

Abstract

Journalists play an important role as mediators of scientific information and their interpretations of climate change influence media debates and public opinion. This study maps the minds of climate journalists from five different countries (Germany, India, Switzerland, the UK, and the US) and different types of leading media outlets. It identifies five cognitive frames which vary between attributing the responsibility for climate change to lobbying and national interests, blaming consumerist culture and the capitalist system, and expressing technological optimism. The study provides evidence for the emergence of a sustainability frame, indicates a ‘blame game’ between industrialized countries and emerging economies, and shows the demand for a global ecological discourse. Finally, it explores how individual factors such as specialization, professional aims, and political alignment influence the cognitive frames of journalists.

Keywords: framing, cognitive frames, climate change, journalism, cross-national comparison

Mapping the Minds of the Mediators: The Cognitive Frames of Climate Journalists from Five Countries

The way climate change is framed in the mass media has important consequences for the development of public opinion on this issue (Corbett & Durfee, 2004; Hart, 2011). Therefore, it is worth exploring where these news frames originate from. It is the basic assumption of this study that news frames, at least to a certain degree, reflect the cognitive frames of journalists. Scheufele and Scheufele (2010, p. 120) put the underlying rationale in a nutshell: “If journalists think about problems, ask for causes, or recommend treatments (cognitive level), they also apply these ways of thinking about an issue to their articles (textual level)”. Research on journalistic framing practices has a long tradition (Brüggemann, 2014; Dunwoody, 1992; Gitlin, 1980; Tuchman, 1978) but we do not know much about the cognitive frames of the journalists covering climate change. We narrow this gap of research by reconstructing these frames and thus identifying one important influence on media coverage and public understanding of climate change.

There are several factors shaping media content on different levels of analysis (Shoemaker & Reese, 1996). However, the journalists’ mindsets are particularly relevant for a number of reasons: Journalists play an important role as mediators of scientific information but they perform it in different ways (Fahy & Nisbet, 2011) and thereby contribute to the social construction of public knowledge and ignorance (Stocking & Holstein, 2009). There is empirical evidence that the journalists’ scientific knowledge (Wilson, 2000), professional norms (Boykoff & Boykoff, 2004), ideological standpoints (Carvalho, 2007), political alignment (Elsasser & Dunlap, 2013) and expertise (Brüggemann & Engesser, 2014) influence their coverage of climate change. Other factors on the country level (Grundmann & Scott, 2007) or the organizational level (McCluskey, 2008) exert their influences on media content indirectly through the journalists by shaping their interpretive frameworks.

In a general sense, we conceive a *frame* as “central organizing idea or story line that provides meaning to an unfolding strip of events” (Gamson & Modigliano, 1987, p. 143) and, more specifically, we understand a *journalist frame* as “knowledge structure” that is “employed by a journalist throughout story construction” (Dunwoody, 1992, p. 78). As operational definition we drew on Entman (1993, p. 52) who disaggregated frames into four basic elements: problem definition, causal interpretation, moral evaluation, and treatment recommendation. This conceptualization has become the point of reference for many empirical analyses (e.g. Kohring & Matthes, 2002; Matthes & Kohring, 2008) but it has been mostly applied to media content.

This study, to the best of our knowledge, is the first to directly access the cognitive frames of journalists through a cross-national survey. We followed Scheufele and Scheufele’s (2010, p. 120) recommendation and explored the journalist’s cognitions by means of a standardized survey. The study addressed climate journalists from five countries (Germany, India, Switzerland, the UK, and the US) and different types of leading news outlets. The first aim of this study is to explore the cognitive frames of climate journalists. The second aim is to identify factors that help explaining these frames.

Conceptualizing and Contextualizing Journalist Frames

Most scholars agree that frames are patterns of interpretation. One point of departure is regarding frames as cognitive structures (Goffman, 1974). These *cognitive frames* have been conceived as sets of schemata that help human beings to process information (Scheufele & Scheufele, 2010). Our study, for the sake of simplicity, will refer to the cognitive frames of journalists as *journalist frames*.

These “frames in thought” can be distinguished from “frames in communication” (Chong & Druckman, 2007). If the latter appear in media content produced by professional journalists they are commonly referred to as *news frames* (e.g. D’Angelo & Kuypers, 2010).

Both types of frames are highly interconnected as Entman, Matthes, and Pellicano (2009, p. 177) showed in their integrative model of the framing process. One of their core assumptions is that the cognitive frames of the communicators influence the news frames. These news frames, in turn, affect the cognitive frames of the audience. While the effects of news frames on the cognitive frames of audience members are relatively well-researched, the question of how frames enter news coverage has been rather neglected (De Vreese & Lecheler, 2012).

The ground for studies on journalist frames was prepared by Tuchman (1978) and Gitlin (1980) who argued that journalistic practices and routines embody cognitive allow journalists to process information more quickly and effectively.

Dunwoody (1992) investigated the relation between journalist frames and news frames. She reckoned that the absence of a journalist frame on scientific risk is one reason for the deficient reporting of risks. Alternative frames, such as the accident frame, are cognitively more easily available to journalists and thus more frequent in news coverage.

Scheufele (2006) explored newsroom frames, which he conceived as the shared cognitive frames of the journalists in a given newsroom on a given topic, by comparing reporting and commentary within the same media outlets. He found high levels of overlap between these two types of frames.

Brüggemann (2014) conceptualized the contribution of journalists to news frames as “journalistic framing practices” which could be located on a continuum between “frame sending” and “frame setting”. Journalists may primarily relay the frames advocated by actors or they may let their own cognitive frames dominate the coverage depending on their professional context and the resonance of the journalist’s frames with the broader cultural “frame repository”.

While there is substantial theoretical work on journalist frames there is still a lack of empirical studies, in particular cross-national ones.

News Frames of Climate Change

In terms of news content, it is possible to distinguish *issue-specific* and *generic* frames. While the former are tailored to a particular event or issue (e.g. climate change), the latter are broader patterns of interpretation that can be applied to a multitude of issues (De Vreese, 2002). Examples of generic frames are conflict, human-interest, responsibility, morality, and economic consequences frames (Semetko & Valkenburg, 2000).

Dirikx and Gelders (2010) showed that some of these generic frames also appeared in public debates on climate change – with the exception of the morality frame and only rare occurrences of the human-interest frame. However, by drawing on a pre-established list of generic frames one cannot guarantee to have identified all relevant frames of a specific issue. This becomes even more evident when considering that Semetko and Valkenburg's (2000) list of frames mainly derived from studies of political communication. Therefore, we will briefly present some of the frames more specific to the issue of climate change (for a general overview: Dahinden, 2002; Nisbet, 2010).

First, the *risk/disaster* frame focuses on the dangers associated with technology and science. This frame is sometimes also entitled “Pandora’s Box”, “Frankenstein’s Monster”, and “Runaway science” (Durant, Bauer, & Gaskell, 1998; Gamson & Modigliani, 1989). It very prominently appears in climate change coverage (Painter, 2013). Second, there is the *uncertainty* frame portraying science as producing contradictory research results, weak explanations, or dubious forecasts. This frame is also highly relevant in climate change debates (Antilla, 2005; Painter, 2013; Schlichting, 2013; Shehata & Hopmann, 2012). Third, the *progress* frame depicts advances in technology and science as beneficial for mankind. This frame is closely related to the *opportunity* frame occurring in climate change coverage (McCright & Dunlap, 2000; Painter, 2013; Zehr, 2009).

In order to completely understand public debates these frames may be useful but not sufficient. The economic consequences frame, for instance, may be used by ‘warners’ to emphasize the costs of anthropogenic climate change, and by the ‘deniers’ to stress the costs of emission reductions.

A number of studies have analyzed news frames on climate change and we display a selection of them in Table 1. Due to different forms of operationalization and measurement the studies produced quite diverse lists of frames. The table also shows that most research has been limited to the elite press and focuses on the US but including more countries and media outlets seems to be pivotal to generalize findings beyond elite Western media.

[Table 1 here]

Many studies refer to Entman (1993) in order to explain their approach to framing. Yet they rarely follow his idea to conceptualize frames as combinations of the frame elements problem definition, causal interpretation, moral evaluation, and treatment recommendation.

Trumbo (1996) regards problems, causes, judgments, and remedies as separate frames. While this approach may be fruitful to show how the debate developed over time from discussing causes to focusing on remedies, this approach is not able to grasp the connections between certain problems and solutions.

Schlichting’s (2013) study comes closer to implementing Entman’s idea. She shows how industry actors connect problem definitions to a policy agenda and how these configurations of frame elements change over time. While the industry used to emphasize scientific uncertainty it is, at present, no longer questioning the existence of anthropogenic climate change. Instead, it depicts itself as forerunner in fighting climate change through technological innovation thus downplaying the need for government regulation.

The other studies listed in Table 1 also show how the framing of climate change has developed over time from debating its very existence to the point of coping with its consequences. Country differences do persist but overall, and even in the US, the skeptics and their counter-frames are much less prominent than the proponents of what Shehata and Hopmann (2012, p. 179) call the “anthropogenic climate change frame”. Today, it seems difficult to question the basic idea of climate change. Therefore, former ‘deniers’ are likely to turn to other frames in order to oppose state regulations which makes it necessary to identify the current frames on climate change inductively.

Method

Sample

The study included five countries: Germany, India, Switzerland, the UK, and the US. The countries under study share high amounts of CO₂ emissions, either in terms of total emissions or per capita (Clark, 2011) and are thus likely to feature vivid debates on climate change. They also differ in terms of climate-change skepticism, which is relatively high in the US, medium in the UK, and low in Germany and Switzerland (Grundmann & Scott, 2014). Beside these countries we included an exemplary emerging economy: India has proven to be a very interesting case in terms of climate-change coverage (Billett, 2010; Painter, 2013).

We selected leading professional news outlets from different sectors of the media landscape: two upmarket newspapers (preferably one conservative and one liberal), one midmarket newspaper, one regional newspaper from a metropolitan area, and one predominant online player (see Table 2). Our selection of news outlets was inspired by previous studies (e.g. Boykoff & Nacu-Schmidt, 2013). As media outlets, in our digital world, are no longer confined to print distribution we included also the online editions.

[Table 2 here]

Operationalization

Journalist frames. In contrast to news frames, journalist frames cannot be precisely measured by content analysis because media content will always represent a mix of journalist frames and other influences from within and outside the newsroom (Scheufele, 2006). Therefore, it is more fruitful to ask the journalists directly. However, even in interviews, as our qualitative pre-test with five climate journalists showed, journalists tend to anticipate the constraints of their daily work in their answers. So, in order to get the most direct access to the journalist frames we let the survey participants imagine a hypothetical situation. We asked them: “Imagine you could decide how the media covered climate change. How important would be the following aspects for you?”

Drawing on Entman’s (1993) definition of frames we assembled three item sets with problems, causes, and solutions of climate change (see Tables 3 to 5). These sets were derived from the natural scientific literature on climate change (e.g. Rahmstorf & Schellnhuber, 2007). 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).

Influencing factors. In order to explain the journalist frames we included a number of potential influencing factors on the individual level that are known to shape the coverage of climate change, such as formal education, expertise on the topic, experience with the topic, professional specialization, and political alignment.

Additionally, we operationalized the journalists’ belief in anthropogenic climate change by asking them how they assessed four core statements of the Intergovernmental Panel on Climate Change (IPCC) on a 5-point scale from 1 (= scientifically untenable) to 5 (= scientifically well-founded). These statements declared that (1) global warming exists, (2) emission reductions are necessary, (3) climate change is caused by humans, and (4) it results

in major problems. The four items were combined into the averaged IPCC Affirmation Index, which reached a satisfactory level of internal consistency (Cronbach's $\alpha = .67$).

We also inquired three professional aims of the climate journalists: (1) increasing knowledge on climate change, (2) raising ecological awareness, and (3) emphasizing the necessity of ecological reforms in politics and economy. All influencing factors with statistically significant correlations to the journalist frames are displayed in Table 8.

Data Collection

As the target population of climate journalists, we defined all people who published articles on climate change in professional news outlets on a regular basis. In order to find these journalists we first analyzed the websites of the news outlets by using *Google* site search. We used the search string “climate change” OR “global warming” OR “greenhouse effect” (and the equivalent in German). The validity of these strings was tested in previous studies (e.g. Schmidt et al., 2013). We complemented the Web search by scouring the print versions of the news outlets in *LexisNexis* and *Factiva*.

Subsequently, we manually identified all articles focusing on climate change and stating author names. From the resulting list of names we excluded all people who published less than two pertinent articles during a one-and-a-half year period (1 January 2011 – 1 August 2012) to eliminate authors that only coincidentally wrote about climate change. We researched the e-mail addresses of the remaining authors. We tested the reliability of the whole author search procedure on a sub-sample consisting of the articles from one news outlet. Two coders achieved a satisfactory agreement of 89 %.

The author search generated a survey population of 170 climate journalists, which we invited by 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 64 people completed the questionnaire, which corresponds to a response rate of 38 %. This can be considered satisfactory for a cross-national online survey among journalists.

Data Analysis

In order to compose the journalist frames of problems, causes, and solutions, we proceeded in two steps. First, we reduced the number of dimensions behind the three item sets by means of three separate principal component analyses (PCA) for the 10 problems, 13 causes, and 15 solutions. PCA is an established method of analysis in framing research (e.g. Semetko & Valkenburg, 2000). We extracted three components for problems, five for causes, and five for solutions which can be regarded as frame elements. Second, we subjected the resulting 13 components to a second-order PCA in order to identify combinations of problems, causes, and solutions across the three item sets. The second analysis produced five components which can be considered the journalists' cognitive frames on climate change. The whole process is illustrated in the Figure by using one of the journalist frames as an example.

[Figure here]

Prior to the data analysis all items were z-standardized. For all the PCAs, the KMO measure of sampling adequacy produced satisfactory values (MSA = .66 – .82). We applied the Kaiser criterion and extracted all components with Eigenvalues $\lambda \geq 1$. The solutions displayed relatively clear elbows on the scree plots and explained between two thirds and three fourths (66 % – 76 %) of total variance. In order to achieve highly interpretable simple structures we conducted Varimax rotations. Another reason for choosing orthogonal instead of oblique rotation was the fact that the second-order PCA aimed at identifying combinations *across* the item sets. This was highly facilitated by orthogonally rotated first-order components because they are per se uncorrelated *within* the item sets.

Findings and Discussion

The prototypical climate journalist in our sample is male, 43 years old, has a master's degree, is employed full-time and regards himself as science or environment journalist. The gender and age distributions of our sample proved to be very similar to U.S. environmental journalists (Sachsman et al., 2010). With regard to these demographics, our sample seems to be representative. For a more in-depth analysis of the sample and a description of the different types of journalists involved see (REFERENCE REMOVED FOR PEER-REVIEW). In the following, we will focus on the reconstruction of the journalist frames on climate change and on exploring the factors that influence journalist frames.

Problems, Causes and Solutions Worth of Journalistic Coverage

According to the journalists in the sample, the most important problem related to climate change is the spread of poverty, hunger, and diseases, followed by extreme weather events such as rain, droughts, and flooding. They attribute the least importance to positive consequences of climate change (see Table 3). Among the causes the participants rated the lack of globally binding agreements on the reduction of CO₂ emissions as most relevant and a presumed failure of the IPCC and other organizations as least relevant (see Table 4). In terms of solutions, renewable energies scored highest and the expansion of nuclear power by far lowest (see Table 5).

[Tables 3, 4, and 5 here]

We also asked the climate journalists how important they considered the three areas of problems, causes, and solutions as a whole. While solutions ($M = 4.8$, $SD = 0.5$) and problems ($M = 4.7$, $SD = 0.6$) reached almost equally high values, causes ($M = 4.4$, $SD = 0.8$) scored significantly lower (paired T -tests with $p < .01$). So the respondents would prefer to focus on

the second part of the causal chain by discussing the harmful consequences of climate change and ways to deal with them.

Frame Elements: Components of Problems, Causes, and Solutions

Before identifying frames, the relatively large lists of problems, causes, and solutions had to be reduced to a manageable number of principal components which can be regarded as frame elements.

The list of problems produced three components: *ecological consequences* of climate change (e.g. melting ice, and rising sea levels), *socio-economic consequences* (e.g. poverty, hunger, and diseases) and *positive consequences* (see Table 3). It should be mentioned that the third component appears a bit underdeveloped because it comes up with only one item loading and its initial Eigenvalue is relatively small.

In terms of causes, five components emerged (see Table 4): The most important one is entitled *lobbying and national interests* and it attributes the responsibility for climate change to lobbyists from CO₂-intensive industries, failed national energy and transport policies, and national interests. *Capitalism and consumption* identifies capitalist logic and consumerist life style as major causes of climate change while another component points to *technological and bureaucratic delays*. There is also a component that addresses *communicative and political deficits* by criticizing scientists and journalists for not being able to communicate adequately and politicians for their lack of commitment to the cause. The final component blames the *emerging economies* for being a major impediment to the solution of the world's climate problems. It is also rather weak in terms of factor loadings and Eigenvalue.

The solutions could be reduced to five components as well (see Table 5): The first component emphasizes *technological solutions* for the avoidance and disposal of CO₂ and supports nuclear power as CO₂-neutral energy source. A second solution path demands *voluntary restraints and economic reforms* of consumers and the capitalist system. Another

treatment is based on *unilateral* (if necessary) *emission reductions* of the industrialized countries. This is contrasted by the component suggesting that *binding agreements* should be reached, preferably on a *global* level. Finally, there is a component which we entitled *non-governmental communication* recommending intensified communication about climate change by scientists, journalists, and civil society.

Journalist Frames: Combinations of Frame Elements

The frame elements can be combined into five journalist frames: (1) industrialized countries' economic policies, (2) sustainability, (3) technological optimism, (4) emerging economies' responsibility, and (5) global ecological discourse (see Table 6).

[Table 6 here]

Industrialized countries' economic policies. From the perspective of the first frame, climate change causes problematic consequences for the human society. 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.

Sustainability. The second frame 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 the industry.

Technological optimism. Clearly distinct from the second frame's critical perspective on capitalism and consumption this frame relies on both old (i.e. nuclear energy) and new

(e.g. climate engineering) technologies to solve the climate problem. This form of optimism also recommends covering climate change's positive consequences more intensively.

Emerging economies' responsibility. This frame is somewhat fragmented because it lacks both problems and solutions. Instead, it is based on a single idea: the emerging economies are a cause for concern because their future growth will prevent a solution to the climate problem.

Global ecological discourse. The final frame differs from the other ones by focusing on the ecological rather than the socio-economic consequences of climate change. According to this frame, the deficient communication about 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 global political agreements.

When we relate these journalist frames to the news frames identified in previous empirical studies (see Table 1) we find that the well-established risk and disaster frame contains a component of socio-economic risk and another component of ecological risk that don't necessarily go together, as our study shows. They are aligned with different problem definitions and treatment recommendations: while the social costs of climate change are absorbed by the *industrialized countries' economic policies* frame, the risks for the ecosystem are emphasized in the context of the *global ecological discourse* frame. There also is a conceptual overlap between the opportunity frame mentioned in the literature and our *technological optimism* frame.

Comparing Journalist Frames across Countries

Due to the limited case numbers per country cross-national differences should be interpreted with caution and our interpretation will focus on comparing three groups: German-speaking countries, Anglo-Saxon countries and India as emerging economy. The *sustainability* frame produces the largest differences (see Table 7). It is strongest in India and

weakest in Great Britain and the USA. When comparing India to the German-speaking and the Anglo-Saxon countries the differences are statistically significant ($F(2, 45) = 3.96, p = .026$). These findings become plausible when considering that India is an emerging economy with a relatively high population increase and economic growth. Climate journalists living there are confronted with an exploding level of consumption and its consequences on a daily basis and may therefore raise questions of sustainability more urgently than their colleagues in the industrialized countries. On the other hand, Great Britain and the USA are widely known for their consumerist culture and this may be reflected in the journalists' reluctance to evoke the sustainability frame which questions the capitalist system.

[Table 7 here]

The situation is completely different when it comes to the *emerging economies' responsibility* frame. This frame is most strongly supported by climate journalists from the Anglo-Saxon countries and least by journalists from India ($F(2, 45) = 2.82, p = .070$). These findings may be an indication for a certain kind of 'blame game' in which the industrialized countries assign the responsibility for climate change to the emerging economies and vice versa. However, shifting the blame to others and trying to put one's own house in order at the same time seems to be no contradiction in the Anglo-Saxon countries where relatively high values for the *industrialized countries economic policies* and the *emerging economies' responsibility* frames co-occur. On the other hand, Indian journalists appear to be rather reluctant to blame any group of countries, be them industrialized or emerging.

Also, a *global ecological discourse* is most emphatically demanded in the Anglo-Saxon countries, which is a very plausible finding given that in both countries public debate is

still haunted by organized climate change denial and therefore better communication is one of more urgent needs in the views of climate journalists.

Individual Influences on Journalist Frames

Among the influencing factors situated at the individual level, the IPCC Affirmation Index had the strongest effect on journalist frames. The more the climate journalists in our sample agreed to the four core statements of the IPCC the more they supported the *industrialized countries economic policies* and *global ecological discourse* frames (see Table 8). This correlation implies that the more “skeptical” the journalists were towards climate change, the more they refrained from those two frames that emphasize both global agreements, the responsibility of the industrialized world and the need to reduce CO₂ emissions. Not only those survey participants in line with the IPCC’s arguments but also those who regarded themselves as more left-wing oriented supported the *industrialized countries economic policies* frame.

[Table 8 here]

We also found that the more specialized the respondents were, the more they preferred to discuss the *emerging economies’ responsibility* and refrained from advocating the *sustainability* frame. Those who regarded themselves as experts on climate change did not favor the *sustainability* frame either. The more the climate journalists took up the cause of raising *ecological awareness*, the more they supported the *sustainability* frame. This may indicate a gap between two groups of journalists: the more politicized ones who promote a change of the political and economic system and the more neutral ones who may have ended up in the science beat and thus may have acquired more expertise on climate change.

Conclusions and Outlook

This study identified five journalist frames of climate change: The first frame emphasized the responsibility of the industrialized world to reduce CO₂ emissions in spite of strong lobbying against climate policy (*industrialized countries' economic policies*). The second frame aimed at a reform of the economic system and a change of consumer behavior (*sustainability*). The third frame relied on technology to solve the problem (*technological optimism*). The fourth frame set the focus on the emerging economies as important contributors to climate change (*emerging economies' responsibility*). Finally, the *global ecological discourse* frame regarded communication as important way to raise awareness for the ecological consequences of climate change.

The analysis shed light on three aspects that have not been fully acknowledged by previous research: (1) Most studies on climate change have overlooked or neglected the *sustainability* frame which plays an important role in environmental communication; (2) the analysis indicates a 'blame game' between industrialized and emerging countries: Journalists in India are reluctant to communicate the contribution of emerging countries to climate change while their colleagues in the Anglo-Saxon countries refrain from questioning the Western consumerist culture; (3) some journalists feel that better communication, a *global ecological discourse*, belongs onto the agenda of climate change coverage. This notion may have been fostered by the antagonism between 'deniers' and 'warners' that has been distorting the climate debate for many years now.

Furthermore, we presented empirical evidence that a series of individual factors influence the cognitive frames of journalists, such as specialization, professional aims, and political alignment. Finally, we provided a methodological contribution on how frames can be reconstructed using a two-step component analysis.

Three limitations of this study may guide the way for future research: (1) the limited number of cases; (2) the need to further validate the journalist frames; (3) the need to empirically analyze the link between cognitive frames and news frames.

First, the limited N , most of all, results from the fact that the universe of climate journalists was per se not as large as other target populations in the social sciences. We tried to compensate for this by expanding the population to five different countries and five news outlets in each country, and by taking several measures to enhance the response rates in our survey. However, the limited N prevented us from conducting robust comparisons between the different types of media because this would have resulted in very small subgroups. Besides, it is probable that some substantial differences between the countries did not reach conventional levels of statistical significance due to limited case numbers.

Journalist frames are latent constructs in the minds of the journalists and difficult to validate. In our study we measured them by correlations on the aggregate level. We have not provided robust evidence that the frame elements actually co-occur on the individual level. Here, more qualitative approaches should complement our study.

Finally, we did not analyze whether the cognitive frames actually guide the journalists' writing and thus shape the news frames. Future studies should therefore combine interviews with journalists and an analysis of their articles. Yet, our study contributes to a better understanding of the current public climate change debate which moves beyond the dichotomy of 'warning' and 'denial' towards more differentiated patterns of interpretation.

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Tables

Table 1: Content Analyses of News Frames on Climate Change

Authors	Type	Content	Frames	Frequency
Antilla (2005)	Issue-specific	Dailies (US, 2003-2004)	Valid science Ambiguous cause or effects Uncertain science Controversial science	
Diriks & Gelders (2010)	Generic	Elite dailies (FR, NL, 2001-2007)	Conflict Consequences Responsibility Human interest Morality	Medium Medium Medium Low None
Good (2008)	Issue-specific	<i>LexisNexis</i> (CA, US, others, 2007)	Frames as combinations of search terms “climate change / global warming” with “science”, “Kyoto”, “politics”, and “economy”	Low in US; science context rather than Kyoto
Grundmann (2007)	Issue-specific	<i>LexisNexis</i> (DE, US 1988-2004)	Avoid global environmental catastrophe Avoid damage to economy as result of emission cuts	Prominent in DE Prominent in US
McCright & Dunlap (2000)	Issue-specific	Documents issued by conservative Think Tanks (US, 1990-1997)	Counter-claim 1: Evidence of global warming is weak/wrong. Counter-claim 2: Global warming would be beneficial. Counter-claim 3: Global warming policies would do more harm than good.	High Low High
Olausson (2009)	Issue-specific	Swedish newspapers (2004-2005)	Mitigation: Transnational concern, responsibility with industrialized nations Adaptation: National/local concern, excluding non-industrialized world Certainty: Anthropogenic climate change as fact	High High High
Painter (2013)	Issue-specific	Dailies (AU, FR, GB, IN, NO, US, 2007-2012), IPCC reports	Risk/disaster Uncertainty Opportunity	Very high High Low

Table 1 (continued): Content Analyses of News Frames on Climate Change

Authors	Type	Content	Frames	Frequency
Schlichting (2013)	Issue-specific	Meta-analysis	1. Scientific uncertainty: no consensus, no need for action 2. Socioeconomic consequences: Kyoto is harmful for Western economies 3. Industrial leadership: Fight climate change through innovations	High in early to mid-1990s High 1997 to early 2000s High since mid-2000s
Shehata & Hopmann (2012)	Issue-specific	Elite dailies (US, SE, 1998-2007), climate summits in Tokyo and Bali	Climate change frame: Global warming caused by humans as serious problem requiring CO2 reduction Counter-frames: a) Uncertainty of science b) economic costs of climate policy (see McCright & Dunlap, 2000, below)	High Very low
Trumbo (1996)	Issue-specific	Elite dailies (US, 1985-1995)	Problems: Impacts of climate change Causes: Evidence supporting that climate change is a problem Judgments: Action statements; calling for or reporting action Remedies: Provide specific information about how solutions should be implemented Attention shifts from problems to remedies and from scientist focusing on problems/causes to politicians focusing on judgments/remedies	Frequency varies over time... ... and between actors
Zehr (2009)	Issue-specific	Elite dailies (US, 2000-2008)	Environmental/economic hybrid frame: Climate protection as economic opportunity	

Table 2: Sampling by Countries and News Outlets

News Outlet	Country					Total
	CH	DE	IN	UK	US	
Upmarket newspaper	NZZ	FAZ	Hindustan Times	Daily Telegraph	WSJ	11
	Tages-Anzeiger	SZ	Indian Express	Guardian	NYT	24
Midmarket 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 papers; ^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 midmarket newspapers are written in Hindi or other languages and could not be analyzed; ^e Times of India is mainly a quality newspaper but also a relevant online player

Table 3: Problems of Climate Change

Items	Component				Descriptive statistics				
	Ecological problems	Socio-economic problems	Positive consequences	Communalities	<i>N</i>	Min	Max	<i>M</i>	<i>SD</i>
Melting ice (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 (rain, storms, droughts, and flooding)	.67			.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	.66			.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		.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
Initial Eigenvalue	4.89	1.10	1.02						
Eigenvalue after rotation	3.42	2.55	1.13						
Explained variance (%)	34.2	25.5	11.3						
Cronbach's alpha	.88	.80							
Total explained variance (%)		71.0							

Note: Principal component analysis with Varimax rotation; $N = 59$; factor loadings $a < .5$ suppressed

Table 4: Causes of Climate Change

Items	Components					Descriptive statistics					
	Lobbying and national interests	Capitalism and consumption	Technological and bureaucratic delays	Communicative and political deficits	Emerging economies	Communalities	<i>N</i>	Min	Max	<i>M</i>	<i>SD</i>
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	.81					.78	62	1	5	4.06	1.07
Lack of globally binding agreements on the reduction of 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
Industrialized countries as the main source of emissions	.50					.71	64	1	5	4.00	0.93
People's lacking responsibility for nature and next generations		.85				.82	64	1	5	3.63	1.23
Consumption and lifestyles of private households and consumers		.70				.80	64	1	5	3.92	1.09
Capitalist economic system focused on growth and profit		.70				.68	64	1	5	3.52	1.26
Unduly slow development of technologies			.84			.73	62	1	5	3.60	0.95
Failure of the IPCC and other international organizations			.67			.67	61	1	5	3.03	1.21
Communication problems of science, the media, and journalists				.91		.86	62	1	5	3.31	1.11
Shortcomings and lacking will of politicians				.53		.72	64	2	5	4.05	0.98
Emerging economies as source of increasing emissions					.96	.94	64	2	5	3.91	0.85
Initial 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						
Cronbach's alpha (items with displayed loadings)	.83	.66	.67	.52							
Total explained variance (%)			75.8								

Note: Principal component analysis with Varimax rotation; *N* = 56; factor loadings *a* < .5 suppressed.

Table 5: Solutions of Climate Change

Items	Components					Descriptive statistics					
	Technological solutions	Voluntary restraints and economic reforms	(Unilateral) emission reductions	Non-governmental communication	Binding (global) agreements	Communalities	<i>N</i>	Min	Max	<i>M</i>	<i>SD</i>
Technological solutions for the disposal of CO ₂	.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	.60					.63	63	1	5	2.67	1.43
Voluntary restraint in consumption and increased awareness		.84				.82	62	1	5	3.58	1.30
Ecological restructuring of the economy		.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 emissions (if necessary: unilateral approach of individual countries)			.67			.68	60	1	5	3.58	1.17
Intensified communication efforts				.80		.70	61	1	5	3.69	1.09
Civil society commitment to increase political pressure				.68		.74	62	1	5	3.74	1.02
Energy policy: renewable energy source as an alternative				.62		.61	63	2	5	4.48	0.69
Binding agreements for the reduction of emissions					.81	.73	63	1	5	4.40	0.91
Including the most important emerging economies					.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						.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						
Cronbach's alpha (items with displayed loadings)	.70	.78	.70	.76	.74						
Total explained variance (%)			70.8								

Note: Principal component analysis with Varimax rotation; *N* = 56; factor loadings $a < .5$ suppressed.

Table 6: Journalist Frames of Climate Change

First-Order Components	Second-Order Components					Communalities
	Industrialized countries' economic policies	Sustainability	Technological optimism	Emerging economies' responsibility	Global ecological discourse	
Lobbying and national interests (cause)	.80					.76
Socio-economic problems (problem)	.71					.78
(Unilateral) emission reduction (solution)	.67					.54
Capitalism and consumption (cause)		.86				.80
Voluntary restraints and economic reforms (solution)		.83				.79
Technological solutions (solution)			.77			.71
Technological and bureaucratic delays (cause)			.77			.68
Positive consequences (problem)			.62			.50
Emerging economies (cause)				.81		.75
Non-governmental communication (solution)				-.70		.61
Communicative and political deficits (cause)					.74	.66
Ecological problems (problem)					.63	.50
Binding (global) agreements (solution)					.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	
Cronbach's alpha (items with displayed loadings)	.65	.76	.58		.39	
Total explained variance (%)			66.6			

Note: Principal component analysis with Varimax rotation; $N = 48$; factor loadings $a < .5$ suppressed.

Table 7: Journalist Frames by Country

Country	Journalist Frame				
	Industrialized countries' economic policies	Sustainability	Technological optimism	Emerging economies' responsibility	Global ecological discourse
CH ($N = 9$)	-0.13	0.19	0.36	-0.16	-0.20
DE ($N = 14$)	-0.29	-0.16	-0.23	-0.01	-0.30
GB ($N = 6$)	0.30	-0.43	0.27	0.37	0.42
US ($N = 10$)	0.59	-0.34	-0.39	0.42	0.37
IN ($N = 9$)	-0.27	0.73	0.25	-0.53	-0.02

Note: Means are z-standardized factor values

Table 8: Individual Influences on Journalist Frames

Influencing Factor	Journalist Frame					Descriptives				
	Industrialized countries' economic policies	Sustainability	Technological optimism	Emerging economies' responsibility	Global ecological discourse	N	Min	Max	<i>M</i>	<i>SD</i>
IPCC Affirmation Index (average of four items ranging from 1 = scientifically untenable to 5 = scientifically well-founded)	.65***				.44**	64	2.25	5.00	4.50	0.60
Professional specialization (1 = all-rounder to 5 = specialist)		-.55**		.29 ⁺		58	1	5	3.62	1.37
Professional aim: Raise ecological awareness (1= I do not agree at all to 5 = I fully agree)		.50**				61	1	5	3.87	1.13
Political alignment (1 = right-wing to 7 = left-wing)	.35*					51	1	7	2.92	1.20
Expertise on climate change (1 = very low to 5 = very high)		-.30*				62	2	5	3.79	0.77
Experience as climate journalist (in years)					-.28 ⁺	61	1	40	8.43	7.58
Formal education (1 = high school to 4 = PhD)			-.26 ⁺			62	1	4	2.92	0.75

Note: Values are Pearson's correlation coefficients, $N = 40-46$; non-significant values are suppressed; marked values are (or tend to be) statistically significant (⁺ $p < .1$, * $p < .05$, ** $p < .01$)

Figure

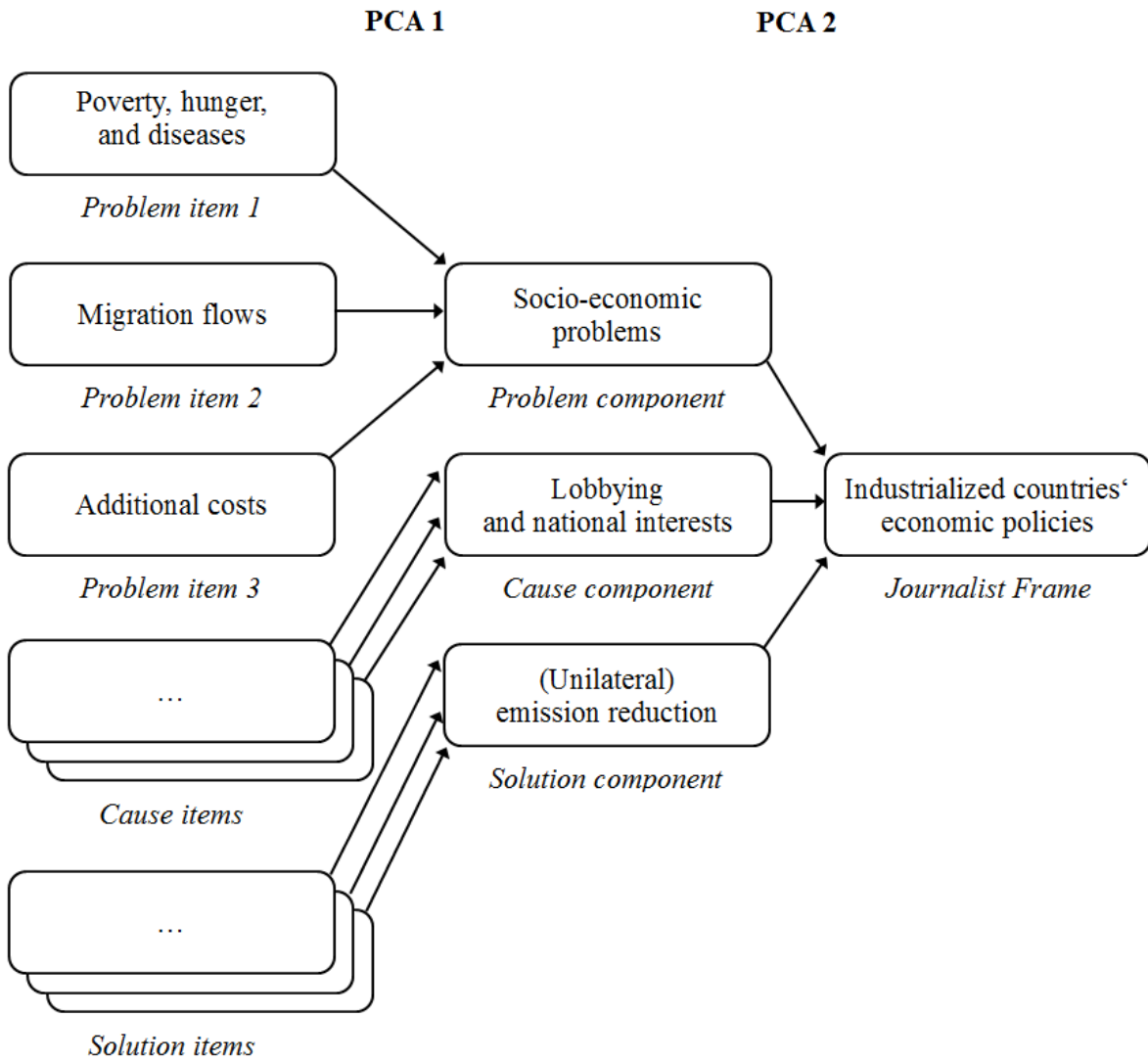


Figure: Composition of Frames