COGITATIO

Media and Communication (ISSN: 2183-2439)
2015, Volume 3, Issue 1, Pages 17-33
Doi: 10.17645/mac.v3i1.253

Article

The Dynamics of Issue Attention in Online Communication on Climate Change

Ines Lörcher * and Irene Neverla

Institute for Journalism and Communication Studies, University of Hamburg, 20144 Hamburg, Germany; E-Mails: ines.loercher@uni-hamburg.de (I.L.), irene.neverla@uni-hamburg.de (I.N.)

* Corresponding author

Submitted: 2 March 2015 | In Revised Form: 4 July 2015 | Accepted: 28 August 2015 | Published: 18 September 2015

Abstract
Issues and their sub-topics in the public agenda follow certain dynamics of attention. This has been studied for "offline" media, but barely for online communication. Furthermore, the enormous spectrum of online communication has not been taken into account. This study investigates whether specific dynamics of attention on issues and sub-topics can be found in different online public arenas. We expect to identify differences across various arenas as a result of their specific stakeholders and constellations of stakeholders, as well as different trigger events. To examine these assumptions, we shed light on the online climate change discourse in Germany by undertaking a quantitative content analysis via manual and automated coding methods of journalistic articles and their reader comments, scientific expert blogs, discussion forums and social media at the time of the release of the 5th IPCC report and COP19, both in 2013 (n = 14.582). Our results show online public *arena-specific dynamics* of issue attention and sub-topics. In journalistic media, we find more continuous issue attention, compared to a public arena where everyone can communicate. Furthermore, we find *event-specific dynamics* of issue attention and sub-topics: COP19 received intensive and continuous attention and triggered more variation in the sub-topics than the release of the IPCC report.

Keywords
climate change; dynamics of sub-topics; issue attention; online communication; online public arenas

Issue
This article is part of a regular issue of Media and Communication, edited by Professor Bradley Greenberg (Michigan State University, USA) and Professor Elisabeth Klaus (University of Salzburg, Austria).

1. Introduction

Issues in the public agenda come and go. They follow certain dynamics of attention in terms of intensity and continuity of communication. Also, the sub-topics of the issue, which basically indicate how the narratives of the issue are constructed, underlie specific dynamics over a course of time. Today, this peculiarity of public communication has to be considered against the background of digitalization and diversified media channels: Apart from the often studied traditional mass media public, the Internet provides arenas for a vast variety of communication, ranging from journalistic to Social Media communication. The Internet has changed public communication and issue attention: Social Media, for example, are supposed to have increased the intensity of attention (McGillivray, 2013). This raises the question, which dynamics of attention and sub-topics for a certain issue can be found online and what are their characteristics, patterns and influencing factors? We assume specific dynamics between the different forms of online communication.

The overall research question, which we investigate for the issue of climate change and the case of Germany, is: *Are there characteristic dynamics of issue attention and sub-topics online and do they depend on*

where and when an issue is communicated online? Do the dynamics of attention and sub-topics of an issue depend on (1) certain events, and (2) the type of online public arena where it is communicated? Do the dynamics depend on the specific stakeholders of each online public arena like journalists, experts or "ordinary citizens" or the constellation of its stakeholders, having equal possibilities to interact? Are these dynamics in Social Media indeed stronger and intensify communication in contrast to journalistic communication?

In this study, we explore the assumption of specific dynamics of attention on issues and their sub-topics in online public arenas for the first time. Furthermore, we develop a theoretical model to explain the assumed differences. It is based on previous empirical findings that explore which variables influence issue-attention cycles (Waldherr, 2012) and on the concept of online public arenas (J.-H. Schmidt, 2013). In contrast to the given literature we do not speak of "cycles", but of "dynamics" of attention on issues and sub-topics, which we understand here as changes in the frequency of communication units (like articles, posts or comments) or of certain sub-topics over time. The dynamics indicate the intensity and also the continuity of attention on issues or sub-topics over time. While the term "cycle" implies a circular process, which could be completed, the term "dynamics" is open to any kind of progress. This provides a conceptualization broadened to include any phenomena, particularly in rather short-term periods, which we have explored in our empirical study.

It is promising to investigate this question by using the scientific issue of climate change as a case. On the one hand, the Internet holds huge potential for science communication (O'Neill & Boykoff, 2011). It offers the public a wealth of information and low barriers to participate in the discourse and interact with scientists, journalists or laypeople (Bowman & Willis, 2003). This means that the dynamics of public attention on issues and sub-topics over the course of time are not only determined by scientists, journalists, politicians and profit or non-profit actors, but also by laypeople. We call these actors in the communication process "stakeholders". On the other hand, scientific topics like climate change are interesting issues to investigate due to their continuity, while keeping in mind that it is the nature of science to bring about new findings and therefore provide an ongoing dynamic of its own.

2. Dynamics of Issue Attention and Interpretation in the Public Sphere

To investigate the overall research question, different areas have to be approached: (1) research on issue-attention (cycles) and (2) research on the dynamics of sub-topics, which can be found in research on narratives and framing.

2.1. Research on Issue Attention

Probably the best known model in research on issue attention (for an overview see Brossard, Shanahan, & McComas, 2004; McComas & Shanahan, 1999; Nisbet & Huge, 2006; Shih, Wijaya, & Brossard, 2008; Waldherr, 2012) is the "issue-attention cycle" created by Downs (1972). According to him, an issue passes through different phases of attention: (1) the *pre-problem stage*, where it is only discussed by specialists, and (2) *alarmed discovery and euphoric enthusiasm*, where it makes a breakthrough into the public agenda and receives a lot of attention, often through key events (Kepplinger & Habermeier, 1995). Then, the public is increasingly able to (3) *realize the cost of significant progress*. This leads to (4) *a gradual decline of intense public interest* and other issues may enter the agenda. In the (5) *post-problem stage*, key events could trigger another attention cycle (Kolb, 2005; Petersen, 2009).

Although this ideal-typical issue-attention cycle could be found to relate to several issues (e.g. Kolb, 2005), it is not universally valid. Differences exist between issues[1] (Waldherr, 2012), countries (Brossard et al., 2004; M. Schäfer, Ivanova, & Schmidt, 2014) and also between online and traditional mass media publics: Anderson, Brossard, and Scheufele (2012) found that a scientific publication received ten times more coverage online and over a longer timespan. However, Anderson et al. (2012) did not explore the causes for these differences. In general, it was criticized that the cycle might only explain the process of issue attention, but not its causes (Nisbet & Huge, 2006; Waldherr, 2012).

Ever since Downs came about with his concept of an issue-attention cycle, further investigations, both theoretically and empirically, have been conducted. Waldherr (2012) made an important contribution to the research on issue attention by detecting four interdependent variables influencing public attention. They might explain the differences between countries, issues and the public arenas: (1) *stakeholders*, (2) *constellations of stakeholders*, (3) *events* and (4) *issues*.

(1) *Stakeholders* that are involved in the public discourse of the respective issue, such as media representatives (Mathes & Pfetsch, 1991), politicians, scientists, lobbyists, and in online public sphere(s) also increasingly laypeople, prolong public attention through launching staged events or shortening them by redirecting toward other topics (Pfetsch, 1994; Waldherr, 2012). Waldherr (2012) found that stakeholders can hinder the ideal-typical course of the "issue-attention cycle".

An issue thus receives more attention if there is a po-

[1] Downs (1972) does not claim to explain every issue career with his model. It should merely explain major social problems: (1) that most of the public does not suffer from, (2) where the suffering is made by social arrangements that benefit the majority or an influential minority and (3) that are not intrinsically interesting.

larized and conflicting (2) *constellation of stakeholders* (Kriesi, 2003). Heterogenous journalists accelerate the dynamics of issue attention and provoke shorter issue-attention cycles (Waldherr, 2012). Wolfsfeld and Sheafer (2006) assume inverted causal relations and state that much attention enables a more conflicting discourse.

The attention and news value of (3) *events* and (4) *issues* are determined by news factors like conflict, prominence, proximity and surprise (Eilders, 1997; Galtung & Ruge, 1965; Schulz, 1990; Staab, 1990). For the purpose of our study, we define *events* according to Shaw (1977, p. 20) "as discrete happenings, that are limited by space and time". They have to be distinguishable from other happenings, although this distinction is not objective (Waldherr, 2012). More concretely, events are composed of distinct actions performed by institutionalized stakeholders in the public sphere. An *issue* is a larger category, under which many related events could be subsumed (Shaw, 1977). However, they could also exist without concrete events. It depends on the context, that is, whether something is defined as an event or issue (Kepplinger, 2001): In our study, for example, the IPCC report and COP19 are defined as events, but they were also coded as sub-topics in online climate change communication.

We consider these four variables as crucial for investigating the causes of possible differences among multiple forms of online communication in the dynamics of issue attention.

2.2. Research on the Dynamics of Sub-Topics and Interpretations

Research on issue-attention (cycles) mostly neglects the dynamics in the focused sub-topics and interpretations over time, or merely makes implicit assumptions about them. Downs (1972), for instance, implies that a problem (like climate change) is framed by specialists in the pre-problem stage and is framed as difficult to solve before the decline of attention. However, research on *narratives*[2] and *framing* explicitly addresses the dynamics in the therewith-related sub-topics and interpretation of the issue (Table 1). Most of the relevant studies come from framing research. There are different and sometimes also conflicting findings on how the interpretation of an issue is supposed to change over time. However, an emphasis on dramatic and risky aspects occurring at the rise of mass media attention is often assumed. Furthermore, many studies have found a shift in frames that deal with solving the problem or focus on the scientific aspects before the decline of attention. This tendency can also be found in the only study that focused on the dynamics of sub-topics and interpretations online: Arens, Böcking, Kummer, and Rüf (2010) investigated—however without any reference to theoretical concepts like issue attention, framing or narratives—the issue-career of the climate summit in Bali as depicted by online news media, blogs and websites created by companies and organizations over the course of six months. They found the main sub-topics like "climate change mitigation measures" or the "Kyoto Protocol" to be stable over time. However, they discovered that sub-topics that focus on how to solve the problem of climate change became more important over time.

[2] Narratives have a plot with a specific sequence. The story reaches a climax, which leads to a resolution and provides insights from the story (McComas & Shanahan, 1999).

Table 1. Research overview on dynamics of sub-topics and interpretations.

Theory	Author	Object of Research	Prevailing Interpretations in Different Phases of Attention				
			Pre-problem	***Rise***	***Maintenance***	***Before decline***	***Decline***
Issue-Attention Cycle	*(Downs, 1972)*	Journalistic mass media	Framed by scientists	Problem	-	Difficult to solve	Not solved
Narratives	*(McComas & Shanahan, 1999)*	Journalistic mass media	-	Risks/danger	Discord between scientists	Difficult to solve	Solved
Framing	*(Miller, Andsager, & Riechert, 1998)*	Journalistic mass media	-	Different frames compete for prerogative	One frames wins	-	-
Framing	*(Nisbet & Huge, 2006)*	Journalistic mass media	No cycle, but waves of attention. High attention: dramatic frame, low attention: technical/scientific frame				
Framing	*(Shih et al., 2008)*	Journalistic mass media	-	Uncertainty	-	-	New evidence
Framing	*(Weaver, Lively, & Bimber, 2009)*	Journalistic mass media	-	Progress/risk	Regulation market incentives		-
Framing	*(Arens et al., 2010)*	Online communication	Stable interpretations			Strategies to solve the problem	

To explain the different findings on the dynamics of sub-topics and interpretations over time, Waldherr's (2012) four variables influencing public issue attention are also crucial. These dynamics are also influenced by: (1) *stakeholders* like journalists (Fröhlich, Scherer, & Scheufele, 2007; Schmid-Petri, 2012), politicians (Schmid-Petri, 2012) or lobbyists (Böcking, 2009), (2) *constellations of stakeholders* (Baumgartner & Jones, 1993), as a polarized constellation leads to a more dramatic framing (Nisbet & Huge, 2006), (3) *events* (Fröhlich et al., 2007; Shih et al., 2008) and (4) *issues* (Nisbet & Huge, 2006; Schmid-Petri, 2012; Shih et al., 2008).

We prefer to analyze "sub-topics" as the level below "issues", instead of "frames" or "interpretations". The term sub-topic does not contain the evaluative aspect of frames. According to Entman's (1993, p. 52) widespread definition, frames "define problems…; diagnose causes…; make moral judgments…; and suggest remedies".

To sum up both research on the dynamics of issue attention and sub-topics together with interpretations: many studies focus on the dynamics of attention without considering the dynamics of sub-topics and the interpretations of an issue. What is also striking is the focus on long timespans, such as several months or years (e.g. Brossard et al., 2004; Downs, 1972; McComas & Shanahan, 1999; Nisbet & Huge, 2006; Shih et al., 2008). The specifics of short event-based issue-attention cycles have only been investigated for events that trigger an extremely high level of attention, such as media hype or media storms (Boydstun, Hardy, & Walgrave, 2014; Wien & Elmelund-Præstekær, 2009). Furthermore, so far, most studies examine the process only in the traditional mass media. Online publics are widely unconsidered, although there are indications that they have higher and longer issue attention (Anderson et al., 2012) but little dynamics in their sub-topics, with a tendency to focus more on problem-solving strategies over time (Arens et al., 2010). This research gap is where the study at hand relates.

This study analyzes for short event-based time spans both the dynamics of attention in the sense of intensity and continuity and the dynamics of sub-topics regarding the issue of climate change in several online publics. For the development of the theoretical model, the presented four variables (stakeholders, constellation of stakeholders, events, issues) are crucial.

3. Climate Change Communication

We refer to climate change as an issue of public communication. It is an abstract issue (M. S. Schäfer & Schlichting, 2014) and its scientific findings are sometimes uncertain and conflicting (van der Sluijs, 2012). Consequently, the mass media play a crucial role in communicating this complex issue to the public (von Storch, 2009). Climate change has been a continuous issue on the public agenda for a long time (Boykoff, 2010) – nonetheless it is also dynamic as new scientific findings often arise.

Many studies have investigated the level of *mass media attention* on climate change and have shown that it has been increasing worldwide (for an overview see A. Schmidt, Ivanova, & Schäfer, 2013). M. Schäfer et al. (2014) identified certain events fostering mass media attention on climate change, such as political events, including international climate summits and the activities of international NGOs. However, the comparative study of German, Australian and Indian mass media attention showed remarkable differences between the countries: the release of the IPCC reports as well as extreme weather, for example, only triggered mass media attention in Germany. Other scientific publications did not influence media attention at all.

Also, the journalistic *mass media's sub-topics and interpretations* of climate change are well researched. One crucial finding is that, despite differences between countries, the journalistic media mostly covered the scientific consensus on anthropogenic climate change (Brüggemann & Engesser, 2014; Painter & Ashe, 2012), as stated in the IPCC report (IPCC, 2013). Particularly, the German mass media mainly represented the scientific arguments of the IPCC reports (Peters & Heinrichs, 2008). Despite country-specific topics that are related to climate change (Neverla & Schäfer, 2010), the discourse in general mainly focuses on scientific aspects, within which scientists are important stakeholders (Peters & Heinrichs, 2008). The German journalistic discourse focuses in particular on mitigation and adaptation measures (Peters & Heinrichs, 2008)—and over the course of time increasingly on citizens' individual measures (Tereick, 2014).

Less is known about online climate change communication (Jaspal, Nerlich, & Koteyko, 2013; Porter & Hellsten, 2014) and the dynamics of attention and sub-topics, although it is relevant: firstly, the Internet is considered to be a more important source of climate change information than family and friends (Synovate, 2010). Secondly, with regard to climate change, Internet usage increases knowledge (Special Eurobarometer 364, 2011; Zhao, 2009), the need for information (Zhao, 2009), and a high need for information also bolsters problem awareness and behavioral intentions (Taddicken, 2013).

Moreover, users pay significant *attention* to climate change online, as there is a huge amount of climate change related content on different platforms (O'Neill & Boykoff, 2011).

Furthermore, results regarding the *sub-topics* of climate change have already been derived from online communication. Although climate change is particularly a science topic online, a huge diversity of topics can be found (Collins, 2013; Koteyko, 2010; Koteyko, Thelwall,

& Nerlich, 2010; Ladle, Jepson, & Whittaker, 2005; Pearce, Holmberg, Hellsten, & Nerlich, 2014; Sharman, 2014)—especially on laypeople's platforms (Lörcher & Taddicken, 2015). This may be explained by the variety of platforms and stakeholders online, such as scientists, laypersons, journalists, politicians, companies and NGOs (M. Schäfer, 2012).

However, studies investigating its *dynamics* hardly exist. Only the above-mentioned study of Arens et al. (2010) on the issue-career after the climate summit in Bali on different online platforms indicates that the main frames were stable, but over the course of time more focus on how to solve the problem of climate change arose.

To sum up: climate change is receiving a great deal of continuous attention in the journalistic mass media and in online communication. The long-term dynamics of attention and sub-topics in the mass media are well studied, however little knowledge exists with regard to online discourses. Different processes can be assumed online, as there are more diverse stakeholders and sub-topics.

To systematically investigate the dynamics of attention and the sub-topics of the different forms of online climate change communication, the theoretical concept of online public arenas (J.-H. Schmidt, 2013) is applied and combined with the findings from Waldherr (2012).

4. Online Public Arenas

The public sphere is a social forum where citizens come to an understanding about common issues (Habermas, 1962/1989). It can be differentiated into *encounter public*, whereby interpersonal communication takes place between citizens in public places, *event public*, such as public lectures or town hall meetings, and the *mass media public* (Gerhards & Neidhardt, 1993).

Also, there is not one universal online public sphere, but different online public spheres. With the rise of the Internet, the concept of differentiated public spheres has been reconsidered (Klaus & Drüeke, 2012; J.-H. Schmidt, 2013) and adapted to the online environment (Gerhards & Schäfer, 2010).

J.-H. Schmidt (2013) refined the concept further and took these changing conditions into account: The constitution of a public sphere interdepends on communication technology and its modes (J.-H. Schmidt, 2013). These new modes of communication feature characteristics of both interpersonal and mass media communication. Hence, we partly find an intermingling of the different partial public arenas online as well as their coexistence on the same website. On Twitter or Facebook for example, we might find encounter public as well as event public and the mass media public.

Schmidt (2013, p. 41, own translation) defines public arenas as "specific constellations of stakeholders (communicator and audience)…, who offer information on the basis of particular rules of selection and presentation as well as a specific software architecture". The arenas, which could possibly overlap, differ, as do the partial public spheres with regard to their barriers to communication, intended audience and goals of communication. Based on Schmidt's (2013) deliberations[3] we distinguish four online public arenas: (1) *mass media arena*, (2) *expert arena*, (3) *discussion arena* (DA) and (4) *mass media induced discussion arena* (MDA) (Table 2). The mass media arena has high barriers for communication and a dispersed, anonymous audience, as seen on journalistic websites. The communicators are usually journalists. The expert arena has also high barriers for communicators and its audience is an expert community consisting of, for example, scientists or other specialized groups. It contains specialized information such as scientific journals or expert blogs. The discussion arena—which is our extension of Schmidt's concept—is characterized by low barriers to communication and an audience that has not been further specified. Since access to communication is open and equal for everybody, diverse stakeholders can be found here. Also, "ordinary citizens" can exchange their views and interaction is easy. An example of this type of arena are discussion fora. Related to the DA is the mass media induced discussion arena (MDA), which depends on the mass media arena. The MDA includes discussion arenas with initial mass mediated input, e.g. reader comments found on online news media.

[3] Schmidt (2013) differentiates between the (1) mass media, (2) expert, (3) collaborative and (4) personal arena.

Table 2. Online public arenas (based on Schmidt (2013)).

Arena	Barriers for communicators	Expertise of communicators	Intended audience	Interaction	Examples
Mass media arena	High	High	Dispersed, anonymous	Not possible	Journalistic online news platforms
Expert arena	High	High	Expert community	Not possible/possible	Professional journals, expert blogs
Discussion arena	Low	Low/high	Not specified	Possible	Discussion forums
Mass media induced discussion arena	Low	Low/high	Not specified	Possible	Online news reader comments

5. Hypotheses Regarding the Dynamics of Attention and Sub-Topics Online

We assume that for a certain issue, in this case climate change, there are specific dynamics of attention and sub-topics depending on when—on the occasion of which *event*—and where—in which *online public arena*—it is communicated online. In this study we explore two core independent variables, i.e. the type of triggering event, and the type of online public arena (which differs with regard to its stakeholders and their constellation to each other), against dependent variables such as intensity and continuity of attention on climate change and its sub-topics.

As stated above, previous findings (Waldherr, 2012) show for the "offline mass media public" that specific characteristics of *events* indeed influence the dynamics of attention and sub-topics. We will investigate online climate change communication during *events* from different systems: the scientific event "release of the IPCC report WG1", published on September 27th, 2013, preceded by final negotiations for several days; and the political event of the United Nations Climate Change Conference "COP19", which took place in Warsaw, November 11th–23th, 2013. The IPCC report is regarded as the most crucial scientific publication on anthropogenic climate change and reflects the current state of climate science (Hulme, 2009; IPCC, 2013, 2014). Though the IPCC reports are based on scientific reviews, they are also embedded in inter-governmental negotiations, but are finally presented as merely scientific reports. The annual COP, with its almost universal membership (195 parties), is the most important internationally concerted action for the mitigation and adaptation of climate change (UNFCCC, 2006, 2014). M. Schäfer et al. (2014) found that both events triggered mass media attention in Germany. It can therefore be assumed that they also triggered online attention—though possibly to a different extent.

Also *stakeholders* and the *constellation of stakeholders* were found to influence the dynamics of attention and sub-topics in the "offline mass media public" (Waldherr, 2012). As the presented online public arenas differ in these variables, we also assume the existence of arena-specific differences.

Regarding the *dynamics of attention* in terms of intensity and continuity of communication, we assume event-specific attention cycles that will not reflect the ideal-typical issue-attention cycle from Downs (1972), who describes long-term attention dynamics.

COP19 contained more of the news factor conflict, which triggered attention (Waldherr, 2012), as many different political stakeholders with conflicting aims were involved in this conference. We therefore hypothesize:

H1: The attention for COP19 is more intensive and continuous compared to the IPCC report.

More variety of opinions on climate change exists among stakeholders in the discussion arena and the mass media induced discussion arena compared to the mass media arena and the expert arena (Lörcher & Taddicken, 2015).

Due to these strong differences across the variety of opinions of the stakeholders, we formulate hypotheses on the differences between the two discussion arenas and the other two arenas, and hypotheses on the differences between mass media and expert arena.

The greater variety of opinions (Lörcher & Taddicken, 2015) may lead to more controversy in the discussion arena and the mass media induced discussion arena—this can increase attention (Kriesi, 2003; Nisbet & Huge, 2006) and it could also lead to more erratic attention for the issue.

H2: The attention for climate change in the discussion arena and the mass media induced discussion arena is more intensive, but less continuous compared to the other arenas.

We expect differences between the mass media arena and the expert arena with regard to intensity and continuity of attention. The aims of communication between the mass media arena and the expert arena differ: The former has the function to cover societally relevant information, which leads to more focus on political aspects (Lörcher & Taddicken, 2015) and furthermore less continuity for the issue climate change, because it competes with other societally relevant questions. The latter rather discusses scientific expert knowledge on climate change and the issue does not compete with other topics (Lörcher & Taddicken, 2015). We therefore hypothesize:

H3: Around COP19, attention is more intensive in the mass media arena, whereas around the release of the IPCC report, attention is more intensive in the expert arena.

H4: In general, there is more continuous attention in the expert arena for climate change as compared to the mass media arena.

We also expect event- and arena-specific differences to exist within the *dynamics of the communicated sub-topics*. Due to the focus on the discourse around specific short-term events, we do not raise hypotheses about shifts to certain sub-topics over time, which studies on long-term dynamics of frames or narratives could find out (Arens et al., 2010; Downs, 1972; McComas & Shanahan, 1999; Weaver et al., 2009).

"COP19" will probably trigger political communication while scientific sub-topics will probably prevail in the discourse around the IPCC report. Furthermore, we assume that, due to the diversity of its stakeholders and their aim to take action on the mitigation and adaptation of climate change, "COP19" is probably more compatible with other sub-topics related to economics, civil society or individual mitigation measures than the IPCC report. Therefore, we assume more dynamic of the sub-topics there—which means more variation in the relative share of the total communication of the sub-topics over time. To describe the variation in the dynamics of the sub-topics, it is not only necessary to look at the continuity of attention to the single sub-topics over time, but also the relative differences between the sub-topics there.

H5: There is more variation in the dynamics of the sub-topics during COP19 as compared to the IPCC report.

In the two discussion arenas there is a huge diversity of sub-topics compared to the other arenas (Lörcher & Taddicken, 2015), which might also foster the dynamics of the sub-topics:

H6: There is more variation in the dynamics of the sub-topics in the two discussion arenas compared to the other arenas.

We also expect differences between the mass media arena and the expert arena with regard to the dynamics of the sub-topics. Due to the function of the mass media arena to cover societally relevant information, which means that different relevant aspects of climate change (e.g. political, economic and scientific aspects) compete with each other, we hypothesize:

H7: There is more variation in the dynamics of the sub-topics in the mass media arena compared to the expert arena.

Despite the assumed arena-specific differences regarding the dynamics of attention and sub-topics, we do not expect that the dynamics in the MDA are independent from mass media coverage. Attention and sub-topics in the MDA are presumably related to the corresponding articles. Finally, the communicators in the MDA are also audiences of mass media coverage, and they process the content actively (Hall, 1973; Morley, 1992). Sub-topics could move from one public arena to the other and then be reframed or modified.

To summarize, in our empirical study we consider two independent variables against three dependent variables, as can be seen in Table 3.

Table 3. Hypotheses.

Independent variables	Dependent variables
Type of event	Intensity of attention (H1) Continuity of attention (H1) Variation in the dynamics of the sub-topics (H5)
Type of online public arena	Intensity of attention (H2, H3) Continuity of attention (H2, H4) Variation in the dynamics of the sub-topics (H6, H7)

6. Method

To answer the hypotheses, a quantitative manual and automated online content analysis was conducted in the four presented online public arenas. The inquiry period spanned from one week before until one week after the release of the 5th IPCC report WG1 (16 September until 7 October 2013) as well as the COP19 (4 until 29 November 2013).

In a conscious case selection at least two platforms with regular activity in all four arenas in Germany were selected. Crucial selection criteria were relevance in terms of the quantity of traffic and preferably, for each arena, different cases regarding the position towards climate change or the role of climate science. These samples were derived from "spiegel.de" and "Welt.de" for the mass media arena and from their reader comments for the MDA, as both outlets have a high level of media penetration (AGOF, 2014)[4]. 'spiegel.de" can be regarded as the online newspaper of record in Germany (Bönisch, 2006; MediaTenor, 2013) whereas "Welt.de" was picked because it sometimes covers climate sceptic positions, which is unusual for the German quality media's coverage. Furthermore, both outlets have an active online user community, with many reader comments submitted compared to other news websites. Two scientific expert blogs were chosen for the expert arena: both "Klimazwiebel" and "Klimalounge" are maintained by renowned climate scientists with distinct viewpoints on the role of climate science. As for the discussion arena, the "climate forum" of the meteorological homepage "wetteronline.de", the public Facebook group "Klimaschützer" and the biggest German climate sceptic platform "EIKE" were chosen. "Wetteronline.de" is one of the few German climate change discussion forums with regular communication that is not administrated by any scientific, political or civil societal organization. The Facebook-page "Klimaschützer" has a high penetration level, with its cumulated 13,329 "likes" (as of May 19th 2014). The social media campaign to fight climate change was initiated by an online provider of a

[4] "spiegel.de" with 10.73, "Welt.de" with 9.26 Mio unique users as of March 2014.

search engine for clean power (Klimaschützer, 2013). "EIKE" (the European Institute for Climate and Energy) is a registered association that is maintained by a group of politicians, engineers, scientists and journalists (EIKE, 2014). These three platforms have different aims regarding climate change communication and also different degrees of organizational structure.

The archiving was conducted by a web-crawler that was developed for the research project at hand. The crawler archived the content according to a list of climate change-related keywords. The basic population of this study was defined as all communication units (articles, posts, reader comments) in German that explicitly mention 1) the phenomenon of climate change in terms of global warming (or a synonym like greenhouse effect) or 2) carbon emissions. Excluded were communication units where climate change was merely mentioned in a list with other terms without any further reference to the phenomenon. Based on these conditions and the two events triggering climate change communication (release of the IPCC report AR5 WG1 and COP19), a search string with several key words was developed. It was controlled manually before the data collection. The keywords used by the web crawler were: climate change, global warming, climate, IPCC report, IPCC, climate summit, COP, climate policy, climate protection, greenhouse effect, greenhouse gas, carbon (dioxide) (originally in German; German synonyms of the terms were also used.) Irrelevant articles or initial posts were later eliminated by manual checks. In total, the material aggregated to 14,582 contributions (articles, posts, comments) (Table 4).

As per the first step of manual coding, a stratified random sampling was drawn if the comment frequencies exceeded 20 comments per initial post. It was subdivided according to the comment frequency succeeding an initial article or post. For 21−50 comments per initial post, every fifth comment was analyzed, while if there were more than 50 comments every tenth comment was selected. Stratified random sampling was applied to the reader comments of "spiegel.de" and "Welt.de" as well as to the "EIKE" forum. A team of 5 researchers coded manually. The coding of 2.923 communication units was done between December 2013 and June 2014 (Table 4).

In a second step, on the basis of the manual coding, an automated content analysis via machine learning was conducted to achieve full data analysis for the reader comments of "spiegel.de", "Welt.de" and "EIKE".[5] For that, RTextTools were applied according to Jurka (2013).

The codebook was developed within the project "climate change from the audience perspectives" (funded by the German Research Foundation) in 2013 to investigate the content, dynamics of attention and form of online climate change communication in different online public arenas. It was validated on the basis of the data material and it was pretested and improved in several coder trainings.

Main variables of the codebook that were analyzed for this study are the sub-topics within the communication units (H5, H6). Sub-topics had to be explicitly mentioned in the text and explicitly related to climate change: Politics and climate change, science and climate change, COP19, IPCC report (as a special subcategory for science), economy and climate change, media/culture/arts/celebrity and climate change (e.g. movies about climate change), citizen activity and climate change (e.g. activities from civil society or individual citizens) and topics without reference to climate change. For every unit, maximally 3 topics could be coded—i.e. the 3 substantial aspects that are discussed the longest or are most important for the argumentation. For every variable, the reliability values for the manual and the automated coding as well as key figures for the machine learning are documented in Table 5.

[5] In cooperation with Ana Ivanova M.A., research associate at the University of Hamburg.

Table 4. Web portal frequencies.

Arena	Web Portal	Frequency of Communication Units (e.g. article, post, comment)	Stratified Random Sampling (for manual coding)
Mass Media Arena	Spiegel.de	72	72
	Welt.de	47	47
Expert Arena	Klimazwiebel	45	45
	Klimalounge	142	142
Discussion Arena	Wetteronline	152	152
	EIKE	1.909	784
	Facebook	55	55
Mass Media Induced Discussion Arena	Comments Spiegel.de	10.678	1.242
	Comments Welt.de	1.482	384
Total		14.582	2.923

Table 5. Reliability values.

Variable	Reliability Manual Coding (Holsti)	Reliability Automated analysis with manual coding (Holsti)*	Classification Performances	F-score ** (mean of manifestation = 0 and manifestation = 1)
Politics and Climate Change	0.82	0.78	RF (Liaw & Wiener, 2002)	0.76
COP19	0.99	0.96	GLMNET (Friedman, Hastie, & Tibshirani, 2010)	0.75
Science and Climate Change	0.87	0.77	RF (Liaw & Wiener, 2002)	0.77
IPCC report	0.97	0.96	GLMNET (Friedman et al., 2010)	0.82
Economy and Climate Change	0.90	0.88	Probability	0.74
Media/Culture/Arts/Celebrity and Climate Change	0.90	0.85	MAXENT (Jurka, 2012)	0.66
Citizen Activity and Climate Change	0.98	0.86	MAXENT (Jurka, 2012)	0.57
Topics without reference to climate change	0.84	0.80	SVM (Meyer, Dimitriadou, Hornik, Weingessel, & Leisch, 2012)	0.62

Notes: * Mean of 2 reliability values: 1. Automated analysis with the majority decision of the coding from the manual coding reliability test. 2. Automated analysis with a test set of 500 manually coded units (that were excluded from the manual coding for the machine learning); **[F = 2*(precision*recall)/(precision+recall)].

To operationalize the dynamics in the intensity and continuity of attention on climate change, we calculated the frequency of communication units (articles, posts or comments) for each date; for the dynamics of attention on the sub-topics the frequency of the respective sub-topics for each date was calculated.[6]

7. Results

7.1. Dynamics of Issue Attention

7.1.1. Event-Specific Dynamics of Attention

The results show that both types of events triggered attention online. As assumed, they provoked event-specific dynamics of attention and do not reflect the ideal-typical issue-attention cycle from Downs (1972) for long time spans. *Hypothesis 1* can be confirmed: the attention for COP19 is indeed more *intensive* compared to the IPCC report (Figure 1: IPCC report, n = 6.200; and Figure 2: COP19, n = 8.382), which means that we find more communication units in this time span. The more diverse stakeholders with conflicting aims might explain this as well as the longer duration of the event. The attention during COP19 is also more *continuous*: the intensity of communication fluctuates more extremely during the release of the IPCC report. By far, we find that most communication occurred on the day where the summary of the IPCC report was presented (27th of September 2013). At first sight, these event-specific differences do not come as a surprise, since it can be argued that the release of the IPCC report was a short-term event with a short but high level of attention, whereas COP19 was a conference that extended over several days. However, both the release of the IPCC report and COP19 were events, which were preceded by public negotiations of the involved stakeholders over several days that led to a common paper. It is therefore rather surprising that the final agreement at COP19 on 23rd of November 2013 did not elicit much attention.

7.1.2. Arena-Specific Dynamics of Attention

Hypothesis 2 can also be confirmed. The attention paid to climate change in the discussion arena (DA) and above all the mass media induced discussion arena (MDA) was indeed more intensive compared to the other arenas at both events (Figure 3—Figure 4). This might be explained by the greater diversity of opinions of the stakeholders due to low communication barriers, which may trigger more controversy. Another reason might be the shorter length of the communication units in the DA and MDA—at least compared to the mass media arena. The strongest dynamics and fluctuation of attention can be found in the MDA. This means that the relative share of the total communication in the MDA varied more over time. The attention was therefore less continuous—however only for the MDA and not the DA and only for the time of the release of the IPCC report.

[6] There are also other ways to operationalize attention apart from the frequency of communication, such as the length of a contribution, its placement or ranking, as well as its scope. However, most of these indicators cannot be used for a comparative analysis of different forms of online communication like articles or comments due to different conditions.

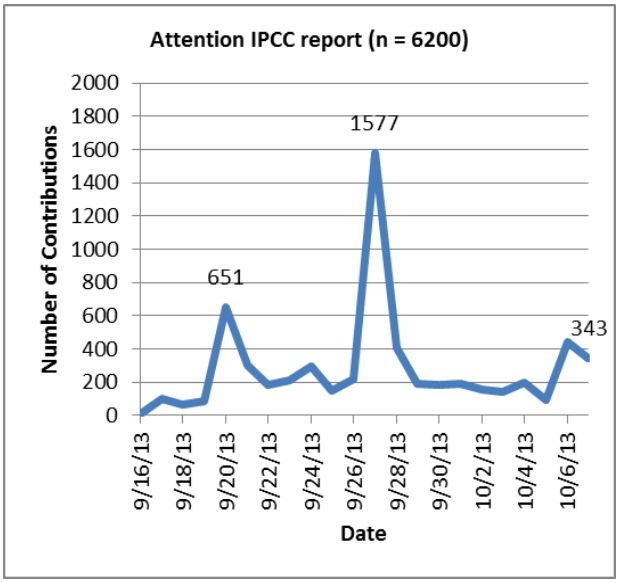

Figure 1. Dynamics of attention during the release of the IPCC report 2013.

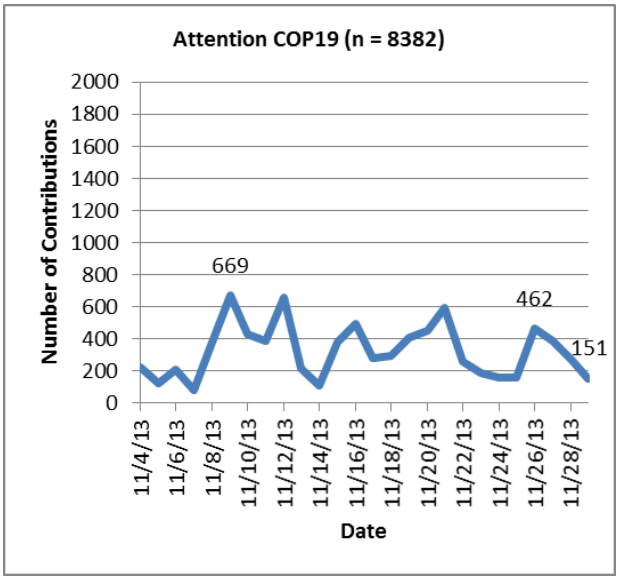

Figure 2. Dynamics of attention during COP19.

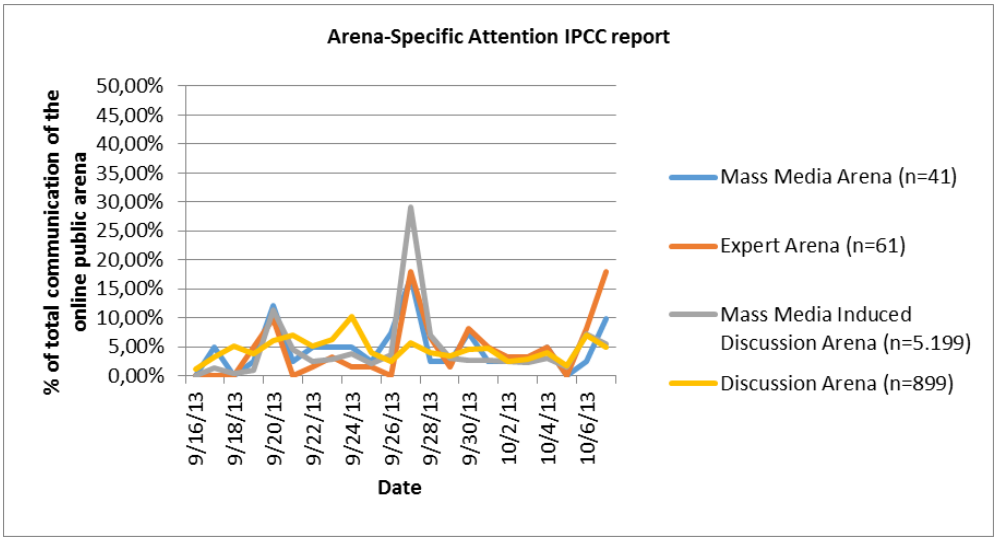

Figure 3. Dynamics of arena-specific attention during the release of the IPCC report 2013.

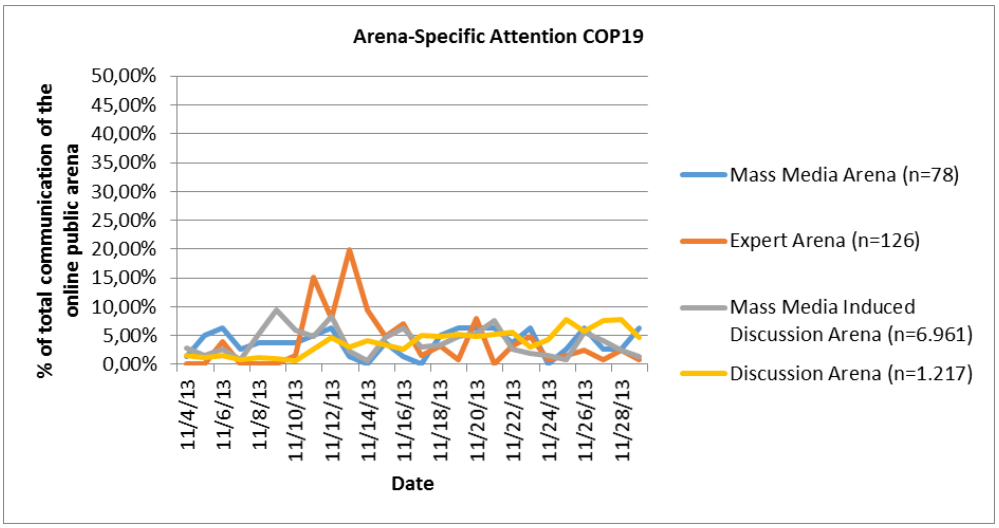

Figure 4. Dynamics of arena-specific attention during COP19.

The attention peak during the release of the summary of the IPCC report (27th of September) can be found in all public arenas except for the DA. All in all, despite the more extreme amplitude in the MDA, the attention dynamics in the mass media arena, the expert arena and the MDA are quite similar. Solely, the attention dynamic in the DA is often not related to the other public arenas.

The dynamics of attention during COP19 differ much more across the public arenas. This means that the attention paid to climate change during the IPCC report seems to have been more triggered by this event as the great peak at 27th of September demonstrates. In particular, in the expert arena we find attention peaks that cannot be explained by the climate summit proceedings. This shows that the expert arena has its own news values, as neither of the events triggered a great deal of communication about the events themselves.

Interestingly, *hypothesis 3* cannot be confirmed: Not only in the mass media arena, but also in the expert arena more intensive communication occurred during the political event COP19 compared to the IPCC report.

Also *hypothesis 4* cannot be confirmed: The attention for the issue climate change is not more continuous in the expert arena compared to the mass media arena. On the contrary: during COP19 the dynamic of attention in the expert arena shows the biggest amplitudes.

7.2. Dynamics of Sub-Topics

7.2.1. Event-Specific Dynamics of Sub-Topics

The general assumption that the scientific event of the IPCC report triggered more communication about scientific topics, whereas political aspects prevailed in the online discourse around COP19, can be confirmed. The top sub-topic during the IPCC report was science (Figure 5). There are more frequent sub-topics during COP19—firstly economy, then science and also politics and citizens (Figure 6). The higher quantity of communication about economics and climate change compared to politics during COP19 underlines the above made observation on the dynamics of attention, whereby the attention paid to climate change during COP19 does not seem to be strongly related to the event—compared to the release of the IPCC report. Beyond that, there is little communication about the events derived from the IPCC report and COP19 (Figures 5−6).

Furthermore, *hypothesis 5* can be confirmed, as there are event-specific dynamics of sub-topics. There is slightly more variation in the dynamics of sub-topics in the communication on COP19 compared to the IPCC report (Figures 5−6). This means that during COP19, over the course of time, the relative share in the total communication of the sub-topics varies more, meaning also that more sub-topics are present in the discourse. This might be explained by the variety of stakeholders from different fields at COP19 and the aim to take action on the mitigation and adaptation of climate change, which is more compatible with other sub-topics. A complementary explanation could be the finding on the dynamics of attention (7.1.2): a higher quantity of climate change communication is not triggered by COP19 itself.

In the time span of the IPCC report, the dynamics of the sub-topics in the course of time are very similar—all of the different sub-topics are communicated most at the release of the summary report.

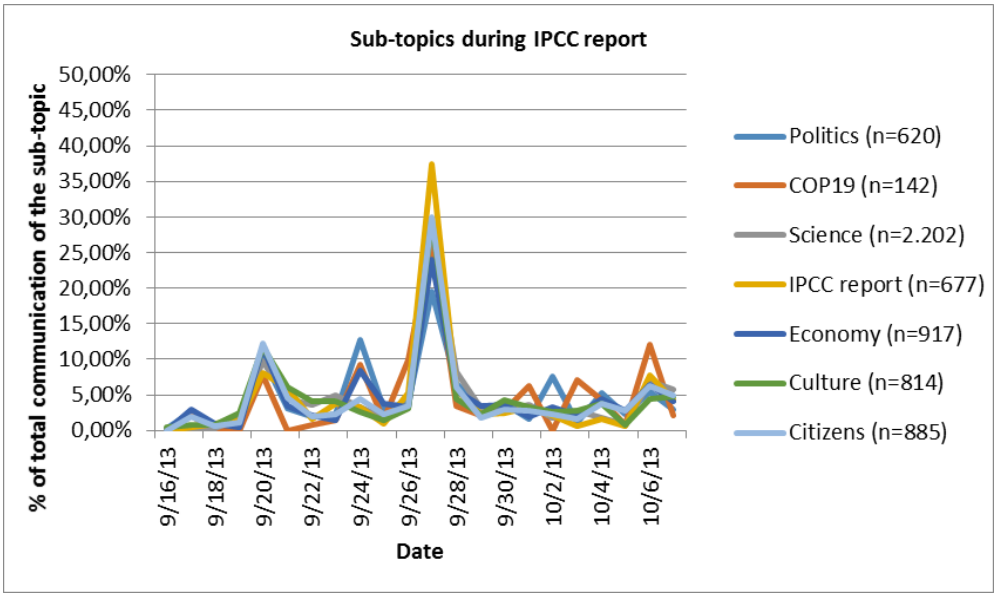

Figure 5. Dynamics of sub-topics during the release of the IPCC report 2013.

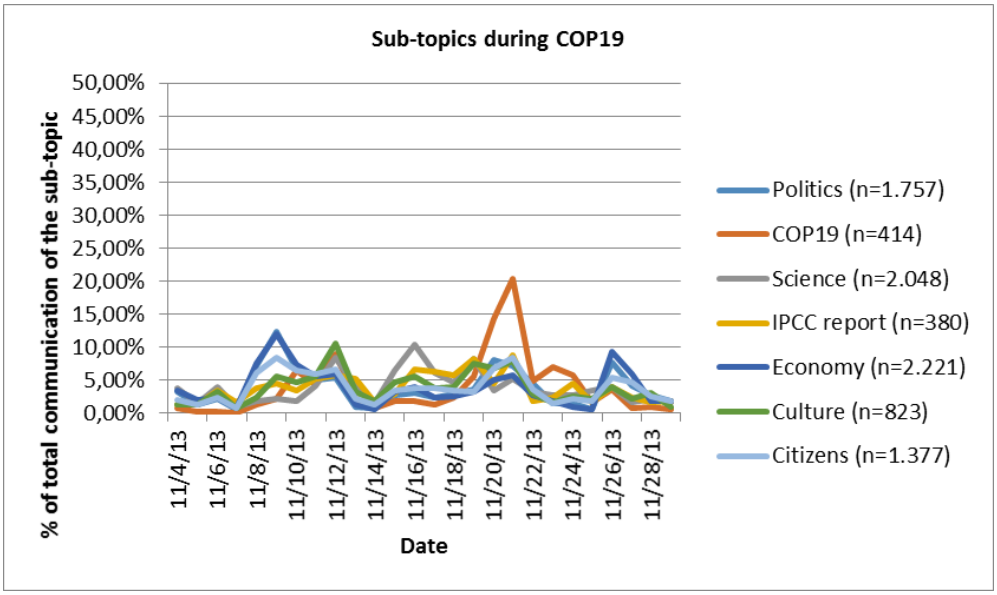

Figure 6. Dynamics of sub-topics during COP19.

Table 6. Sub-topic frequencies in different online public arenas (in %).

Sub-Topics	Arena Total N = 14.582	Mass Media Arena N = 119	Expert Arena N = 187	Discussion Arena N = 2.116	Mass Media Induced Discussion Arena N = 12.160
Politics and Climate Change	16	61	12	10	17
Science and Climate Change	29	33	62	33	28
COP19	4	34	1	2	4
IPCC Report	7	23	17	9	7
Economy and Climate Change	22	31	1	6	25
Media/Culture/Arts/Celebrity and Climate Change	11	3	13	13	11
Citizen Activity and Climate Change	16	5	5	8	17
Topic without reference to Climate Change	18	2	0	22	18

Note: Multiple response set, 3 options.

7.2.2. Arena-Specific Dynamics of Sub-Topics

The communicated sub-topics differ strongly between the online public arenas, although climate change is a science topic (Table 6): in the DA and the MDA we have a larger diversity of sub-topics compared to the other arenas, as we have a large number of communications that do not make reference to climate change. This means that communicators possibly associate sub-topics with climate change that, from our point of view, are not directly related to it. In that sense, they communicate creatively. In contrast to the other arenas, political aspects as well as the events "IPCC report" and "COP19" are especially discussed in the mass media arena and science is the main sub-topic in the expert arena.

Hypothesis 6, regarding the arena-specific dynamics of sub-topics, cannot be confirmed. This means that, despite a huge diversity of sub-topics in the two discussion arenas, no obvious differences in the dynamics of sub-topics can be found. However, this result is based on a small number of cases in the mass media arena and expert arena that do not allow for a convincing interpretation of the figures (Figure 7).

In the MDA, there is not much variation in the dynamic of the sub-topics. Especially during COP19, the relative share of each sub-topic over time is very similar. In the DA, in contrast, the dynamics of attention of certain sub-topics vary more.

Hypothesis 7 cannot be proven reliably, because the number of cases in the mass media arena and the expert arena are too small to interpret the differences in the dynamics of the sub-topics. It can, however, be stated that more sub-topics are frequently communicated in the mass media arena compared to the expert arena (Figure 7).

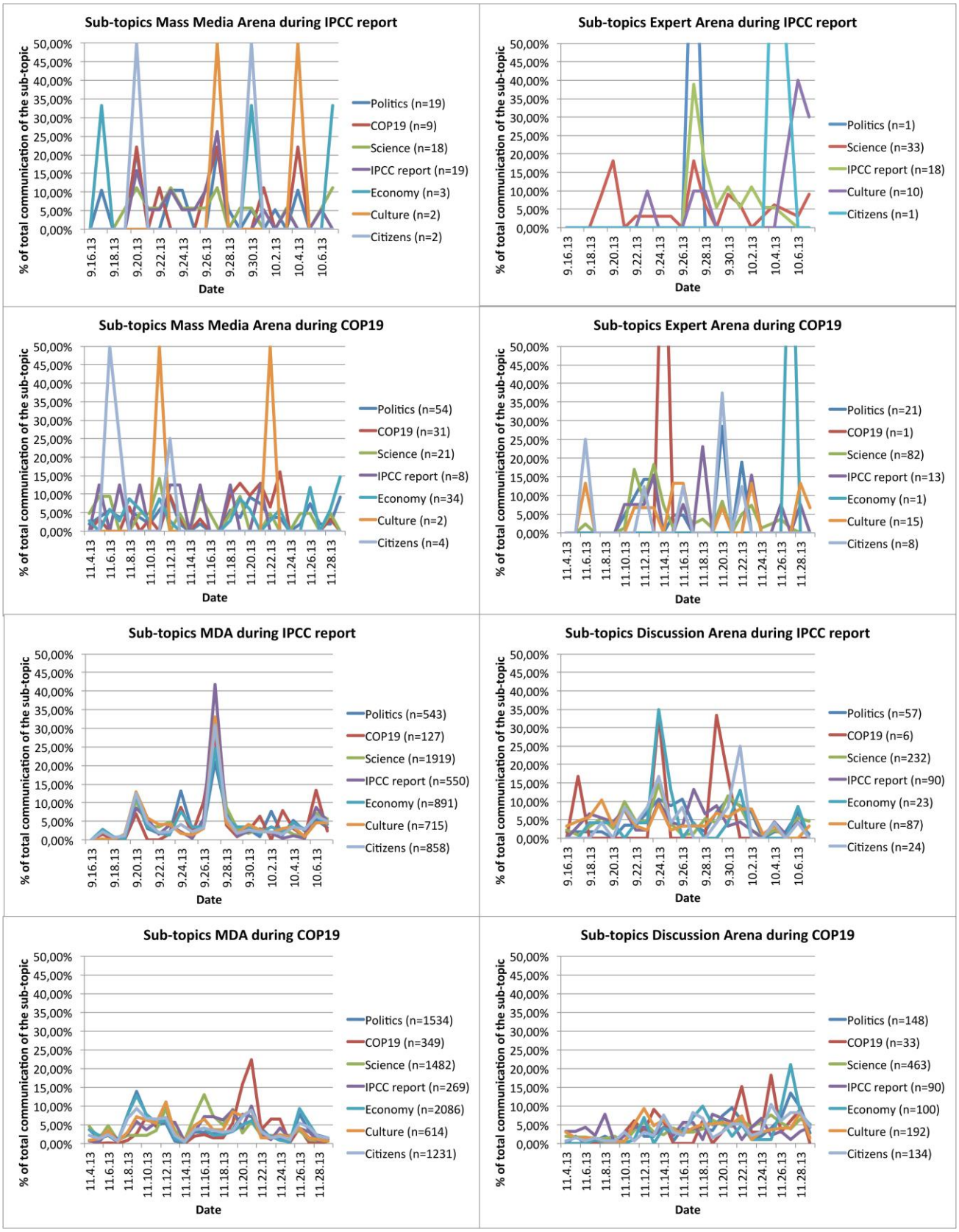

Figure 7. Overview: Dynamics of arena-specific sub-topics during the release of the IPCC report 2013 and COP19. Note: Different scales used in support of a better visualization.

8. Conclusions

The aim of this study was to investigate if climate change has specific dynamics of attention on the issue and its sub-topics depending on the triggering event and the type of online public arena, i.e. when and where it is communicated.

So far, we have known very little about the dynamics of attention on issues and sub-topics in online discourse, as most previous studies only focused on traditional, i.e. "offline" journalistic media. Furthermore, they only focused on the long-term dynamics of media attention. The few studies that analyzed online attention found indications of more and longer issue attention (Anderson et al., 2012) and little dynamics in the interpretations, with a tendency to focus more on problem-solving strategies over time (Arens et al., 2010). However, they analyzed the Internet globally and did not investigate the differences between the various online public arenas.

Our results show that the dynamics of issue attention and sub-topics online are indeed influenced by (1) *events* and by (2) the respective *online public arenas* due to their specific *(constellations of) stakeholders*. So, Waldherr's (2012) influencing factors should therefore be taken into account in further research on issue attention and even the dynamics of sub-topics.

The short-term dynamics of attention triggered by events proceed very differently. When looking at *event-specific issue attentions*, more intensive and continuous issue attention can be found related to the political event COP19, which might be explained in part by a longer duration of the event, but also by the diversity of involved stakeholders with conflicting positions. However, we find more extreme online attention peaks around the scientific event of the IPCC report release in 2013. This means that, despite the fact that both events are characterized by negotiations that lead to a final agreement, one event triggered more concentrated communication at certain times. Results on the sub-topics might explain this observation, because the communication during the release of the IPCC report is more related to the event than was found during COP19.

Furthermore, we found *arena-specific attention dynamics*. The attention towards climate change in lay communication differs from journalistic and scientific expert communication, because there is a higher intensity of attention. For the continuity of attention, we find slightly more ambiguous results. The attention in the MDA shows big amplitudes, whereas the DA does not. The expert arena, which we expected to show the most continuous attention for climate change, has the highest amplitudes of attention during COP19. Furthermore, we find the biggest amplitudes of issue attention in the expert arena. This is surprising, as we expected that scientists are the stakeholders with the steadiest interest in climate change. The result, that issue attention in the mass media arena is relatively continuous, is interesting because it is a common reproach to journalism in the public opinion that the mass media agenda changes too fast. It has to be taken into account that especially in the mass media arena, the attention to the issue of climate change is influenced by the presence of other competing issues.

Our results also showed *event-specific dynamics of sub-topics*. The dynamics of sub-topics in the communication on COP19 vary more as compared to the IPCC report. Science was the most frequent sub-topic during the release of the IPCC report, while during COP19 different sub-topics affected the discourse, especially economy and climate change. There could be two different reasons for this result: (1) the aim of COP19 was to take action in terms of the mitigation and adaptation of climate change, which is more compatible with other sub-topics and (2) much of the online communication during COP19 was not triggered by the event as compared to the IPCC report.

Our research reveals that it is crucial to differentiate between forms of online communication. Here, the concept of online public arenas proves to be sustainable in analyzing different forms of online communication with different constellations of stakeholders.

The study also makes a methodological contribution, as it proves that automated content analysis based on the machine learning of manually coded content works even for user-generated content like reader comments. This is remarkable, because user-generated content does not have a standardized structure like journalistic articles, but is often fragmentary and characterized by a style of everyday language and even deficient modes of speaking.

The major limitation of this study is its character as a case study on the issue of climate change—a long-term and global issue that is generated basically from the scientific field. Further research should therefore also investigate the influence of other issues on the dynamics of attention and of therewith-related sub-topics. The influencing factor "issue" (Waldherr, 2012) was the only one not taken into account in this study. The issues should differ in the societal fields in which they are embedded and, as such, assess whether they are related to long-term or short-term processes and/or local-related or global-related processes. We may assume that there are also "issue-specific" dynamics of attention and sub-topics—however, its underlying variables still have to be explored further.

It also has to be taken into account that our results are valid for short-term dynamics, and have yet to be proven for long time-spans.

Further research could also investigate the dynamics in the interpretation of the sub-topics. Here, it would be valuable to analyze the interpretations of the sub-topics not only via quantitative measures, but also by using qualitative methods. Likewise, it seems prom-

ising to research the dynamics of attention and subtopics not only within the online public arenas, but also between them. Are there Intermedia Agenda Setting effects or are the online public arenas fragmented from each other?

Acknowledgments

The research presented in this paper was conducted within the framework of the project "climate change from the audience perspective" under the leadership of Prof. Dr. Irene Neverla and Prof. Dr. Monika Taddicken. This project is part of the Special Priority Program 1409 "Science and the Public" which is funded by the German Research Foundation (DFG). The authors would like to thank Prof. Dr. Monika Taddicken for her help in the conceptualization and implementation of the content analysis, Ana Ivanova M.A. for the implementation of the automated content analysis, the student assistants Tjado Barsuhn, Jana Eisberg, Carolin Grüning, Kira Klinger and Sabrina Pohlmann for coding, Sandra Banjac for proofreading, and the editors and anonymous reviewers for their helpful suggestions.

References

AGOF. (2014). Angebotsranking, from http://agof.de/angebotsranking

Anderson, A. A., Brossard, D., & Scheufele, D. A. (2012). News coverage of controversial emerging technologies. *Politics and the Life Sciences, 31*(1-2), 87-96.

Arens, M., Böcking, S., Kummer, S., & Rüf, F. (2010). Das Meinungsklima zur Klimakonferenz. In M. Welker & C. Wünsch (Eds.), *Die Online-Inhaltsanalyse* (pp. 427-447). Köln: Herbert von Halem.

Baumgartner, F. R., & Jones, B. D. (1993). *Agendas and instability in American politics*. Chicago: University of Chicago Press.

Böcking, T. (2009). *Strategisches Framing*. Köln: Halem.

Bönisch, J. (2006). *Meinungsführer oder Populärmedium?* Münster: LIT Verlag.

Bowman, S., & Willis, C. (2003). We media. Retrieved from http://www.hypergene.net/wemedia/download/we_media.pdf

Boydstun, A. E., Hardy, A., & Walgrave, S. (2014). Two faces of media attention. *Political Communication, 31*(4), 509-531. doi: 10.1080/10584609.2013.875967

Boykoff, M. T. (2010). Indian media representations of climate change in a threatened journalistic ecosystem. *Climate Change, 99*(1-2), 17-25.

Brossard, D., Shanahan, J., & McComas, K. (2004). Are issue-cycles culturally constructed? *Mass Communication and Society, 7*(3), 359-377.

Brüggemann, M., & Engesser, S. (2014). Between consensus and denial. *Science Communication, 36*(4), 399-427.

Collins, L. (2013). Do online user comments provide a space for deliberative democracy. *Make Science Public*. Retrieved from https://blogs.nottingham.ac.uk/makingsciencepublic/2013/10/11/do-online-user-comments-provide-a-space-for-deliberative-democracy

Downs, A. (1972). Up and down with ecology—The "issue-attention cycle". *Public Interest, 28*(Summer), 38-50.

EIKE. (2014). EIKE. Retrieved from http://www.eike-klima-energie.eu/eike

Eilders, C. (1997). *Nachrichtenfaktoren und Rezeption*. Opladen: Westdeutscher Verlag.

Entman, R. M. (1993). Framing: Towards clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Friedman, J., Hastie, T., & Tibshirani, R. (2010). Regularization paths for generalized linear models via coordinate descent. *Journal of Statistical Software, 33*(1), 7.

Fröhlich, R., Scherer, H., & Scheufele, B. (2007). Kriegsberichterstattung in deutschen Qualitätszeitungen. *Publizistik, 52*(1), 11-32.

Galtung, J., & Ruge, M. H. (1965). The structure of foreign news. *Journal of Peace Research*(2), 64-91.

Gerhards, J., & Neidhardt, F. (1993). Strukturen und Funktionen moderner Öffentlichkeit. In W. Langenbucher (Ed.), *Politische Kommunikation* (pp. 52-88). Wien: Braumüller.

Gerhards, J., & Schäfer, M. S. (2010). Is the Internet a better public Sphere? *New Media and Society, 12*(1), 143-160.

Habermas, J. (1962/1989). *The structural transformation of the public sphere* (trans. T. Burger and F. Lawrence). Cambridge: Massachusetts Institute of Technology Press.

Hall, S. (1973). *Encoding and decoding in the television discourse*. Birmingham: Centre for Cultural Studies, University of Birmingham.

Hulme, M. (2009). Mediated messages about climate change. In T. Boyce & J. Lewis (Eds.), *Climate change and the media* (pp. 117-128). New York: Peter Lang.

IPCC. (2013). The physical science basis. Summary for policymakers. Retrieved from http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf

IPCC. (2014). Organization. Retrieved from from http://ipcc.ch/organization/organization.shtml

Jaspal, R., Nerlich, B., & Koteyko, N. (2013). Contesting science by appealing to its norms. *Science Communication, 35*(3), 383-410.

Jurka, T. P. (2012). Maxent. *The R Journal, 4*(1), 56-59. Retrieved from http://journal.r-project.org/archive/2012-1/RJournal_2012-1_Jurka.pdf

Jurka, T. P. (2013). RTextTools. *The R Journal, 5*(1), 6-12. Retrieved from http://journal.r-project.org/archive/2013-1/collingwood-jurka-boydstun-etal.pdf

Kepplinger, H. M. (2001). Der Ereignisbegriff in der Publizistikwissenschaft. *Publizistik, 46*(2), 117-139.

Kepplinger, H. M., & Habermeier, J. (1995). The impact of key events on the presentation of reality. *European Journal of Communication, 10*(3), 371-390.

Klaus, E., & Drüeke, R. (2012). Öffentlichkeit in Bewegung? In T. Maier, M. Thiele, & C. Linke (Eds.), *Medien, Öffentlichkeit und Geschlecht in Bewegung* (pp. 51-70). Bielefeld: Transcript.

Klimaschützer. (2013). Info. Retrieved from https:// http://www.facebook.com/Klimaschuetzer/info

Kolb, S. (2005). *Mediale Thematisierung in Zyklen*. Köln: Herbert von Halem Verlag.

Koteyko, N. (2010). Mining the internet for linguistic and social data. *Discourse & Society, 21*(6), 655-674.

Koteyko, N., Thelwall, M., & Nerlich, B. (2010). From carbon markets to carbon morality. *Science Communication, 32*(1), 25-54.

Kriesi, H. (2003). Strategische politische Kommunikation. In F. Esser & B. Pfetsch (Eds.), *Politische Kommunikation im internationalen Vergleich* (pp. 208-239). Wiesbaden: Westdeutscher Verlag.

Ladle, R. J., Jepson, P., & Whittaker, R. J. (2005). Scientists and the media. *Interdisciplinary Science Reviews, 30*(3), 231-240.

Liaw, A., & Wiener, M. (2002). Classification and regression by randomForest. *R News, 2*(3), 18-22.

Lörcher, I., & Taddicken, M. (2015). Let's talk about...CO2-Fußabdruck oder Klimawissenschaft? In M. S. Schäfer, S. Kristiansen, & H. Bonfadelli (Eds.), *Wissenschaftskommunikation im Wandel* (pp. 258-286). Köln: Herbert von Halem.

Mathes, R., & Pfetsch, B. (1991). The role of the alternative press in the agenda-building process. *European Journal of Communication, 6*(1), 33-62.

McComas, K., & Shanahan, J. (1999). Telling stories about climate change. *Communication Research, 26*(1), 30-57.

McGillivray, D. (2013). Digital cultures, acceleration and mega sporting event narratives. *Leisure Studies, 33*(1), 96-109.

MediaTenor. (2013). Spiegel und Bild demonstrieren Stärke. Retrieved from http://www.mediatenor.de/ newsletters.php?id_news = 803

Meyer, D., Dimitriadou, E., Hornik, K., Weingessel, A., & Leisch, F. (2012). Misc Functions of the Department of Statistics (e1071): TU Wien. Retrieved from http://CRAN.R-project.org/package = e1071

Miller, M. M., Andsager, J. L., & Riechert, B. P. (1998). Framing the candidates in presidential primaries. *Journalism & Mass Communication Quarterly, 75*(2), 312-324.

Morley, D. (1992). *Television, audiences, and cultural studies*. London: Routledge.

Neverla, I., & Schäfer, M. S. (2010). Das Medienklima. *Mitteilungen DMG, 2010*(3), 9-12.

Nisbet, M. C., & Huge, M. (2006). Attention cycles and frames in the plant biotechnology debate. *The Harvard International Journal of Press/Politics, 11*(2), 3-40.

O'Neill, S., & Boykoff, M. (2011). The role of new media in engaging the public with climate change. In L. Whitmarsh, I. Lorenzoni, & S. O'Neill (Eds.), *Engaging the public with climate change* (pp. 236-250): Routledge.

Painter, J., & Ashe, T. (2012). Cross-national comparison of the presence of climate scepticism in the print media in six countries, 2007–10. *Environmental Research Letters, 7*(4). Retrieved from http://stacks.iop.org/1748-9326/7/i = 4/a = 044005

Pearce, W., Holmberg, K., Hellsten, I., & Nerlich, B. (2014). Climate change on twitter. *PLOS ONE, 9*(4), 1-11.

Peters, H. P., & Heinrichs, H. (2008). Legitimizing climate policy. *International Journal of Sustainability Communication, 3*, 14-36.

Petersen, K. K. (2009). Revisiting Downs' issue-attention cycle. *Journal of Strategic Security, 2*(4), 1.

Pfetsch, B. (1994). Themenkarrieren und politische Kommunikation. *Aus Politik und Zeitgeschichte, 39-40*, 11-20.

Porter, A. J., & Hellsten, I. (2014). Investigating participatory dynamics through social media using a multideterminant "frame" approach. *Journal of Computer-Mediated Communication, 19*(4), 1024-1041.

Schäfer, M. (2012). Online communication on climate change and climate politics. *Wiley Interdisciplinary Reviews: Climate Change, 3*(6), 527-543.

Schäfer, M., Ivanova, A., & Schmidt, A. (2014). What drives media attention for climate change? *International Communication Gazette, 76*(2), 152-176.

Schäfer, M. S., & Schlichting, I. (2014). Media representations of climate change. *Environmental Communication, 8*(2), 142-160. doi: 10.1080/ 17524032.2014.914050

Schmid-Petri, H. (2012). *Das Framing von Issues in Medien und Politik*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Schmidt, A., Ivanova, A., & Schäfer, M. (2013). Media attention for climate change around the world. *Global Environmental Change, 23*(5), 1233-1248.

Schmidt, J.-H. (2013). Onlinebasierte Öffentlichkeiten. In C. Fraas, S. Meier & C. Pentzold (Eds.), *Online-Diskurse* (pp. 35-56). Köln: Herbert von Halem Verlag.

Schulz, W. (1990). *Die Konstruktion von Realität in den Nachrichtenmedien*. Freiburg: Alber.

Sharman, A. (2014). Mapping the climate sceptical blogosphere. *Global Environmental Change, 26*, 159-170.

Shaw, D. L. (1977). The press agenda in a community setting. In D. L. Shaw & M. E. McCombs (Eds.), *The*

emergence of American political issues (pp. 19-31). St Paul, MN: West Publishing Co.

Shih, T.-J., Wijaya, R., & Brossard, D. (2008). Media coverage of public health epidemics. *Mass Communication and Society, 11*(2), 141-160.

Special Eurobarometer 364. (2011). Public awareness and acceptance of CO2 capture and storage. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_364_en.pdf

Staab, J. F. (1990). *Nachrichtenwert-Theorie*. Freiburg: Alber.

Synovate. (2010). *Climate change global study 2010*. Bonn: Deutsche Welle Global Media Forum.

Taddicken, M. (2013). Climate change from the user's perspective. *Journal of Media Psychology, 25*(1), 39-52.

Tereick, J. (2014). *Klimawandel im Diskurs (Doctoral Dissertation).* University of Hamburg, Hamburg.

UNFCCC. (2006). Handbook. Retrieved from http://unfccc.int/resource/docs/publications/handbook.pdf

UNFCCC. (2014). Fast facts & figures. *2014*. Retrieved from http://unfccc.int/essential_background/basic_facts_figures/items/6246.phpvan der Sluijs, J. P. (2012). Uncertainty and dissent in climate risk assessment. *Nature and culture, 7*(2), 174-195.

von Storch, H. (2009). Climate research and policy advice. *Environmental Science & Policy, 12*(7), 741-747. doi: http://dx.doi.org/10.1016/j.envsci.2009.04.008

Waldherr, A. (2012). *Die Dynamik der Medienaufmerksamkeit*. Baden-Baden: Nomos Verlagsgesellschaft.

Weaver, D. A., Lively, E., & Bimber, B. (2009). Searching for a frame. *Science Communication, 31*(2), 139-166.

Wien, C., & Elmelund-Præstekær, C. (2009). An anatomy of media hypes. *European Journal of Communication, 24*(2), 183-201. doi: 10.1177/0267323108101831

Wolfsfeld, G., & Sheafer, T. (2006). Competing actors and the construction of political news. *Political Communication, 23*(3), 333-354.

Zhao, X. (2009). Media use and global warming perceptions. *Communication Research, 36*(5), 698-723.

About the Authors

Ines Lörcher

Ines Lörcher is a research associate in the project "climate change from the audience perspective" (German Research Foundation, DFG) and member of the research group "Climate Change Perception, and Communication" in the Cluster of Excellence "CliSAP" at the University of Hamburg, Germany. She holds M.A. degrees in Communications, Political Science and Cultural Anthropology from the University of Mainz, Germany. Currently, she is working on her PhD thesis on climate change communication in different online publics.

Irene Neverla

Irene Neverla, Prof. Dr., is Chair of Journalism and Communications in the Faculty of Social Sciences and Economy at the University of Hamburg, Germany. Her research work and publications are on the public discourse (seen both from journalism theory and from audience research), environmental communication (with a special focus on the public discourse on climate change), visual communication and press photography, European and other transcultural public spheres.