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Echo Chambers of Denial:

Explaining user comments on climate change

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Abstract:

Although there is a broad consensus among scientists and journalists regarding the existence of anthropogenic climate change as a global problem, some segments of the population remain doubtful about the human impact on climate change. The internet provides citizens with opportunities to publicly voice their concerns, and user comment sections of online news outlets are a popular form of user-generated content in which the opinions of those willing to engage in discussions online become public. This study identifies factors that foster comments that are skeptical or supportive of the validity of basic assumptions of anthropogenic climate change, drawing on online news outlets in the US, the UK, Germany, India, and Switzerland. Our results show that users adapt to the dominant opinion within the respective media outlet: User comment sections serve as an echo chamber of journalism rather than as a corrective mechanism to address contrarianism in the news. There are also important cross-national differences: climate change denial is more vocal in user comment sections in countries where the climate change debate reflects the scientific consensus on climate change. Here, user comments create niches of denial. This paper improves our conceptual understanding of the contexts that lead users to speak out or remain silent about beliefs that are contrary to the majority opinion.

Keywords: Journalism, climate change, user comments, content analysis

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1. Introduction

Climate change is an example of a politically and socially relevant issue about which opinions are heterogeneous and sometimes even polarized (Hoffman, 2015). There is a broad consensus among scientists (Anderegg, Prall, Harold, & Schneider, 2010; Cook et al., 2013) and even among many journalists (Brüggemann & Engesser, 2017) that the current process of climate change is mostly brought about by human behavior such as fossil fuel burning, which increases the proportion of greenhouse gases in the atmosphere (also referred to as anthropogenic climate change). Yet, some segments of the population remain skeptical of, or unsure about, the causes and risks associated with climate change (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2016; Metag, Fuchslin, & Schäfer, 2015; Pew Research Center, 2015). Today, the internet provides citizens with various channels through which they can voice their doubts. Compared to opportunities to participate in traditional legacy media, comment sections of online media provide a more open and easily accessible forum for the voices of the active audience. Even though their participatory potential has not yet been fully exhausted (Domingo et al., 2008), user comment sections provide ordinary users with a public space for debate. Comment sections can constitute counter publics, where opinions that cannot be found in the mainstream media can be expressed. As far as discursive change is concerned, counter public can enrich debates and have beneficial effects for democracy (Toepfl & Piwoni, 2015). Analyzing and understanding the factors that predict user comments on climate news is especially important, as such comments can influence public opinion on climate change (cf. Friemel & Dötsch, 2015; Lee & Jang, 2010). Yet few studies have explored user comments on climate news (for exceptions, see Koteyko, Jaspal, & Nerlich, 2013; de Kraker, Kuijs, Cörvers, & Offermans, 2014; Porten-Cheé & Eilders, 2015).

This study examines which factors foster comments that are skeptical or supportive of the validity of basic assumptions about anthropogenic climate change. User comments are not

necessarily representative of public opinion; they reflect only the views of a small proportion of online news readers (Springer, Engelmann, & Pfaffinger, 2015) who have a strong interest in climate change (Koteyko et al., 2013). Analyzing reader comments is nevertheless important, as they represent the opinions of those who are willing to engage in public debates on climate change. Since their opinions are publicly visible, they might be perceived as reflecting the opinions of others, and therefore user comments can influence public opinion on climate change (cf. Friemel & Dötsch, 2015; Lee & Jang, 2010) and contribute to the formation (and possibly the polarization) of attitudes (cf. Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014).

2. Climate news and its readers

Even though the issue of climate change has largely moved beyond the question of whether it is happening and whether it is caused by humans (for an overview of the climate debate, see Moser, 2010; Schäfer, 2015), "doubt and skepticism linger in various sectors of society" (Moser, 2010, p. 32) and are more prevalent in some countries than in others. Yet under which circumstances do people publicly take a stand and voice their skepticism, or make affirmatory statements about the anthropogenic nature of climate change? User comments are a publicly visible and accessible forum for the voices and opinions of ordinary citizens. The much-debated theory of the *spiral of silence* provides a starting point for analyzing user comments. The core assumption is that people risk social isolation when openly expressing views that deviate from public opinion (Noelle-Neumann, 1980). According to this theory, if people assume, for example, that a public consensus that anthropogenic global warming exists, then they would not voice their doubts publicly. The news media play an important role in forming perceptions of public opinion: "mass media content influences what individuals perceive as majority or minority opinion and affects whether they adapt their discursive behavior accordingly" (Porten-Cheé & Eilders, 2015, p. 144).

The internet has brought about changes that could challenge the assumptions of the spiral of silence: it enables users to express opinions anonymously, which might reduce their fear of isolation in response to expressing opinions that deviate from the majority opinion. Yet there is no clear empirical evidence on how anonymity affects spiral of silence processes (Porten-Cheé & Eilders, 2015; Woong Yun & Park, 2011). There are however concerns that anonymity, especially in the context of user comments sections, leads to incivility (Coe, Kenski, & Rains, 2014; Freelon, 2015) and is affecting the quality of debates (Ksiazek, 2016; Ruiz et al., 2011). However, previous studies have shown that most user comments are neither impolite nor uncivil (Coe, Kenski, & Rains, 2014; Rowe, 2014).

At the same time, the online environment facilitates selective exposure: people have easier access to information that is consistent with their opinions. The psychological need to confirm their views and reduce cognitive dissonance (Donsbach, 2009) leads to a confirmation bias when interpreting information (Kahan, 2010). These psychological mechanisms, combined with algorithms designed to match content with people's pre-existing opinions and preferences (Pariser, 2011), have led people into a web of "echo chambers", which refer to a common frame of reference and positive feedback mechanisms that reinforce existing opinions rather than foster dialogue and critical reasoning (Farrell, 2015; Jamieson & Cappella, 2008). This reinforcement and support can produce more extreme opinions and increase polarization in societies (Sunstein, 2003).

Within echo chambers, people might "mistake the selected confirmative media content for public opinion" (Eilders & Porten-Cheé, 2016, p. 94). As a consequence, we might find spiral of silence processes where people refrain from voicing opinions that deviate from the majority opinion *within* the respective echo chamber. Echo chambers are particularly problematic for the issue of climate change, as they can lead to the perception that "anthropogenic climate change is up for debate, when in fact outside of this echo chamber there

is overwhelming evidence and scientific agreement about climate change" (Farrell, 2015, p. 720).

The basic logic of the theory of the spiral of silence can – and should – be adapted to this new online media environment (Schulz & Roessler, 2012; see also Stoycheff, 2016) and combined with the concept of echo chambers. It might be possible that "we observe several Spiral of Silence processes on different levels today (…). These processes follow the Spiral of Silence notion but are limited to online or real-world communities rather than affecting the discussion in society as a whole" (Schulz & Roessler, 2012, p. 361). Networks of ideologically consistent echo chambers may connect such communities and produce bubbles of public opinion that diverge strongly from dominant public opinion as represented in mainstream mass media outlets. The public opinion climate, as perceived by a given individual, may thus be determined by the opinions flowing through their personal network of echo chambers, which may or may not include mass media outlets. In such a situation, the benchmarks for creating spirals of voice (and silence) in user comment sections may be opinions represented in different news outlets, or even at the level of the news story, rather than aggregated public opinion at the national level. The basic mechanism of the spiral of silence may thus still explain why users voice certain opinions in the comments section or remain silent. This may have further effects on the silence vs. voice of opinions on climate change among the readership of the user comments.

In general, the phenomenon of readers commenting on journalistic output is not new. Before the internet, readers could provide their feedback and opinions through letters to the editor. Thus core journalistic culture remains largely unchanged (Domingo et al., 2008); what has changed are the *interactions* between journalists and readers. While journalists commonly select only a small number of letters to the editor to print in newspapers, the internet permits reader participation on a larger scale. Even though some newspapers screen comments before

they are published, journalists generally have less control over the content of comments that are posted in response to their articles. Furthermore, while letters to the editor are usually signed with the author's name, user comments can be made anonymously. This gives more reluctant users a chance to express their views and opinions, increases the number of people who participate in discussions, and invites broader participation and a wide range of opinions (McCluskey & Hmielowski, 2012).

Research on user comments has shown that readers appreciate the comment function as part of their online news consumption, and perceive comments by other users to be interesting (Bergström & Wadbring, 2015). Journalists, however, have been more critical of user comments and raised concerns about the quality of their content – particularly their lack of factual information and constructive feedback (Bergström & Wadbring, 2015; Nielsen, 2012). Nevertheless, journalists overall believe that readers should have the ability to comment on online news (Nielsen, 2012). The proportion of online news readers that engages in discussions is relatively small compared to those who read online news (Diakopoulos & Naaman, 2011; Springer, Engelmann, & Pfaffinger, 2015). However, the number of participants varies depending on the news story and is positively influenced by the news values – such as *proximity*, *impact*, and *continuity* – included in the story (Weber, 2014).

In the context of news reporting on climate change, reader comments have only very recently gained scholarly attention, despite their potential to create or deny opportunities for deliberative public debates on climate change (cf. Collins & Nerlich, 2015). Little is known about climate-related *discussions* that take place among readers in comment sections. A study by de Kraker et al. (2014) examined opinions on climate change that are expressed in the user comment sections of Dutch newspapers. The results show that the majority of comments express climate-skeptical views, which is in stark contrast with public opinion surveys that reveal there are very few climate skeptics in the Netherlands. A study from the UK by Koteyko

et al. (2013) yields similar results: using computer-assisted content analysis, frequent keywords in comments posted by *Daily Mail* readers were analyzed. The findings show that comments play an important role in voicing climate-skeptical positions; they do not merely reproduce opinions expressed in the news story. Porten-Cheé and Eilders (2015) used the theory of the spiral of silence to analyze the effects of user-generated content in the climate change debate in Germany. Using online diaries as well content analysis, the study found no support for the spiral of silence online, as dissonance between individuals' opinions and perceived public opinion did not prevent people from speaking out. The authors argue that this lack of support for the spiral of silence might be due to the characteristics of the German climate change debate: due to a low degree of moral conflict, the fear of isolation might be reduced so that people do not refrain from articulating a minority opinion (Porten-Cheé & Eilders, 2015, p. 149). In conclusion, extant research on climate-change-related user-generated content lacks a comparative dimension, and little is known about the content that readers post online. Thus, studies have not yet been able to provide information on which factors predict whether users voice climate-skeptical views in user comments.

3. Hypotheses

There are several potential factors of influence located at different levels (Reese & Shoemaker, 2016) that can affect news content and as well as readers' expression of support or challenge of the assumptions related to anthropogenic climate change. This section identifies factors (a) at the country level, (b) at the level of the news outlet, (c) at the level of the individual journalist, and (d) at the level of the individual news story.

3.1. Country level

Patterns of discussion among readers might vary depending on the *country* they live in. More intense discussions on climate change are likely to take place in countries with high levels of CO_2 emissions, since those states are primarily responsible for global warming (cf. Clark, 2011). However, the degree of climate change skepticism in a country has a greater impact on readers' voicing support for or challenging the existence of anthropogenic climate change. Comparative studies have identified pronounced differences in national debates on climate change (Carvalho, 2007). The central variable for distinguishing the debates is the degree of polarization between the voices denying the problems related to anthropogenic climate change and those advocating decisive action. In the United States, there is a sharp divide between people who doubt and people who support the scientific consensus on anthropogenic global warming (Nisbet, 2014), whereas in Germany and Switzerland (and other European countries), there is a general agreement in the mass media, and among political elites, about the causes and consequences of climate change and the resulting need for action (Grundmann & Scott, 2014). The UK can be placed somewhere between these two extremes; it has salient opposing voices in the conservative and tabloid press (Painter, 2011), but a general acknowledgement of anthropogenic climate change among political elites. In emerging economies such as India, the media coverage is focused on the "risk-responsibility divide" between the early-industrialized Western countries and the rest of the world (Billett, 2010; Thaker & Leiserowitz, 2014).

According to the spiral of silence theory, we would expect that people living in countries where climate skepticism is more widely accepted are more willing to express skeptical opinions, while they would be more reluctant to do so if they felt they were in the minority. As online news can be accessed from all over the world, we cannot be certain that people commenting on news articles are residents of the country where the news outlet is based. However, we can assume that the majority of the outlet's readers live either in the same country or one that shares the same language and is culturally close, such as people from Austria who

consume German news media, or US citizens reading *The Guardian* online. If the country of origin is a relevant determinant of public opinion and peoples' willingness to express their opinions online, then we expect that:

H1: The number of challenging comments will be higher – and the number of supportive comments lower – in countries that feature more prominent contrarian voices compared to countries with a more broadly accepted consensus on anthropogenic climate change.

3.2. Media outlet

The media outlet may also affect discussions on climate change in its respective user comment sections. Richardson and Stanyer (2011) have shown that in the UK, the average number of comments that a news story receives varies between media types. Those published in tabloids receive, on average, only 3.29 comments, compared to 18.62 in broadsheets. The total number of users who participate in discussions also varies (619 for tabloids, 17,963 for broadsheets).

Equally important for the present study is that different types of media, i.e. tabloids vs. broadsheets, also diverge in their reporting on climate change. For American and British quality newspapers, Boykoff (2007) has shown that in recent years, the majority of news stories are in line with the scientific consensus of the human contribution to climate change. The coverage in tabloid newspapers, however, diverges significantly from this scientific consensus: about one-third of the news stories analyzed claimed that human contributions to climate change were negligible (Boykoff & Mansfield, 2008). Here, the question is whether reporting also affects readers' perceptions of public opinion on climate change, which – according to the spiral of silence approach – leads to user comments that conform to the facts presented in the news reporting.

The political leaning of a news outlet also affects its reporting on climate change. There is evidence of a relationship between right-wing attitudes and climate skepticism in public opinion (e.g. McCright & Dunlap, 2011) and between a conservative newsroom policy and climate skepticism expressed in media coverage (Boykoff & Mansfield, 2008; Painter & Ashe,

2012). For example, a comparative study by Painter and Ashe (2012) revealed stark differences between conservative and left-leaning newspapers in leaving skeptical voices uncontested. Following the spiral of silence theory, if more skeptical voices are represented in conservative media, then climate-skeptical readers should feel more confident about voicing these views publicly. Our hypotheses regarding the media outlet are:

H2.1: *There will be more challenging comments – and fewer supportive comments – in tabloid newspapers compared to other news outlets.*

H2.2: *There will be more challenging comments – and fewer supportive comments – in conservative media compared to other media outlets.*

3.3. Journalists

Journalists have a central role in science communication, including on the topic of climate change: "Science journalists have often been singled out as professional mediators existing on a boundary, transporting and translating information from the specialist scientific context to the public" (Shanahan, 2011, p. 905). By bringing media attention to a certain issue, journalists are able to raise public concern and support for policy actions. Climate news is predominantly written by journalists who share a broad consensus on anthropogenic climate change (Brüggemann & Engesser, 2017); the exceptions are a few columnists who lack expertise in the field but still frequently comment on climate change. Columnists, particularly in the UK and US, provide niches of denial in legacy media outlets that otherwise do not openly challenge the scientific consensus on climate change (Brüggemann & Engesser, 2017; Elsasser & Dunlap, 2013). Extant research has shown that newspaper commentaries include more contrarianism than newspaper reporting and, more importantly, that skeptical voices found in the opinion pages are uncontested (Painter & Ashe, 2012, p. 5). Thus, applying the logic of the spiral of silence to the level of the individual journalist, we expect that news stories written by columnists encourage contrarian user comments. Therefore, our hypothesis is:

H3: *The number of challenging comments will be higher if a news story was written by a columnist.*

3.4. News story

The content of a news story itself also has a strong influence over whether readers comment online, and whether these comments express support for or challenge the notion of anthropogenic climate change. Previous research indicates that the content and topic of a news story are related to the number of comments (Boczkowski & Mitchelstein, 2012; Weber, 2014). Overall, there is a broad scientific consensus that anthropogenic climate change exists (Anderegg, Prall, Harold, & Schneider, 2010; Cook et al., 2013; Whitmarsh, 2011), which is also articulated by the Intergovernmental Panel on Climate Change (IPCC), which is responsible for assessing the scientific information relevant to understanding the risk of climate change. The news media coverage – and especially online news – is often more divided, which provides a forum for climate-skeptical voices that challenge these assumptions (Schäfer, 2012). Following the logic of the spiral of silence, statements challenging the scientific consensus in a news story might tempt more skeptical readers to likewise express their skepticism of the existence of anthropogenic climate change. Hence, we expect that:

H4: *The number of challenging comments will be higher – and the number of supportive comments is lower – if the content of a news story challenges the scientific consensus on anthropogenic climate change.*

4. Methodology

To analyze user comments on climate news, we draw on data collected in the context of the Framing Climate Change project. As we expect discussions to differ across countries, the study compares countries with different perspectives on climate change: Germany, India, Switzerland, UK, US, and India. All five countries share high levels of total and per capita CO_2 emissions (Clark, 2011) and are thus likely to feature vivid debates on climate change. The industrialized countries have different levels of climate change skepticism, which is relatively

high in the US, medium in the UK, and low in Germany and Switzerland (Grundmann & Scott, 2014; Pew Research Center, 2015). In India, is included as an emerging economy where citizens are particularly concerned about climate change (Pew Research Center, 2015), and the climate change debate is more focused on the "risk–responsibility divide" between the early-industrialized Western countries and the rest of the world (Billett, 2010; Thaker & Leiserowitz, 2014).

The study examines leading professional news outlets from different sectors of the media landscape: upmarket newspapers (preferably one conservative and one liberal), tabloids or midmarket newspapers, as well as regional newspapers from a metropolitan area, and predominant online players (see Appendix I for further details). In the original sample, 25 news outlets were included. Yet, *The Sun* had to be excluded from the sample, as the comment function was not enabled on any of articles included in our sample.

For the content analysis, we analyzed the websites of the news outlets from 1 January 2011 – 1 August 2012 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 has been tested in previous studies (Schmidt, Ivanova, & Schäfer, 2013). We complemented the web search by scouring the print versions of the news outlets in LexisNexis and Factiva. We then manually identified all articles focusing on climate change[2] that were freely available (i.e., not behind paywalls) and therefore easily accessible to public debate. While the original data set includes a total of 936 news stories (for further details see Brüggemann & Engesser, 2017), for the present study we use a subsample of news stories published in online newspapers (N = 803).

4.1 Operationalization of dependent variables

[2] We used a subsample to test whether coders were able to reliably identify climate-related articles from one news outlet. Two coders achieved a satisfactory agreement of 89% (Brüggemann & Engesser, 2017).

For each online news story, coders were asked to read the first 10 user comments that contained more than 10 words. They were then asked to count the number of comments that accept/affirm/support the validity of the anthropogenic climate change based on the IPCC consensus, or support the IPCC as such, or mainstream climate science. The IPCC consensus is operationalized as consisting of four different statements: (1) Global Warming: the average global temperature has been rising for about 150 years, (2) Anthropogenity: global warming has been largely caused by humans through CO_2 emissions and greenhouse gases, (3) Major Problems: the impact of global warming will most likely create major problems for our global ecosystem, and (4) Emission Reduction: humankind must strongly reduce CO_2 emissions in order to limit future global warming. User contributions that do not explicitly support anthropogenic climate change, but take it for granted and comment, e.g. directly on solutions to avoid emissions, were also coded in this category as they express implicit support. The dependent variable *Support* measures the percentage of supportive comments of the 10 comments coded.

Challenging comments are those that challenge/call into question the validity of anthropogenic climate change, or criticize the IPCC or mainstream climate science. The dependent variable *Challenge* measures the percentage of challenging comments of the 10 comments coded. For a better overview of the descriptive analysis, we calculated the percentage of neutral comments based on the number of comments that are neither supportive nor challenging.

The reliability of the coding was tested based on a randomized sample of 57 articles using the standardized Lotus reliability coefficient (for a discussion of the merits of this measure compared to other coefficients, see Fretwurst, 2015). After a first reliability test failed to generate satisfactory results, the codebook was further simplified and elaborated and the

coders were trained for three additional weeks. The second test (with new articles) provided satisfactory results (support: S-Lotus = 0.72, challenge: S-Lotus = 0.78).

4.2. Operationalization of independent variables

According to the different levels of influence identified in our hypotheses, the independent variables (Table 1) include the country in which the news story was published, whether the media outlet is a tabloid newspaper or a conservative news outlet, and whether the news story is written by a columnist and/or its content deviates from the IPCC consensus.

[Table 1 about here]

5. Results

5.1 User comments on climate news across countries and media outlets

This article aims to identify the factors that predict whether readers of climate change news stories in Germany, India, Switzerland, the UK, and the US voice support or challenge anthropogenic climate change in user comments. Such an analysis requires that news stories receive user comments in the first place; it cannot be assumed that readers will comment on every climate news story. In fact, only slightly more than half of the news stories in our sample (54%, N = 440) received at least one user comment. The stories in our sample from three news outlets, the *Indian Express*, the *Manchester Evening News*, and the *Berliner Zeitung*, received no comments; these outlets were excluded from the sample. The analysis of supportive and challenging user comments is based on 440 news stories, published in 21 news outlets. For each news story, up to 10 user comments were coded. The total number of comments analyzed is 3,470. Of this sample, 29% (N = 974) of the comments express support for anthropogenic

climate change, while 20% (N = 712) challenge its validity. The tone of about half of the comments (51%, N = 1,784) remains neutral on this question.

Figure 1 shows the percentage of challenging, supportive, and neutral comments by country. The neutral comments vary from 47% to 54%. A one-way analysis of variance (ANOVA) shows that there are no significant differences in neutral comments across countries, while the share of supportive and challenging comments varies significantly (see Appendix II for further details). In Switzerland and Germany, the percentage of supportive and challenging comments is distributed approximately evenly, while the proportion of supportive comments clearly prevails in India, the US, and the UK.

[Figure 1 about here]

Figure 2 illustrates that challenging and supportive comments not only vary across countries, but also across media outlets. The readership of the German tabloid *Bild* seems to be the most climate skeptical, as 46% of the comments challenge the existence of anthropogenic climate change. This is followed at some distance by the Swiss paper *Berner Zeitung* (34% challenging comments). *The New York Times* is on the other end of the scale, as there are no skeptical comments in our sample. However, the comments on *The Hindu* website express the highest explicit support for the existence of human-caused climate change (63%). The highest percentage of neutral comments can be found in *MidDay*. These first descriptive results hint at the importance of the news outlet for voicing supportive vs. skeptical comments in the comment section.

[Figure 2 about here]

5.2 Explaining supportive and challenging comments

This raises the question of what factors predict the number of comments that support vs. challenge the validity of anthropogenic climate change. To validate the initial descriptive findings, a regression analysis was conducted (Table 2). Regarding the country-level differences, our first hypothesis (H1) assumes that the number of challenging comments will be higher – and the number of supportive comments lower – in more climate-skeptical countries (i.e., the US and the UK) compared to countries with a more broadly accepted consensus of anthropogenic climate change (i.e., Germany and Switzerland). Yet, this is clearly not the case. Our results indicate that the share of skeptical comments is significantly lower – and the share of supporting comments significantly higher – in countries that are generally considered to be more doubtful of anthropogenic climate change. In India, where the climate debate is arguably less polarized, we find a similar pattern. This might indicate that, at the country level, the degree of polarization of the climate change debate – reflected in public opinion and the strength of contrarians among elites – is not the central factor for explaining patterns in user comments.

[Table 2 about here]

The second hypothesis assumed that levels of skeptical user comments differ between different types of media outlets. Therefore we expected the number of challenging comments to be the highest – and the number of challenging comments to be lowest – in tabloids (H2.1) and conservative news outlets (H2.2). We find support for both hypotheses, which is in line with previous research showing that conservative media draw conservative audiences who are more likely to reject climate change (McCright & Dunlap, 2000). Thus user comments seem to adapt to the dominant opinion of the media outlet.

Journalists are another potential source of influence, since they determine the content as well as the style in which a news story is written. We expected news stories written by columnists to receive more challenging comments (H3), as they not only report scientific facts, but also often give contrarians a chance to voice their (climate) skepticism. This hypothesis can partially be confirmed: while news stories written by columnists do not receive more challenging comments, they receive significantly *fewer* supportive comments. Thus news stories written by columnists seem to prevent people from voicing statements supporting anthropogenic climate change.

Finally, reader comments might be affected by the content of the news story. We hypothesized that articles that deviate from the scientific (IPCC) consensus are more likely to provide a forum for climate-skeptical comments (H3). Yet, our results cannot confirm such a relationship. Thus, an individual article's bias towards contrarianism does not encourage people to openly agree or disagree with the author. Overall, a complex picture emerges with regards to our theoretical framework that is elaborated on below.

6. Discussion & Conclusion

This paper examines factors at the country, media outlet, journalist, and news story levels that predict the expression of support for (or challenge of) anthropogenic climate change in the user comment sections of online newspapers. The theoretical framework was based on the spiral of silence, according to which people fear social isolation if they openly express opinions that deviate from public opinion (Noelle-Neumann, 1980). Therefore, we assumed that we would find more climate-skeptical user comments in the US and the UK, where climate skepticism is more widespread, than in Germany, India, and Switzerland. Yet, on the contrary, our results reveal that in the US media, users voice significantly fewer challenging comments, and in both the US and the UK we find significantly more supportive comments.

This finding contradicts the assumptions put forward by the spiral of silence, which suggests that this theory needs to be adapted to the new online environment. The ability to post anonymously may encourage user comments that diverge from the public consensus on climate change that prevails in countries like Germany and Switzerland. It may be that in countries where climate change is a less polarized issue, and where public opinion converges towards the scientific/IPCC consensus, climate change contrarians are marginalized in the broader public debate and therefore withdraw to comment sections to voice their skepticism.

The results obtained at the level of the news outlet are more consistent with our theoretical expectations. As expected, we found more comments that challenge anthropogenic climate change in tabloids and conservative news outlets, which is consistent with previous research (Boykoff & Mansfield, 2008; Painter & Ashe, 2012). User comments provide echo chambers for the contrarianism raised in the news coverage of such outlets. Climate-skeptical readers find information that is consistent with their own beliefs, and hence gives them the impression that their opinion is the prevalent one in society. This pattern is very much in line with the psychological mechanism at the core of the spiral of silence approach. At an even lower analytical level, our results show that it matters whether a news story is written by a columnist, while we could not confirm that the content of the individual news story affects the extent to which users voice a challenge to, or support for, human-caused climate change.

The most plausible explanation for these findings is that public opinion at the country level might no longer be the most important reference framework to explain voicing opinions publicly. The spiral of silence has its roots in the 1970s in West Germany, when the news coverage was rather homogenous and dominated by a few major media outlets. Today, the number of media outlets and their content has diversified. Previous research has shown that people tend to turn to news outlets whose reporting is in line with their own opinions (e.g., Iyengar & Hahn, 2009). Consequently, the public sphere has disintegrated into different spheres

that represent different communities. On the internet, due to selective exposure facilitated by search engines and social networks, these communities tend to evolve into networks of consonant echo chambers (Sunstein, 2002), where either supporters or challengers – e.g., of anthropogenic climate change – have the upper hand. In such environments, users might get the impression that most people share their view (cf. Leviston, Walker, & Morwinski, 2012), as they are reading news and user comments that are similar to their own opinions. This dynamic might be further enhanced by the psychological mechanism that people tend to overestimate the number of people who share their views on climate change (Leviston, Walker, & Morwinski, 2012), which may lead to a false consensus effect (Ross, Greene, & House, 1977).

This has happened to varying degrees in the countries analyzed. In the US, the climate change issue has become part of a wider "cultural schism" (Hoffman, 2015); it has joined gun control, abortion, and other issues that people refrain from talking about with strangers. This phenomenon can clearly be explained by the spiral of silence: social isolation is to be feared if you warn about climate change in ultra-conservative groups. Even though the fear of isolation might be reduced in the online environment, users still face feedback and criticism from others if their opinion deviates from the majority opinion of the online forum. This would, for example, apply to a media user who publishes a skeptical comment under an article in the liberal *Huffington Post*, whose columnists clearly identify with the mission to warn about the dangers of climate change. Therefore it is in *USA Today*, which provides a relatively neutral terrain, where similar numbers of doubts and warnings about climate change are raised.

The finding that the US outlets overall display a clear tendency to support anthropogenic climate change might also reflect the fact that our sampling looked for online news outlets with a wide readership. Thus, we did not look at blogs of climate change deniers or news outlets with smaller online audiences than those of the *New York Times* or the *Huffington Post*. In the UK, on the contrary, the *Daily Telegraph* is home to a community of skeptics: the content

analysis of the media coverage in our sample reveals how one columnist produces dozens of articles that deny climate change (Brüggemann & Engesser, 2017). In countries with a less polarized discourse like Germany and India, doubtful readers might still dare to raise their voices even in news outlets that clearly share the consensus on climate change.

Thus, this research has enriched our knowledge about the active online audiences of news outlets in different contexts and our understanding of the circumstances in which people voice their opinions in online comment sections or remain silent. It thus also helps adapt the spiral of silence to today's media environment. We confirm the suggestion of earlier theorizing that we might "observe several Spiral of Silence processes on different levels today" (Schulz & Roessler, 2012, p. 361). The organizational levels of various media outlets with different ideological leanings and editorial policies towards climate change are the decisive focal point of like-minded communities of journalists and audiences that support or challenge climate change, thus constituting echo chambers of denial or support for the scientific consensus on this issue. Thus, the spiral of silence should be applied to the relevant communities in public communication, which crystallize around certain news outlets, rather than national publics. Our research suggests that in times of polarized discourses, nations no longer constitute the most relevant communities of communication.

This conclusion needs further empirical validation, as our research has several limitations. While we analyzed 803 news stories in 24 news outlets and covered 3,470 comments, we were only able to examine the first 10 comments of each news story, which is only a small proportion of the total number of comments. And as the sample was not drawn randomly, we cannot claim that it is representative. Nevertheless, the first 10 comments are important, as they arguably receive the most attention from other users. By focusing on the relationship between news stories' content and user comments, we were unable to investigate factors related to interactivity and the potential effects that user comments themselves might

have on generating comments by other users (Ziegele, Breiner, & Quiring, 2014). Furthermore, we cannot make any claims about the influence of individual-level factors on why readers decide to comment on news in the first place, or their motives for voicing support or skepticism. The future research agenda is thus twofold: first to broaden the sample – and explore other polarized issues – in order to examine whether the findings of this study hold under these conditions. Second, more in-depth analysis of user comments is needed: qualitative studies could try to explore what users *think*, but refrain from posting – provided that studies can overcome the spiral of silence effects that are also at work when answering survey and interview questions from researchers.

The findings of this study about the fragmentation of online discourses into ideologically like-minded echo chambers have implications for science communication: if climate scientists want to spread evidence-based knowledge where it is most needed, they need to go beyond the liberal elite media and engage with tabloid news outlets and conservative media in order to better inform the debate. Niches of denial persist in these outlets, particularly in the comments of columnists and users.

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Table 1: Independent Variables

	Measurement
US	Categorical variable (1= US news story, 0=otherwise, reference category Switzerland[a)]).
UK	Categorical variable (1= UK news story, 0=otherwise, reference category Switzerland)
Germany	Categorical variable (1= Germany news story, 0=otherwise, reference category Switzerland).
India	categorical variable (1= India news story, 0=otherwise, reference category Switzerland)
Tabloid	Categorical variable (1= tabloid, 0=otherwise).
Conservative media	Categorical variable (1= conservative media, 0=otherwise)
Columnist	Categorical variable (1= journalist of news story is columnist, 0=otherwise)
IPCC consensus	Categorical variable that takes the value 1 if an article contradicts one of the statements of the IPCC consensus (see above), and 0 otherwise (S-Lotus = 0.80).

[a)] We chose Switzerland as reference case, as both supportive and challenging comments are distributed approximately equally (25%challenging and 24% supportive comments)

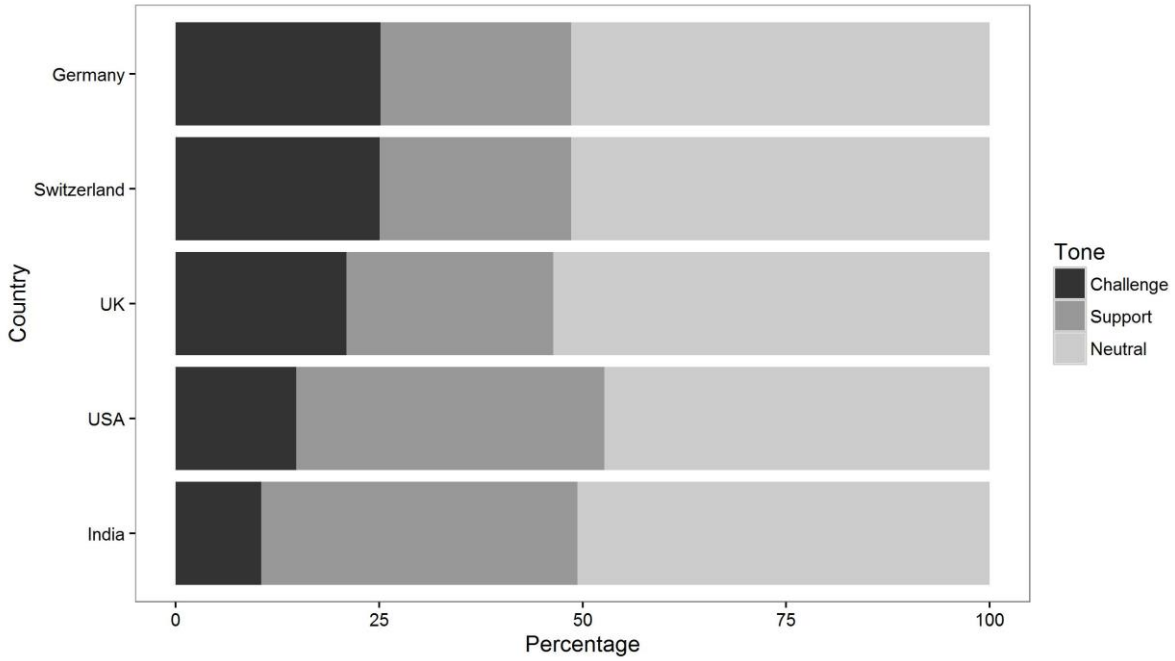
Table 2: Regression Models of User Comments on Climate News

	Support		**Challenge**	
	Coef.	SE	Coef.	SE
US	11.28*	4.45	-8.80*	4.26
UK	7.82*	3.78	-7.06	4.22
Germany	-3.64	4.09	2.09	4.40
India	12.53*	6.35	-12.42*	4.99
Tabloid	-13.70*	5.84	11.72*	5.12
Conservative media	-20.73***	2.81	8.37**	2.69
Columnist	-12.38***	3.13	8.55	4.52
IPCC challenged	0.11	2.73	1.57	3.55
Constant	31.70***	3.52	20.65***	3.97
R2	0.21		0.13	
N	440		440	

Note: ∗p<.05, ∗∗p<.01, ∗∗∗p<.001, SE= robust standard errors. Switzerland is used as a reference category. The N refers to the number of news stories, for which we calculated the percentage of supportive and challenging comments respectively. A regression using standardized IVs can be found in Appendix III.

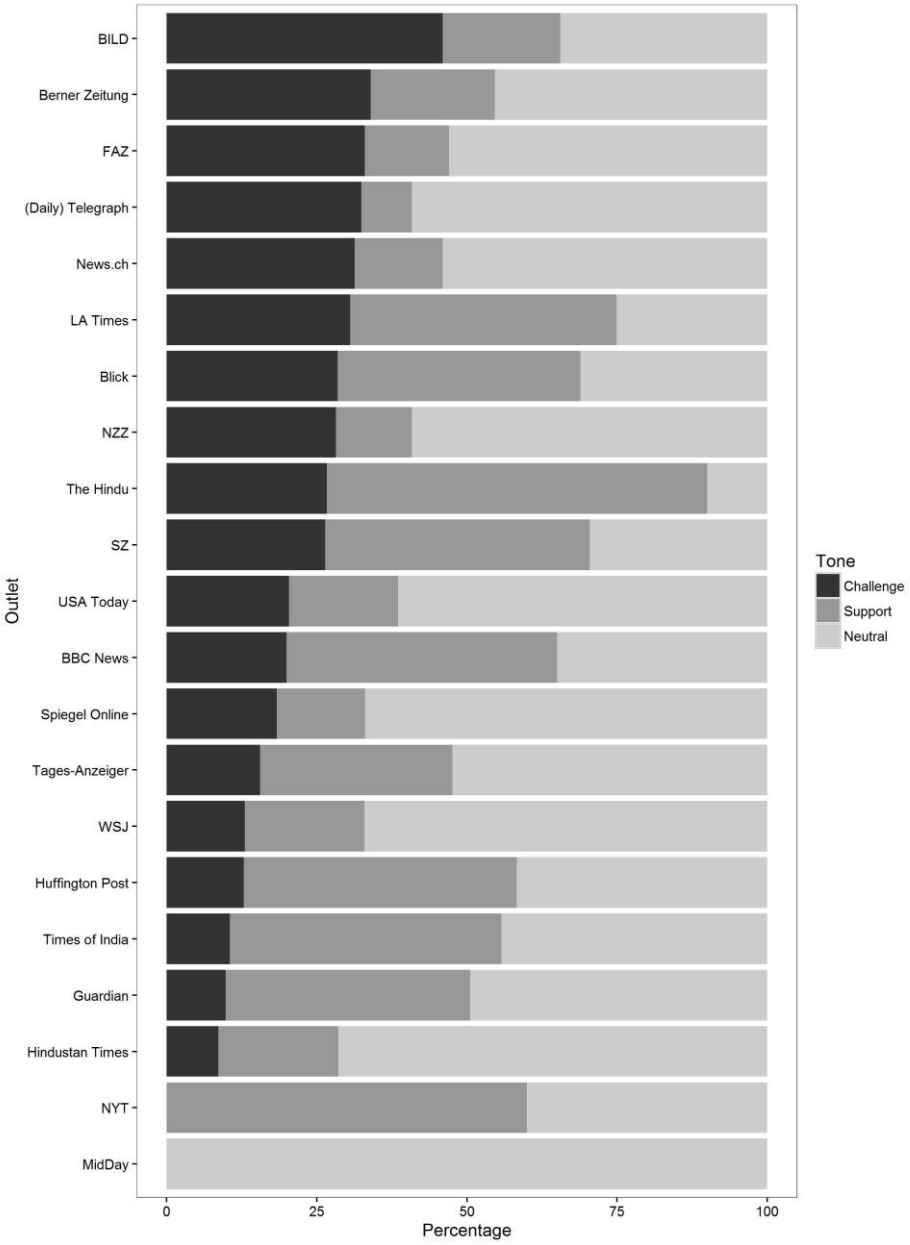
Walter, Stefanie; Brüggemann, Michael; Engesser, Sven (2017): Echo Chambers of Denial. Explaining User Comments on Climate Change. In *Environmental Communication: A Journal of Nature and Culture* 12 (2), pp. 204–217. Available online at https://dx.doi.org/10.1080/17524032.2017.1394893.

Figure 1 Challenging, supportve and neutral comments across countries (N=3,470)



Walter, Stefanie; Brüggemann, Michael; Engesser, Sven (2017): Echo Chambers of Denial. Explaining User Comments on Climate Change. In *Environmental Communication: A Journal of Nature and Culture* 12 (2), pp. 204–217. Available online at https://dx.doi.org/10.1080/17524032.2017.1394893.

Figure 2: Percentage of supportive and challenging comments by news outlet (N=3,470)



Walter, Stefanie; Brüggemann, Michael; Engesser, Sven (2017): Echo Chambers of Denial. Explaining User Comments on Climate Change. In *Environmental Communication: A Journal of Nature and Culture* 12 (2), pp. 204–217. Available online at https://dx.doi.org/10.1080/17524032.2017.1394893.

Appendix I

Media Sample

News Outlet	Country				
	Switzerland	Germany	India	UK	US
Upmarket newspaper	NZZ	FAZ	Hindustan Times	Daily Telegraph	WSJ
	Tages-Anzeiger	SZ	Indian Express	Guardian	NYT
Midmarket newspaper	Blick	BILD	MidDay[d]	(The Sun)	USA Today
Regional newspaper [a]	Berner Zeitung[c]	Berliner Zeitung	The Hindu	Manchester Evening News[c]	LA Times
Online player [b]	News.ch	Spiegel Online	Times of India[e]	BBC News	Huffington Post

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 offline parent news outlet; [c] Only one author could be identified; [d]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. Sampling time frame: 1.1.2011-1.8.2012. The sun is in brackets, as it was included in the original sample, but it had to be excluded from this study, as they did not allow for user comments.

Appendix II

Anova country level

	F	Sig.
Neutral comments	0.586	0.673
Supportive comments	6.914	0.000
Challenging comments	6.655	0.000

Appendix III

Regression with standardized independent variables

	Support		**Challenge**	
	Std. Coef.	SE	Std. Coef.	SE
US	4.74*	1.87	-3.69*	1.79
UK	3.46*	1.67	-3.12	1.87
Germany	-1.63	1.83	0.93	1.97
India	3.95*	2.00	-3.91*	1.57
Tabloid	-3.35*	1.43	2.86*	1.25
Conservative media	-9.24***	1.25	3.73**	1.20
Columnist	-3.75***	0.95	2.59	1.37
IPCC challenged	0.04	0.90	0.51	1.17
Constant	28.96***	1.17	20.05***	0.97
R2	0.21		0.13	
N	440		440	

Note: ∗p<.05, ∗∗p<.01, ∗∗∗p<.001, SE= robust standard errors.