necessarily characterized by a strong media adaptation of their work. The next sections will explain both dimensions separately.

Explaining Media Interactions

To explain the degree of individual scientists' media interactions, we constructed a factor condensing all scientists' interactions with news media. After statistical transformation,[10] the distribution of this factor mirrored a normal distribution, with the exception of the first category representing no contact with news media, which has the highest frequency. Therefore, a two-step approach was used to explain the intensity of media interactions.

First, logistic regression analysis with a dichotomous dependent variable was used to explain which scientists have media interactions at all. The analysis shows a high model fit and explanatory power (Nagelkerkes R^2 is .25).[11] Three independent variables significantly influenced the scientists' media interactions (see Table 6): Career advancement has the strongest effect ($B = .21$, $p < .01$). Furthermore, scientists' self-assessed knowledge of how the media operate ($B = .08$, $p < .01$) and the expected positive effects on one's scientific reputation ($B = .04$, $p < .05$) have a positive influence.

The second step explained the intensity of media interactions by introducing the logarithm of media interactions for values >0 as a dependent variable in linear regression analysis. The intensity of media interactions for scientists who reported at least one such interaction could be explained satisfactorily with multivariate regression analysis, which explains approximately 28% of the variance (see Table 7).

Although gender and age do not have significant effects in this analysis, the inner-scientific position of the scientists, again, turned out to be particularly relevant. Career advancement exceeds all other factors in terms of influence ($B = .38$, $p < .01$): Distinguished scientists, scientists in positions of leadership, and scientists with many publications have significantly more

Table 6. Logistic Regression Analysis.

		Exp(B)[a]	Standardized regression coefficient B[b]
Constant			
Control variables	Gender		
	Age		
Respondents' scientific standing	Career advancement	3.051**	.21**
	Extent of climate reference		
	Dependence on external funding		
	Employment in private institution		
	Discipline		
Individual expectations and experiences[c]	Knowledge of media operations	1.612**	.08**
	Evaluation of reporting on personal research field		
	Anticipated positive effects on media presence and reputation	1.285*	.04*

Note: $n = 944$; goodness-of-fit model: χ^2 (omnibus test) = 187, degrees of freedom = 10, $p < .001$; Hosmer and Lemenos model: $\chi^2 = 7.412$, degrees of freedom = 8, $p = .493$; correctly classified cases = 73%; Nagelkerkes $R^2 = .25$.

[a]Exp(B) coefficients show how the odds of having contact compared with having no contact [Probability ($y = 1$)/Probability($y = 0$)] change, by *one unit* in the respective independent variable.

[b]To assess the relative predictive importance of the independent variables and for the purpose of comparability, the semistandardized regression coefficients were calculated, as proposed by Kaufman (1996). They vary between −1 and +1 and indicate the predicted change in the probability of having news media contact for a *one standard deviation* change in each predictor, compared to the baseline of the initial news media contact probability in the sample (which is actually the mean of the dependent variable and equals .669). This means that according to the results in this table, one standard deviation increase of career advancement, which is the strongest predictor, increases the probability of having a news media contact by .214 compared to the baseline. This is a relatively large increase of approximately one third of the initial probability of $p = .669$.

[c]This table does not include the variables "Prior reactions from colleagues to media presence" and "Experience with journalists" because only those scientists who reported at least one contact with one type of media were asked these respective questions.

*$p < .05$. **$p < .01$.

media interactions than others. In addition, scientists from private institutions ($B = .08$, $p < .01$), scientists with a stronger focus on climate research ($B = .12$, $p < .01$) and social scientists ($B = .08$, $p < .01$) have significantly more media interactions than their colleagues. This corresponds to the assumptions outlined above.

Scientists' individual experiences with and expectations from news media also affect their number of media contacts. In particular, their awareness of how the media operate influences their contact intensity ($B = .21$, $p < .01$). Furthermore, expected positive effects on one's scientific reputation ($B = .10$, $p < .01$) as well as positive experiences with past media contacts ($B = .10$,

Table 7. Multiple Regression Analysis.

		Ln (media interactions)[a]	Media adaptation
Constant		−2.608**	
Control variables	Gender		
	Age		
Respondents' scientific standing	Career advancement	.38**	−.10*
	Extent of climate reference	.12**	
	Dependence on external funding		
	Employment in private institution	.08**	
	Discipline	.08**	
Individual expectations and experiences	Knowledge on media operations	.21**	.11**
	Evaluation of reporting on personal research field		.08*
	Colleagues' reactions to media presence	.08**	
	Experience with journalists	.10*	
	Anticipated positive effects on media presence and reputation	.10**	.28**
Explained variance		.28	.12

Note: Ordinary least squares estimation; $n = 614$ (media interactions), $n = 925$ (media adaptations); all effects shown are standardized.

[a]Although the effects shown are standardized in the case of both media interactions and media adaptation, the interpretation of the values differs slightly due to the logarithmization, that is, the effects for media interactions indicate a *relative* change in interaction intensity, rather than an absolute change.

*$p < .05$. **$p < .01$.

$p < .05$) and positive feedbacks from colleagues ($B = .08$, $p < .01$) show positive effects on this dimension of medialization.

Explaining Media Adaptation

To explain scientists' adaptation toward media demands, linear regression analysis was used. It showed that respondents' scientific standing and career progress are, again, significant factors that influence media adaptation. However, this time the correlation is negative: Researchers who think of media interests in their scientific work are not experienced scientists who have climbed the career ladder; rather, they are junior researchers ($B = -.10$, $p < .05$).

Among individual expectations and experiences, an expected positive impact of media presence on one's scientific reputation has the largest effect for media adaptation ($B = .28$, $p > .01$). Knowing how the media work

($B = .11$, $p < .01$) and a positive evaluation of media reporting on one's field ($B = .08$, $p < .05$) also contribute to a more pronounced medialization in this dimension. Accordingly, climate scientists who adapt to news media are those who assume that the incorporation of possible media interest will reflect positively on their scientific reputation. This multivariate regression analysis, however, only explains 12% of media adaptation, less than for the first dimension.

Conclusion and Discussion

This study shows that medialization among German climate scientists exists—at least to some extent. By providing the most comprehensive and extensive empirical analysis so far, it underpins the findings of a number of earlier, smaller scale analyses (Bray & von Storch, 2007, 2010; Post, 2009). It documents signs of medialization in media interactions and media adaptation.

Regarding media interactions, the results revealed that a majority of German climate scientists have had professional contact with news media in the past years—some of them very often, and with various media. The extent of these contacts exceeds that of other scientific fields, even ones that have likewise been the subject of public debate, such as biomedicine (Peters, Brossard, et al., 2008). However, in most cases, media contacts are initiated by journalists' requests and by the PR departments of research institutions, which pass on requests to the scientists. Hence, a professionalization on the institutional level seems to be another important facet of climate science medialization.

Concerning media adaptation, an overwhelming majority of the 1,130 respondents reported considering potential media interests, at least to some extent, when making scientific decisions such as choosing research topics (82.3%). Even though such considerations are not the primary drivers for research decisions for most scientists, this result is still somewhat surprising. Choosing research questions for any reason other than a scientific one is seen as problematic within the scientific community, as it pertains to the core of scientific work. This is even more relevant in research fields such as climate change, where public debates have raged around scientific data, findings, and rigor. It can therefore be assumed that the measurement in this study underrepresents actual adaptation behavior—which makes the result even more surprising.

In line with previous results (Rödder et al., 2011; Rödder & Schäfer, 2010), this study indicates that the medialization of science is not a general characteristic that encompasses all aspects of science. Rather, it occurs under

specific circumstances. First, medialization to date has not caught on for all scientists, or at least not with the same magnitude. Second, medialization does not constitute a coherent syndrome. The two dimensions distinguished here, media interactions and media adaptation, tend to be associated with different researchers. Regarding media interaction, professional contact with media actors is more common for experienced, high-ranking, frequently published scientists. Conversely, media adaptations are most common among scientists with little scientific experience and lower academic rank. However, scientists with a great willingness to adapt to media interest do not form a coherent sociodemographic group, as evidenced by the relatively low explanatory power of the respective regression analysis.

Given that medialization is supposed to be a trend, it would be interesting to measure medialization over time, to determine, for example, if there is an increase in one or both of the dimensions introduced here. This question will be addressed with future surveys that will repeatedly survey German climate scientists. Because of the cross-sectional nature of the study at this stage, however, we can only hypothesize how the results may affect the future development of science. The finding that experienced scientists often interact with journalists while not being adapted to the media, and that junior scientists exhibit the opposite characteristics, may be a socialization effect. Possibly, people who work in scientific communities for longer periods of time are influenced more strongly through scientific perspectives, norms, and behaviors (Merton, 1985). Thus, the more pronounced media adaptation among junior researchers would be reduced once they have attained leading positions in their respective fields.

Further studies have to show if this hypothesis can be substantiated. It is desirable that these studies exceed the limits of this current analysis by further developing the survey design. As this is one of the first studies to quantify medialization, we encountered a number of difficulties we could not fully solve, for example, concerning a robust measurement of media adaptation. Given that this study only measured explicitly stated media adaptation, it would be interesting to include actual, current, or past behavior in the study to control for possible biases. Furthermore, different aspects of media adaptation, such as choosing research questions and publication strategies, should be examined separately in further research to shed more light on the question of where exactly in scientific work media adaptation can be found—and where it cannot. Furthermore, as discussed above, future studies should not only include survey data but also consider the institutional level of medialization. For example, they should analyze both the establishment of public relations departments in scientific institutions and

medialization over time on the basis of longitudinal studies. Finally, it would also be interesting to analyze the media side of medialization, particularly journalists' approach to the scientific field. Doing so would provide a more comprehensive overview of the science-media interactions.

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Notes

1. A number of contributions have proposed other terms that overlap with the phenomenon in question, such as *mediation* (Altheide & Snow, 1988), *mediazation* (Thompson, 1995), or *mediatization* (Hjarvard, 2008; Krotz, 2009; Schulz, 2004). The authors will refer to and include these works in this article wherever they refer to phenomena similar to those being analyzed.
2. As climate researchers are not organized in a coherent collective, they could not be located via membership in a professional association. Finally, the often-used alternative of using publication databases as a basis for random sampling would also have flawed the analysis, as younger and less experienced scholars, on average, have fewer publications and are consequently underrepresented in these databases.
3. The first invitation to participate in the survey was sent on November 19, 2010. Afterward, two reminders were sent on November 25, 2010, and January 11, 2011. The survey was closed on February 1, 2011.
4. We first translated the original German questionnaire into English. Afterward, a native speaker proofread it. The resulting English and German versions were finally compared and adapted to each other in order to obtain equivalent questions and response items. The questionnaire is available at http://www.klimacampus.de/mccc_medialization.html.

5. Question: "To what degree does your research deal with climate change, its reasons and consequences?" Possible answers: "is not a topic of my research," "is only a peripheral topic of my research," "is one of several research topics for me," "is an integral topic of my research," or "is my only research topic."
6. All variables were obtained from the survey. Table 2 provides an overview; the underlying questions and response options can be found in the questionnaire and are available at http://www.klimacampus.de/mccc_medialization.html
7. Internet forums, blogs, online encyclopedias such as Wikipedia, and other online media were excluded.
8. When the analysis is restricted to scientists with at least one peer-reviewed publication, similar to Peters (2009; Peters, Heinrichs, et al., 2008), the rate of professional contact with the news media rises to 77%.
9. We found relatively similar results—indicating a significant but limited importance of news media for scientists—when asking to what degree scientists use the mass media as a source of information in their field of study, that is, if mass media had become a relevant source of information inside the scientific community, in addition to conventional sources like publications, personal conversations, or professional conferences. Again, our results reveal the importance of mass media, on the one hand, and its subordination to established sources of scientific information, on the other. In all, 14% of the respondents used television, 13% used radio, and 26% used newspapers at least once per week for professional purposes. However, scientific sources of information were much more important than these general news media. Academic journals were the clear front-runner, with 92% of respondents reporting that they read these at least once per week. A total of 86% of respondents obtained their information through personal contact with colleagues, followed by visiting the websites of scientific institutions (58%).
10. The factor's distribution is skewed (mean = 0.56, SD = 0.72; skew = 2.04; kurtosis = 5.55) and does not meet the requirements for linear regression analysis. Therefore, its values were transformed by taking their natural logarithm. This can be justified theoretically: Presumably, a change to a higher response category is of greater relevance in the lower range, that is, from "1 contact" to "2 to 5 contacts," than in the higher range. Interactions will become less complicated the more frequent they are, for example, due to established networks and clearer expectations.
11. This measure is equivalent to the coefficient of determination (R^2) in linear regressions.

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