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Climate Journalists as Interpretive Community: Identifying Transnational Frames of Climate Change

Michael Brüggemann and Sven Engesser
Institute of Mass Communication and Media Research (IPMZ)
University of Zurich

Email: m.brueggemann@ipmz.uzh.ch
and s.engesser@ipmz.uzh.ch

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Abstract

The framing of climate change in media coverage has been widely studied but the journalists' role in frame building has not been sufficiently examined. This study identifies journalist frames on climate change: shared patterns of interpretation among journalists that may shape news content. The study surveyed climate journalists from 24 leading newspapers and online outlets in five countries (Germany, India, Switzerland, UK, and the USA). It follows an integrative approach to framing analysis, taking into account broader generic and issue-specific frames. It finds that climate journalists form an interpretive community built around a common master frame and five (sub-)frames.

Keywords: framing, climate change, journalism, interpretive community

Climate Journalists as Interpretive Community: Identifying Transnational Frames of Climate Change

Climate change is one of the most important issues of our time and the way journalists frame their stories on climate change has important consequences for the development of public awareness and opinion (Corbett & Durfee, 2004; Maibach, Nisbet, Baldwin, Akerlof, & Diao, 2010; Hart, 2011). Since there is no doubt that news frames matter, it is also worth exploring where they originate from. Patterns of interpretation in the journalist's mind might precede patterns of presentation in news stories. Therefore, investigating the patterns of interpretation shared by journalists (journalist frames) is an important step towards explaining patterns in news content (news frames). To identify *journalist frames* on climate change is the purpose of this article. It explores these patterns of interpretation across different news outlets and different countries. The study aims at contributing to framing theory and methodology, journalism research, and science communication in general.

Research on Climate Journalists

Within science communication, journalism research is still far from being fully developed (Schäfer, 2011) but there are some important studies that have surveyed science or environmental journalists (Detjen, Fico, Li, & Kim, 2000; Giannoulis, Botetzagias, & Skanavis, 2010; Maillé, Saint-Charles, & Lucotte, 2010; Sachsman, Simon, & Myer Valenti, 2006, 2010; Schneider, 2010). There are a few qualitative case studies that draw on interviews with climate journalists (e.g. Berglez, 2011; Stocking & Holstein, 2009) and an early quantitative survey with a focus on climate journalism in the US (Wilson, 2000).

We argue that a study of climate journalism should cut across nations and beats. On the one hand, focusing on a single country would lead to a nationally biased sample of journalists. The cross-national approach allows us to expand the database of the study and generalize the findings (Esser & Pfetsch, 2004, p. 384). On the other hand, there is evidence

that the journalists from the science and environment beats write better informed stories about climate change (Wilson, 2000) and that they treat certain sources (such as environmental NGOs) in a different way than journalists from the politics beat (McCluskey, 2008). However, it is important to keep in mind that climate change is a story that naturally cuts across beats so that quite a few journalists without a background in science will write about climate change. Therefore, we did not start by looking for journalists from certain beats but by searching for articles on climate change. The authors of these articles constitute our target population of climate journalists. It was an open empirical question how many of them actually belonged to the science or environmental beat.

Journalists as Interpretive Community

While the epistemology of many journalists stresses that journalism is about 'describing reality as it is' (as shown in surveys such as Hanitzsch et al., 2011), research recognizes journalism as an *interpretive* activity. If the job of a journalist is to interpret the world it is a relevant research question whether certain or all journalists form *interpretive communities*. This concept has been introduced by Zelizer (1993) into journalism research. A similar concept used in political science is labeled "epistemic communities" (Haas, 1992). These communities are linked by shared discourses and interpretations of key events. Journalists are known for their high degree of co-orientation among their peers and journalism is shaped by processes of inter-media agenda-setting (Reinemann, 2004). It is therefore highly plausible that interpretive communities evolve among journalists. This idea may be tested by looking at the journalists' collective interpretations of an issue such as climate change.

The concept of interpretive communities has been extended to include sources (Berkowitz & TerKeurst, 1999). Journalists who regularly interact with certain sources may not only form an interpretive community with their own kind but also with their sources. It is

therefore possible, that climate journalists and for example scientists involved in the IPCC (Intergovernmental Panel on Climate Change) reporting process may form such bonds.

The idea of interpretive communities may be even further elaborated: It is likely that there is an internal hierarchy with opinion leaders and followers within such a community. The "lead" in this case would be a question of long-standing expertise on a topic such as climate change and working for core high reputation media: For US environmental journalists, the New York Times plays such a role (Sachsman et al., 2006). In particular, colleagues with less expertise may follow the lead of science writers who work for prestigious outlets such as the NYT or the BBC.

Interpretive communities may extend to include certain segments of the audience. A study on attitudes of US citizens towards climate change finds different interpretive communities among the domestic audience. These communities are are united by shared conceptualizations and responses to climate change and the two main groups (in the US at the time of the study) were the "naysayers" and the "alarmists" (Leiserowitz, 2007).

Finally, interpretive communities do not necessarily involve direct interactions of its members. They may be connected by reading the same newspaper and sharing a certain view of the world. They do not necessarily know each other. Longstanding direct interactions and knowing each other will nevertheless enhance the likelyhood that an interpretive community will evolve.

The concept of interpretive community may therefore include journalists, sources, and audience members who are united around certain interpretations on a broader issue such as climate change and connected by means of direct *or* mediated interactions. Such interpretive communities, if they exist across national borders, may be strong influencing factors not only on media coverage but also on the wider public and political debates about issues such as climate change.

The Framing Approach

Interpretive communities are held together by shared interpretations on certain issues. Thus, shared frames may be powerful indicators of an interpretive community. In the following, we will therefore briefly elaborate what the framing concept is about.

Framing is a useful concept for analyzing interpretations. It has been described as a "bridging concept between cognition and culture" (Gamson, Croteau, Hoynes, & Sasson, 1992, p. 384; Reese, 2007; van Gorp, 2007). Frames are patterns of making sense of the world that connect individual cognitive processes with the social construction of reality. Frames structure both journalistic reporting (patterns of presentation) and journalistic thinking (patterns of interpretation) (Gitlin, 1980). On the cognitive level, frames are sets of schemata that help human beings to process information (Scheufele, 2006). On the level of news content, frames have been operationalized in a number of different ways (Matthes, 2009) which lead researchers to conclude that we are dealing with a fractured or fragmented paradigm (Entman, 1993; Scheufele, 1999).

The main two schools see news frames either as very general ways of depicting the world in media coverage (generic frames) or as the ways in which debates on specific issues are structured (issue-specific frames, de Vreese, 2002). Issue-centered frame analysis is often following the methodological approach introduced by Entman (1993) by searching for problem definitions, evaluations, causal attributions, and treatment recommendations. These frame elements combine in typical ways to form common frames. Within the analysis of issue-specific frames there may appear broader *master frames* (Benford & Snow 1992) that integrate part of the debate and comprise several (sub-)frames.

These frame concepts are not necessarily mutually exclusive if we understand frames as patterns of interpretation that exist on different levels of abstraction. Generic, issue-specific, master and (sub-)frames coexist as different types of frames. Consequently, framing

studies may combine the analysis of generic and issue-specific frames and look for the interactions between the two. Following this line of reasoning, we have explored journalist frames of climate change following an integrative framework that includes both generic and issue-specific frames.

An Integrative Approach to Measure Journalist Frames of Climate Change

Empirically, we intent to identify journalist frames, i.e. sets of schemata journalists evoke when processing information. Yet, journalist frames are not something the journalist comes up with autonomously. He or she may be part of an interpretive community that shares certain frames. We argue that the stronger the agreement to the relevance of certain frames the stronger the cohesion of an interpretive community. This can be regarded as a gradual process ranging between two opposite poles: On the one hand, total dissent about the relevant frames indicates the absence of an interpretive community. On the other hand, complete consensus indicates an all-pervasive interpretive community. As an operational threshold for our empirical study we assumed the existence of an interpretive community if the majority of climate journalists widely agreed on the relevance of the same frames.

Our study pursues an integrative approach in trying to identify generic frames applicable to science communication and issue-specific frames related to the climate debate. The study identified the broader *generic frames* and a *master frame* on climate change deductively by drawing on prior studies. It identified issue-specific frames on climate change inductively by setting up lists of frame elements and looking for typical combinations of frame elements in the data.

Generic Frames in Environmental, Risk, and Science Communication

Climate change as an issue lies at the crossroads of environmental, science, and risk communication – with strong ties to political communication. A list of frames that has been used by a number of subsequent studies has been compiled by Semetko and Valkenburg (2000). It includes the following frames: human interest, conflict, responsibility, morality, and economic. The frames were operationalized by asking the coders of a content analysis four questions for each frame, e.g. for the economic frame: "Is there a mention of economic losses or gains now or in the future?" (Semetko & Valkenburg, 2000, p. 100). Our study adapted this approach by asking journalists similar questions.

Drawing on the results from other framing studies, the list of Semetko and Valkenburg needs to be slightly modified and extended. Their *conflict* frame is closely related to a frame that is labelled *strategic game* frame (Aalberg, Strömbäck, & de Vreese, 2012). One of Semetko and Valkenburg's coding questions for the conflict frame reads "Does the story refer to winners and losers?" This refers to the pattern of depicting politics as a strategic game.

This framing of issues with reference to strategies of actors for gaining power and votes is also often contrasted with an *issue* frame (Lawrence, 2000). This frame discusses the substance of the different policy options at hand. For Semetko and Valkenburg, the mere mention of "different sides of an issue" is regarded as one indicator of a conflict frame. In our view, the mere mention of different policy options should not be coded as a conflict frame. The difference between focusing on political conflict or the contest of strategic actors (conflict/strategic game frame) and focusing on the substance of different policies (issue frame) seems the conceptually more convincing distinction.

The frames discussed so far are mainly derived from the analysis of political news and they also apply to other fields of communication. Dirikx and Gelders (2010) show that the frames by Semetko and Valkenburg also occur in debates on climate change except for the

morality frame and with only rare occurrences of the human interest frame. The frames mentioned so far *cannot*, however, claim to be necessarily the most relevant frames for an issue like climate change.

In the field of science communication, based on a review of the relevant literature (and two prior reviews by Nisbet 2010 and Dahinden 2002), we recommend to extend the list by including three more frames: First, a *progress* frame, that depicts advances in technology and science as beneficial for mankind and part of an accumulative growth of relevant knowledge. Second, there is a *risk/disaster* frame which, on the contrary, focuses on the risks associated with technology and science and disasters that might occur or have occurred. This frame is also sometimes coined as 'Pandora's Box', 'Frankenstein's monster', and "runaway science" (Durant, Bauer, & Gaskell, 1998; Gamson & Modigliani, 1989). Thirdly, there is a scientific *uncertainty* frame: It depicts science as producing contradictory research results, weak explanations or dubious forecasts. This frame is highly relevant for the analysis of climate change debates, especially in the US (Antilla, 2005; Shehata & Hopmann, 2012). These three frames apply to a number of topics (such as nuclear energy, biotechnology, and climate change), as proved by a number of studies but obviously, they do not apply to all kinds of topics. In the field of science and environmental communication, we do therefore expect the prominent occurrence of the following frames:

1. Responsibility
2. Conflict/Strategy
3. Issue
4. Human-interest
5. Economic
6. Morality
7. Progress
8. Risk/Disaster
9. Uncertainty

One might therefore formulate the following hypotheses for journalist frames of climate change: *H1: The majority of climate journalists will widely agree to the relevance of*

the nine generic frames listed above. H2: The agreement to the morality and human interest frames will be lower than for the other generic frames (in line with the findings of Dirikx and Gelders (2010)).

Master Frames

Earlier studies of news content also show that part of the debate on climate change especially in Anglo-Saxon countries is structured around the conflict between climate *warners* and climate *skeptics/contrarians/deniers* (Boykoff & Boykoff, 2004; Brossard, Shanahan, & McComas, 2004; Carvalho, 2007; Grundmann, 2007; Shehata & Hopmann, 2012).

The warners represent the relatively broad consensus of international science as reflected in IPCC reports and articles in peer reviewed journals (Oreskes, 2004). This consensus view is reflected in the "anthropogenic climate change frame": "The climate change frame posits that global warming is a significant social problem caused by human activity through the emission of carbon dioxide and other so-called greenhouse gases into the atmosphere. […] reduction of greenhouse gas emissions follows as the logical solution according the climate change frame." (Shehata & Hopmann, 2012, p. 179).

The "anthropogenic climate change frame" may be regarded as a *master frame* in the debate since it has been found to be widely shared among scientists and in the public debates on climate change in different countries and since it has the potential to integrate several (sub-)frames. One might even argue that the more relevant debates among *informed* publics on climate change today take place within the assumptions of this frame. As we will survey the journalists that have published several articles on climate change, we assume that many of them are familiar with the state of the art of scientific knowledge on the issue. They might,

thus, form an interpretive community around the assumptions of this master frame that this study operationalized as follows:

1. The average global temperature has been rising for about 150 years.
2. Global warming has been largely caused by humans through CO_2 emissions and greenhouse gases.
3. The impact of global warming will most likely create major problems for our global ecosystem.
4. Humankind must strongly reduce CO_2 emissions in order to limit future global warming.

The study will thus test the following hypothesis:

H3: The majority of the climate journalists will show support for the consensus view on climate change.

Skepticism comes in different forms and tackles different of the four statements above. For the purposes of our study, climate skeptics or contrarians are people who challenge one or more of the statements above. In the US, "no regulation necessary" is a common theme of different approaches of climate change denial (Dunlap & McCright, 2011). Climate denial in the US is heavily sponsored by conservative foundations and industry associations and finds positive resonance in the "echo chamber" of conservative broadcast media (Fox News, talk radio) and blogs (Dunlap & McCright, 2011). We do not expect climate journalists to reflect populist climate denial. On the contrary, there might rather be a growing gap between public and expert opinion on this topic and we expect climate journalists to share the IPCC interpretations on climate change. This is also supported by recent findings that the climate change deniers are less frequently quoted in the US press today than before (Zehr, 2009).

Issue-Specific Frames

Beyond the generic frames and the broad master frames discussed so far, it is very useful to add an additional layer to this framing analysis. The mechanisms of framing go deeper than the use of broad frames such as conflict or economic consequences. For the issue

of climate change, the economic consequences frame might be used by the warners to point out the costs of the consequences of climate change. It might also be used by the contrarians who point to the costs of climate change regulation. If one wants to understand the cleavages in public debates and how different actors try to influence public opinion, one might draw on Entman's (1993) model to identify issue-specific frames.

Here, it is more difficult to come up with a list of frames deductively and based on the literature. We will therefore use an *inductive* empirical approach to find out the deeper structures of interpretation concerning climate change. Based on our knowledge of the topic we formulated and tested three sets of frame elements: one list of *problematic consequences* related to climate change (e.g. melting ice and extinction of certain species but also possible positive consequences), one list of *causes* why humanity continues to produce growing CO_2-emissions (e.g. lack of binding agreements, capitalism, consumer choices, and failure of the IPCC), and one list of *solutions* (e.g. global agreements and adaptation to global warming).

Some problems, causes and, solutions are obviously conceptually linked and this is the whole idea of frames understood as sets of frame elements. Our study reconstructed empirically which frame elements combine to form journalist frames. Also, it is an open empirical question how these issue-specific frames relate to the broader types of frames established above. Therefore, we end up with two research questions that our study aims at responding to: *RQ1: What combinations of problem definitions, causal interpretations, and treatment recommendations are relevant in the view of the climate journalists? RQ2: What are the relations between agreement to the master frame, to generic frames, and to issue-specific frames?*

Method

In order to identify the shared frames on climate change, we conducted an e-mail administered online survey among climate journalists. As target population, we defined all people who published articles on climate change in professional news outlets on a more or less regular basis. The study included five countries: Germany, India, the UK, the US, and Switzerland. With this country sample (countries of different sizes, cultural background, as well as degrees of industrial development and carbon footprint), we deliberately increased the variance within the sample in order to create a hard case for testing our hypotheses.

From each country we selected leading professional news outlets from different sectors of the media landscape: two quality newspapers (preferably one conservative and one liberal), one tabloid or mid-market newspaper, one regional newspaper from a metropolitan area, and one predominantly online player (see table 1). As media organizations are no longer confined to print distribution we included both the print and online editions in our sample.

[Table 1 about here]

In order to find the climate journalists we first searched the websites of the news outlets by using Google site search. We used the search strings “climate change” OR “global warming” OR “greenhouse effect” for English-language news outlets and “Klimawandel” OR “globale Erwärmung” OR “Treibhauseffekt” for the German-language websites. These search strings were elaborated by Schäfer, Ivanova, and Schmidt (2011). This procedure secured a higher level of sampling equivalence than using the different search engines implemented on the different news outlets’ websites. We complemented the Web search by searching the print versions of the news outlets in the LexisNexis and Factiva databases.

Subsequently, we manually identified all articles focusing on climate change and including author names. From the resulting list of names we excluded all people who published less than two articles on the topic during a one-and-a-half year period before data

collection (1 January 2011 – 1 August 2012) in order to eliminate authors that only coincidentally wrote about climate change. For the remaining authors, we tried to find a corresponding e-mail address on the Web. We tested the reliability of the whole author search procedure on a sub-sample consisting of the articles from one news outlet. Two coders worked from different computers and achieved a satisfactory percent agreement of .89.

The author search generated an initial sample of $N = 181$ climate journalists, which we invited per e-mail to participate in our bilingual (English and German) online survey. The survey period lasted two weeks (27 September – 10 October 2012). We sent two e-mail reminders to the journalists and, wherever possible, also reminded them by phone. A sample of $N = 64$ completed the questionnaire which corresponds to a response rate of 35 %. This can be considered satisfactory for a cross-national online survey among journalists.

Measures

In contrast to news frames, journalist frames cannot be measured by content analysis. News content will always represent a mix of journalist frames and other influences within the newsroom and from external actors (Scheufele, 2006). Therefore, one needs to survey journalists, but even in interviews (as our qualitative pre-test with five journalists showed), journalists tend to anticipate the influences and constraints of their daily work in their answers. So in order to get access to the journalist frames understood as their own interpretations and criteria of relevance, we asked the survey participants to imagine a situation where *they* could personally determine how the media covered the climate change. We were interested to what degree they would agree to the different perspectives on climate change provided by the different frames.

There are two established ways of measuring frames in social science: First, it is possible to follow a deductive approach, extract the frames from the research literature, and

measure them holistically. Second, one can pursue an inductive approach, measure different frame elements and explore empirically how they combine into frames (Kohring & Matthes, 2002, Matthes & Kohring, 2008).

We combined both ways of measurement into an integrative approach: The climate change master frame and the generic frames had been drawn from a review of previous studies (see above). The survey participants were asked to assess the master frame on a 5-point scale from 1 (*scientifically untenable*) to 5 (*scientifically well-founded*) and rate their agreement to the relevance of each generic frame on a 5-point scale from 1 (*I do not agree at all*) to 5 (*I fully agree*).

Since research had not yet fully identified the issue-specific frames for climate change we measured them in a modular way. Drawing on Entman (1993) who defined frames as a combination of "problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (p. 52), we created three item sets with problems, causes, and solutions of climate change. The survey participants were asked to attribute importance to each item on a 5-point scale from 1 (*not important at all*) to 5 (*very important*).

Data Analysis

The four items of the climate change master frame reached a satisfactory level of internal consistency (Cronbach's $\alpha = .67$) and could be combined to an average index. For the issue-specific frames we had to identify combinations of frame elements.

We started with three separate first-order Principal Component Analyses for the 10 problems, 13 causes, and 15 solutions. We extracted three components for problems, five for causes, and five for solutions. They all had both initial Eigenvalues $\lambda \geqslant 1$ and produced a relatively clear elbow on the scree plots. The solutions explained 71 %, 6 %, and 71 % of

variance respectively. In order to approximate the solutions to an interpretable simple structure we conducted Varimax rotations.

On the basis of the 13 components resulting from the first analysis, we conducted a second-order Principle Component Analysis (with Varimax rotation) which produced four components explaining 67 % of variance. The resulting components are interpreted as frames that combine the relevancy that journalists attribute to certain problems related to climate change, the causes they hold responsible for this problem, and the solutions they find newsworthy.

Findings

Before we present our central findings concerning master frame, generic frames, and issue-specific frames, we will briefly describe the composition of the sample. The study includes considerable shares of climate journalists from all four countries. Most survey participants came from Germany (28 %), followed by respondents from the US (22 %), India (20 %), Switzerland (19 %) and, with a bit of distance, the UK (11 %).

More than two thirds (72 %) of the climate journalists were male. Their average age was 43.8 (SD = 10.3, N = 46) and roughly two thirds (67 %) of the survey participants were 40 years or older. When it came to education, more than half of the respondents (53 %) held an MA degree and an additional 19 % even held a PhD.

The relatively high age and levels of education did not necessarily correspond to a long-standing experience in climate change coverage. Even though the average number of years spent as a climate change journalist was 8.4 (SD = 7.6, N = 61), almost half of the sample (47 %) worked five years or less as climate journalist and only a third (33 %) was ten years or longer assigned to the topic.

Almost half of the respondents (45 %) covered climate change at least once a week while 13 % published only one article on the topic per year or even less. In terms of beats, one fourth (25 %) of the participants considered themselves as science journalists, while around a sixth (17 %) preferred the more specialized term "environmental journalist". Roughly a tenth of the sample (9 %) associated itself with the political, economics, or general news beat. A share of 8 % considered itself as "bloggers".

In sum, it seems that intensive climate change coverage remains a relatively new phenomenon largely drawing on experienced and educated staff. Climate change coverage mainly rests in the hands of science and environmental beats but there are also substantive contributions from political, economic and general news journalists, as well as from bloggers.

Support for the Climate Change Master Frame

When we look at the climate journalists' support for the climate change master frame, we see a clear pattern of consent with the IPCC-sponsored frame of anthropogenic climate change (see table 2). On average, the survey participants rated all four statements as scientifically well-founded. The respective mean scores ranged from 4.41 to 4.66 on the 5-point scale. Between 88 % and 92 % of the respondents reached values of 4 or 5.

The item simply stating that the global temperature had been rising during the last 150 years was most strongly supported, while the item which implied major problems for the global ecosystem received the least support. For the combined master frame index, the mean score was $M = 4.50$ and more than almost nine out of ten journalists (88 %) reached a value of 4 or 5. Just one respondent scored below 3 indicating that he, indeed, could be counted as climate skeptic. This shows the almost total absence of outright denial of anthropogenic climate change within our sample. We found a very broad consensus among the participants supporting the climate change master frame, so that hypothesis 3 clearly is supported.

[Table 2 about here]

Agreement to the Generic Frames

When it came to the agreement to the generic frames, the preferences of the journalists were more diverse, as indicated by lower means and higher standard deviations (see table 3). Still, only for one generic frame (*uncertainty*), the mean score dropped significantly below 4 and significantly less than two thirds of the respondents scored values of 4 or 5. Even for this exception, the mean of 3.53 was well on the positive side of the 5-point scale and more than half of the sample (55 %) reached values of 4 or 5.

So we can state that all generic frames from our list were considered relevant perspectives on climate change in the view of climate journalists. Survey participants agreed by far the most and significantly more often with the *risk* frame than with the other frames: This understanding of the journalistic task in communicating climate change seems part of the general consensus shared across countries and media outlets. The *morality* and *human interest* frames scored relatively low but especially the *human interest* frames scored not as low as expected. The frame that is perceived as being least desirable in climate coverage is the *uncertainty* frame. This corresponds to the findings for the master frame: A high level of consensus among the participants about the nature of climate change plausibly leads to a low level of support for reporting the uncertainty of scientific findings on climate change. Emphasizing the risks was most important to journalists and talking about uncertainty of climate research was least important. Journalists are obviously cautious about emphasizing the uncertainty in scientific models in order to avoid providing argumentative resources for climate change denial.

In the light of these findings, hypothesis 1 is fully and hypothesis 2 is partly supported. One reason why our results differ from Dirikx and Gelders' (2010) may be that we included

mid-market, tabloid and online media and a wider country sample. Also, their focus on the coverage about the climate summits may have lead to minimize coverage of coverage from a human interest perspective. In our survey the uncertainty frame seems much less desirable for journalists while giving a human face to this issue and reporting in an emotional tone seems important for them in order to draw more public attention to climate change.

[Table 3 about here]

Assessment of Different Frame Elements

Before we identify frames as combinations of frame elements this section will touch upon the evaluations of the single elements. The most relevant *problems* related to climate change that journalism should focus on are – according to our respondents – the spread of poverty, hunger, and diseases. They attribute the least importance to coverage of possible positive effects of climate change (see table 4). Among the *causes* for the problems related to climate change the survey participants rated the lack of globally binding agreements for the reduction of CO_2 emissions as most relevant and a presumed failure of the IPCC and other international organizations as least important (see table 5). In terms of *solutions*, the climate journalists rated renewable energies as most relevant and the expansion of nuclear power by far as least relevant (see table 6). The responses reveal a consistent common pattern of interpreting climate change as a severe problem in line with the master frame described above. The blame for the failure to deal with climate change is clearly not with the international institution of the IPCC but rather with the national governments who are held responsible for not coming up with global climate agreements (see tables 5 and 6).

Frames as Combinations of Frame Elements

The first step towards the identification of issue-specific frames as combinations of frame elements is to reduce the number of items by means of principal component analyses. The longer set of problems can be divided into three components: *Ecological consequences* of climate change, *socio-economic consequences* and *positive consequences* explaining altogether 71 % of the variance (see table 4). It should be noted that the importance of the third component is relatively small (as can be seen from the lower Eigenvalue and the lower explanatory power as shown in table 4).

[Table 4 about here]

For the *causes*, five components emerged that explain 76 % of the variance (see table 5): The first and most important component (*lobbying and national policies*) attributes responsibility for the problems related to climate change to the strong influence of lobbyists from the CO_2-intensive industries and to a failure of national energy and transport policy as well as a focus on promoting national interests rather than on global agreements. Somewhat less important are the other four components: *capitalism and consumption* identifies capitalist logic and consumerist life styles as major causes, while another component blames *technological and bureaucratic delays* for the climate problems. In contrast to this view of climate change as problem of technology and proper political management, the *communication and political deficits* component defines the problem as caused by bad communication on the side of science and journalism and on personal shortcomings of the politicians. The least explanatory power is connected to the fifth component that blames the *emerging economies* as the major impediment for solving the world's climate problems.

[Table 5 about here]

The number of items on *solutions* could be reduced to five components that have roughly equal explanatory power (see table 6): The first component emphasizes *technological*

solutions for the avoidance and the disposal of CO2 emissions together with a belief in nuclear energy as an CO2-neutral energy source. A second solution path demands *voluntary restraints* of consumers and industry *and economic reforms* of the capitalist system. Another solution is based on (if necessary) *unilateral emission reductions* of the industrialized countries. This is contrasted by the component that implies that *globally binding agreements* should be reached. Finally, there is a component that includes items that center on improving communication about climate change by scientists and journalists and on civil society putting more pressure on politicians (*non-governmental communication*).

[Table 6 about here]

Five Frames of Climate Change

As the final step on the way to inductively identify frames we subjected the 13 components from above to a second-order principal component analysis (see table7). This method generated five components that represent common combinations of problems, causes, and solutions. We can thus interpret the results from the principal component analysis as issue-specific frames on climate change. We labeled these frames: (1) *industrialized countries' economic policies, (2) sustainability, (3) technological optimism, (4) emerging economies' responsibility, and (5) global understanding of ecology*. They explained 66.6 % of the variance and all frames are of roughly equal importance with a somewhat bigger explanatory power of the first frame. Below, we will elaborate on how the different frame elements fit together to form these frames and whether they correlate with the other types of frames (master frame and generic frames) that have already been introduced above (drawing also from information in table 8).

[Table 7 about here]

(1) Industrialized countries' economic policies. From the perspective of this frame, climate change causes problematic consequences for humankind and society and the responsibility for solving the problem lies with the industrialized countries, their organized corporate interests and their national policy failure. Lobbyists and national interests block the effective reduction of emissions. Obligations to reduce emissions should be pursued unilaterally if global agreements cannot be reached.

This frame is significantly and most closely related (r = .65**) to the master frame as promoted by the IPCC and discussed above. It is also strongly (r = .64**) related to the generic *risk/disaster* frame: Journalists see their mission as pointing out the risks and dangers associated with climate change and they call for political action within the Western world. This framing goes with an explicit attribution of responsibility that leads to a strong correlation with the generic *responsibility* frame (r = .49**). Also, the *economic* and *morality* frame correlate highly with this pattern of interpretation (r = .57** and r = .53**): This shows that both moral arguments and utilitarian, economic arguments coexist within this framework: Journalists favor a diversity of different generic frames in order to draw attention to the climate problem.

(2) Sustainability. The second issue-specific frame shows high internal consistency and may be labeled sustainability. It displays a causal interpretation that sees both capitalism as a structure and consumption behavior as a culture at the root of the problem. Consequently, solutions are sought in economic reforms of the system and in voluntary restraints of consumers and economic actors. The generic framing associated is the *issue* frame (r = .34**), discussing the concrete issue at hand and the corresponding action options rather than dealing with political strategies and conflicts.

(3) Technological optimism. Clearly distinct from the second frame's critical perspective on capitalism and consumption is this frame which trusts in old (nuclear power)

and new (climate engineering etc.) technology to solve the climate problem. It is interesting to note that this optimism also extends to recommend a more intensive coverage of the positive consequences of climate change. This frame is not strongly related to the IPCC master frame but to the generic *uncertainty* frame (r = .40**): While trust is put in technological progress, the uncertainties of climate science should be emphasized. This frame can be regarded as a blue print for a new discursive strategy of climate *policy* denial – as opposed to climate change denial: It does not directly question that climate change takes place but emphasizes the uncertainty of climate change research. It promotes industry interests by supporting nuclear power and by favoring new technology to solve the problems.

(4) Emerging economies' responsibility. This frame is rather incomplete as it does not connect a problem analysis with treatment recommendations but is based on a single idea: the emerging economies are a cause for concern as their future growth will prevent a solution to the climate problem.

(5) Global understanding of ecology. The last frame differs from the other frames by focusing on the ecological rather than the socio-economic consequences of climate change. Journalists see the consequences of climate change for the ecosystem as the most relevant set of problems that one should write about. According to this frame, the deficient communication of these problems is the cause for the current failure to reduce emissions. Consequently, this frame promotes a better public understanding of ecology in order to prepare the ground for reaching global political agreements. This frame also strongly correlates with the master frame (r = .44**).

[Table 8 about here]

Discussion and Conclusion

This study started out from the assumption that journalism is about interpreting the world and that journalist frames (cognitive patterns of interpretation) matter for explaining news frames (patterns of presentation). We took climate change as a relevant case for examining journalist frames across different media outlets and countries with a view to explore common frames as an indicator for the existence of a transnational interpretive community among climate journalists.

The article defined framing as a process of interpretation that works on different levels of abstraction. Broad generic frames that are applicable to a number of different issues coexist with issue specific frames. The latter group of frames falls into broader master frames that are issue specific but integrate a number of more concrete (sub-)frames. For this most concrete layer of framing the study followed Entman's (1993) concept of defining frames as combinations of frame elements.

The study identified journalist frames on the different levels of framing and explored the interrelations between different types of frames. Drawing on past studies of frames in the field of political communication as well as science communication, we established a list of generic frames. Confirming our hypotheses (H1, H2), the study found broad support for the cognitive relevance of these frames for journalists with a distinct hierarchy of frames ranging from the risk/disaster frame that seems most relevant for climate coverage to the uncertainty frame that journalists personally ascribe the lowest importance.

There is a high level of consensus among journalists about their duty to report the risks and imminent disasters associated with climate change. Journalists do apparently not want to further spread the impression of "uncertain science" among the public. This is in line with our second finding that there is a common master frame of anthropogenic climate change which reflects the positions of the IPCC and a broad consensus among scientists (supporting H3).

Outright denial of climate change does not exist among the journalists that have responded to our questionnaire (with one outlier).

Theoretically, this could be the result of a silent minority or spiral of silence effect but we do not think that this is the case here. Climate change deniers do not tend to be shy about their convictions: They rally against climate science and the IPCC in public through op-eds, blogs and books – not only in the US, but (to a lesser extend) also in all other countries in our sample. Therefore, we interpret our findings as evidence of an interpretive community that is built around the assumptions implied in the master frame on anthropogenic climate change. This frame is shared among leading scientists, journalists and – not analyzed in this study – a certain part of the audience. In the US and partly the UK public climate denial is still vivid and partly even growing in recent years. There seems to be growing gap between climate skeptics and the interpretive community of climate journalists in major news outlets.

Adding to this impression of shared interpretations among climate journalists across borders are the results on a number of single items in the survey: The journalists seem to agree with regards to some political orientations such as opposing nuclear power as a solution to the climate change problem and in *not* putting the blame on the IPCC but rather on actors at the national level.

Within the boundaries of these shared interpretations, however, there is room for divergent interpretations reflected in the five issue-specific frames. The first frame emphasizes the responsibility of the industrialized world to reduce emissions in spite of strong lobbying against climate policy (*industrialized countries' economic policies).* The second frame aims at a reform of the economic system and a change of consumer behavior *(sustainability*). The third frame trusts in technology to solve the problem *(technological optimism).* The forth frame puts the focus on the emerging economies as contributors to climate change *(emerging economies responsibility).* Finally, the *global understanding of*

ecology frame regards climate change as a communicative challenge of explaining the imminent threat to the global eco-system.

The study clearly indicates that climate journalists share interpretations about climate change to a considerable degree and thus form an interpretive community, but the five (sub) frames also indicate that different cultures of interpretation co-exist within the common framework. There is a certain dominance of the progressive framing of climate change as a problem of capitalism and policy failure among the industrialized countries. It would be interesting to analyze the interpretative sub-communities that emerge along the lines of the different issue-specific frames. Different political orientations, beats, socio-demographic groups, news outlets, or countries are likely to go with certain frames: The technological optimism frame may be closer to conservative views while the sustainability frame seems moderately progressive. Technological optimism might also become the new skeptics frame as it effectively shifts attention away from the need for strong climate policies or broader reforms of the political and economic system as promoted by two of the other frames.

Futures studies should furthermore be dedicated to the question of how the journalist frames are reflected in the news content they produce. We have assumed above that journalists frame matter, but the open question is to what degree and under which circumstances can journalists actually turn their interpretations into coverage.

The integrative approach to measure journalist frames provided some interesting insights. By means of exploring the relations between generic frames and issue-specific frames, the study was able to proof our conceptual claim that both types of frames may be seen as complementary and useful for being studied together. First, generic frames and issue-specific frames illustrated each other. If we would have followed only the issue-specific frames approach the prevalence of the risk frame and the relative unimportance of the uncertainty frame would have remained hidden from our eyes. If we would have merely

pursued the generic frames approach, we would have missed the different perspectives offered by the issue-specific frames. Second, from a methodological point of view, the holistic way of measuring generic frames and the modular way of operationalizing the issue-specific frames validated each other as could be seen by the correlations between the two types of concepts. Beside cluster analysis which is already more widely established in the context of framing research, principal component analysis proved to be another valuable method to inductively identify frames.

The findings of this study seem relevant not only for future research on framing and climate change communication but also for the field of science communication in general: Framing of other issues than climate change could be analyzed using our integrative approach and the lists of generic frames advanced in this article. It would be interesting to further explore the scope of interpretive communities around science issues: Are there different communities *among* scientists or *between* scientists and journalists? Which kinds of audiences become parts of those communities?

Finally, for climate communication, journalists seem part of an elite interpretive community that is not always able to connect to politicians and the wider public opinion. This disconnect between expert and popular interpretive communities which is especially obvious in the case of the US may become tragic for mankind if it continues to impede effective climate policy making.

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Table 1

Sample of Countries and News Outlets

	Country					
News Outlet	CH	DE	IN	UK	US	Total
Quality newspaper	NZZ	FAZ	Hindustan Times	Daily Telegraph	WSJ	11
	Tages-Anzeiger	SZ	Indian Express	Guardian	NYT	24
Tabloid/mid-market newspaper	Blick	BILD	MidDay[d]	The Sun	USA Today	3
Regional newspaper[a]	Berner Zeitung[c]	Berliner Zeitung	The Hindu	Manchester Evening News[c]	LA Times	10
Online player[b]	News.ch	Spiegel Online	Times of India[e]	BBC News	Huffington Post	16
Total	12	18	13	7	14	64

Note: [a]The regional newspaper should come from another metropolitan area than the other newspapers; [b]The online player should have a certain degree of financial and editorial independence from its parent news outlet; [c]Only one author could be identified; [d]No authors could be identified; most other Indian mid-market newspapers are written in Hindi languages and could not be analyzed; [e]The Times of India is mainly a quality newspaper but also a relevant online player

Table 2

Support for the Climate Change Master Frame

	N	Min	Max	*M*[a]	*SD*	Total % of values 4 and 5
For about 150 years the average global temperature has been rising	64	1	5	4.66	0.88	92%
Humankind must strongly reduce CO_2 emissions in order to limit future global warming	64	1	5	4.47	0.91	88%
Global warming has been largely caused by humans through CO_2 emissions and greenhouse gases	64	1	5	4.45	0.82	88%
The impact of global warming will most likely create major problems for our global ecosystem	64	2	5	4.41	0.75	91%
Master frame index[b]	64	2.25	5.00	4.50	0.60	88%

Note: [a]Values are mean scores on a 5-point scale (1 = scientifically untenable, 5 = scientifically well-founded); [b]Cronbach's α for the items of the master frame index = .67

Table 3

Agreement to the Generic Frames

	N	*Min*	*Max*	*M*	*SD*	Total % of values 4 and 5
Risk/Disaster ("Risks climate change poses for the ecosystems and humankind")	62	2	5	4.73[a]	0.55	95%
Issue ("Pros and cons of the solutions and options aimed at containing climate change")	62	2	5	4.40[b]	0.82	83%
Progress ("Scientific and technological progress made in the research on climate change")	62	2	5	4.35[b]	0.83	78%
Economic ("Economic costs of climate change and various options")	62	2	5	4.34[b]	0.89	83%
Human-Interest ("Human concerns of climate change: personal tragedies and emotional images")	62	1	5	4.03[b]	0.97	70%
Responsibilty ("Those who are responsible for causing and solving the climate change problem")	61	1	5	4.02[b]	1.07	66%
Conflict/Strategy ("Conflicts of interest associated with climate change and the strategies of the various actors")	62	1	5	4.00[b]	1.09	67%
Morality ("Moral and ethical questions raised by climate change")	61	1	5	3.93[b]	1.05	70%
Uncertainty ("Uncertainties and contradictions of scientific models and prognoses")	62	1	5	3.53[c]	1.11	55%

Note: Values are mean scores on a 5-point scale (1 = I do not agree at all; 5 = I fully agree); Diffferent letters mark significantly different means (CI of 95 percent).

Table 4

Frame Elements: Problems

Items	Components			Communalities	Descriptive statistics				
	Ecological consequences	Socio-economic consequences	Positive consequences		*N*	Min	Max	*M*	*SD*
Melting ice (for example polar caps, permafrost, and glaciers)	.83			.74	63	2	5	4.51	0.80
Rising sea levels	.81			.71	64	2	5	4.52	0.84
Changes in sea currents	.74			.58	62	2	5	4.10	0.92
Extreme weather events (for example rain, storms, droughts, and flooding)	.67	.46		.67	64	2	5	4.59	0.71
Extinction of species and spreading of new species	.67			.57	64	2	5	4.47	0.73
Climate impacts on your country (for example on agriculture)	.66	.42		.71	63	1	5	4.54	0.78
Spread of poverty, hunger, and diseases		.85		.80	64	1	5	4.70	0.68
Migration flows		.83		.74	63	1	5	4.29	0.83
Additional costs for the national economy caused by climate change		.74		.66	63	1	5	4.35	0.90
Positive consequences (for individual industries and regions)			.95	.92	62	2	5	3.68	1.02
Intitial Eigenvalue	4.89	1.10	1.02						
Eigenvalue after rotation	3.42	2.55	1.13						
Explained variance (%)	34.2	25.5	11.3						
Total explained variance (%)		71.0							

Note: Principal Component Analysis with Varimax rotation; $N = 59$; factor loadings $a < .4$ suppressed.

Table 5

Frame Elements: Causes

Items	Components					Communalities	Descriptive statistics				
	Lobbying and national policies	Capitalism and consumption	Technological and bureaucratic delays	Communication and political deficits	Emerging economies		*N*	Min	Max	*M*	*SD*
Strong influence of lobbyists from the (CO_2-intensive) industries	.90					.82	63	1	5	4.08	1.00
Failed national energy and transport policy leads to increasing CO_2 emissions	.81					.78	62	1	5	4.06	1.07
Lack of globally binding agreements on the reduction of CO_2 emissions.	.63					.61	64	1	5	4.28	0.92
National interests thwarting the international climate policy	.58		.57			.71	62	2	5	4.18	0.84
Industrial countries as the main source of emissions	.50		.48			.71	64	1	5	4.00	0.93
People's lacking sense of responsibility for nature and next generations		.85				.82	64	1	5	3.63	1.23
Consumption and lifestyles of private households and consumers		.70	.40			.80	64	1	5	3.92	1.09
Capitalist economic system focused on growth and profit maximization		.70				.68	64	1	5	3.52	1.26
Unduly slow development of technologies for avoiding emissions and adapting to climate change			.84			.73	62	1	5	3.60	0.95
Failure of the IPCC and other international organizations in charge of climate policy			.67	.42		.67	61	1	5	3.03	1.21
Communication problems on behalf of science, the media, and journalists.				.91		.86	62	1	5	3.31	1.11
Shortcomings and lack of will on behalf of politicians when it comes to consequent climate policy	.41	.43		.53		.72	64	2	5	4.05	0.98
Newly industrialized countries (such as China, India, Brazil) as a source of rapidly increasing emissions					.96	.94	64	2	5	3.91	0.85
Intitial Eigenvalue	4.76	1.54	1.33	1.18	1.04						
Eigenvalue after rotation	2.88	2.08	2.07	1.60	1.22						
Explained variance (%)	22.2	16.0	15.9	12.3	9.4						
Total explained variance (%)			75.8								

Note: Principal Component Analysis with Varimax rotation; $N = 56$; factor loadings $a < .4$ suppressed.

Table 6

Frame Element: Solutions

Items	Components					Communalities	Descriptive statistics				
	Technological solutions	Voluntary restraints and economic reforms	(Unilateral) emission reductions	Non-governemntal comunication	Binding (global) agreements		*N*	Min	Max	*M*	*SD*
Technological solutions for the disposal of CO2 (for example underground) and geo–engineering	.81					.68	64	1	5	3.61	1.18
Technological solutions for avoiding emissions	.79					.76	64	2	5	4.33	0.82
Energy policy: expansion of nuclear power as an alternative to coal power stations	.60					.63	63	1	5	2.67	1.43
Voluntary restraint in consumption and increased awareness of responsibility for next generations		.84				.82	62	1	5	3.58	1.30
Ecological restructuring of the economy with the aim of sustainable development		.83				.78	64	1	5	4.23	0.96
Self-commitment of the industry, corporate responsibility	.50	.65				.83	62	1	5	4.18	1.05
Raising the costs for emissions			.86			.81	61	2	5	4.43	0.81
Self-commitment of all rich countries to reduce their emissions (if necessary: unilateral approach of individual			.67			.68	60	1	5	3.58	1.17
Intensified communication efforts on the subject of climate change through science and journalists				.80		.70	61	1	5	3.69	1.09
Civil society commitment in order to increase the pressure on politics				.68		.74	62	1	5	3.74	1.02
Energy policy: renewable energy source as an alternative to coal power stations			.44	.62		.61	63	2	5	4.48	0.69
Binding agreements about the reduction of greenhouse gases, preferably including all states					.81	.73	63	1	5	4.40	0.91
Including the most important newly industrialized countries (for example China) in binding climate agreements					.80	.68	63	2	5	4.44	0.84
Bans and tight rules for reducing emissions			.57		.57	.67	62	1	5	4.05	1.05
Adapting to climate change (for example: dams built to higher levels, resettling, adapting farming practices)	.44				-.46	.51	64	2	5	4.14	0.87
Initial Eigenvalue	4.72	1.97	1.53	1.33	1.06						
Eigenvalue after rotation	2.27	2.18	2.13	2.05	1.98						
Explained variance (%)	15.1	14.6	14.2	13.7	13.2						
Total explained variance (%)			70.8								

Note: Principal Component Analysis with Varimax rotation; $N = 56$; factor loadings $a < .4$ suppressed.

Table 7

Components Constituting Issue-Specific Frames

First-Order Components	Second-Order Components					Communalities
	Industrialized countries' economic policies	Sustainability	Technological optimism	Emerging economies' responsibility	Global understanding of ecology	
Lobbying and national politicies (cause 1)	.80					.76
Socio-economic consequences (problem 2)	.71					.78
(Unilateral) emission reduction (solution 3)	.67					.54
Capitalism and consumption (cause 2)		.86				.80
Voluntary restraints and economic reforms (solution 2)		.83				.79
Technological solutions (solution 1)			.77			.71
Technological and bureaucratic delays (cause 3)			.77			.68
Positive consequences (problem 3)			.62			.50
Emerging economies (cause 5)				.81		.75
Non-governmental communication (solution 4)				-.70		.61
Communication and political deficits (cause 4)					.74	.66
Ecological consequences (problem 1)					.63	.50
Binding (global) agreements (solution 5)					.52	.57
Initial Eigenvalue	2.34	1.82	1.67	1.56	1.26	
Eigenvalue after rotation	1.94	1.83	1.76	1.56	1.56	
Explained variance (%)	15.0	14.1	13.5	12.0	12.0	
Total explained variance (%)			66.6			

Note: Principal Component Analysis with Varimax rotation; $N = 48$; factor loadings $a < .4$ suppressed.

Table 8

Correlations between Generic Frames, Issue-Specific Frames and Masterframe

	Issue-Specific Frames					
Generic Frames	Industrialized countries' economic policies	Sustainability	Technological optimism	Emerging countries' responsibility	Global understanding of ecology	Master frame
Risk/Disaster	.64**	.31*	.05	-.40**	.19	.44**
Issue	.18	.34*	.12	.13	.08	.14
Progress	.26+	.06	.05	.15	-.14	.05
Economic	.57**	.08	.09	-.10	-.12	.37**
Human-Interest	.40**	.27+	.33*	-.26+	.04	.39**
Responsibility	.49**	.25+	.27+	.02	.19	.40**
Conflict/Strategy	.31*	.09	.20	-.05	.11	.16
Morality	.53**	.16	.19	-.01	.01	.29*
Uncertainty	-.16	-.10	.40**	.11	.09	-.21+
Master frame	.65**	.11	.02	-.09	.44**	1.00

Note: Pearson's correlation coefficients; +p < .1, *p < .05, **p < .01; N_{min} = 46 for correlations with issue-specific frame, N_{min} = 61 for correlations between generic frames and master frame