Article

National prisms of a global phenomenon: A comparative study of press coverage of climate change in the US, UK and China

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Abstract

This study compares press coverage of climate change in the US, the UK and China from a longitudinal perspective, through a combination of computer-assisted quantitative linguistic analysis and critical discourse analysis. Specifically, we examine the extent to which these three countries portray climate change similarly or differently, and further explore how moral reasoning – a growing area of research in climate change communication – may shape media portrayal of the issue across different cultures. There have been few scholarly inquiries examining how moral reasoning is deployed in media discourse around climate change. This study aims to address this gap with a comparative analysis of moral reasoning in news about climate change in leading national newspapers from three countries over a 6-year period. The findings suggest that while US and UK newspapers tended to frame climate change coverage as a domestic issue, Chinese media tended to frame it as a global issue that the world community needs to tackle. Moreover, US and UK newspapers often adopted the balanced reporting norm in communicating uncertainty and controversy, in contrast to the climate consensus

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that was firmly embedded in Chinese media discourse. Overall, the findings show mixed support for East and West differences in the moral rhetoric underpinning their climate change press coverage.

Despite the strong scientific consensus that human activities are causing climate change, the issue remains divisive among the general public, prompting research into the role of media consumption in public acceptance and concern about the issue (e.g. Zhao et al., 2016). Previous studies have found that the amount of media coverage of climate change predicts public opinion (Carmichael et al., 2017), public concern (Carmichael and Brulle, 2017), and discussion of climate change on social media (Kirilenko et al., 2015). Media coverage has even been linked to the creation and introduction of legislative policies to address climate change (Dolšak and Houston, 2014). The news media continue to serve as one of the most important venues for discursive competitions between stakeholders seeking to frame and define environmental issues, and therefore, have a considerable capacity to influence the public agenda.

Combining computer-assisted quantitative linguistic analysis and critical discourse analysis, the present study compares press coverage of climate change in the US, the UK and China from a longitudinal perspective. In so doing, this study examines the extent to which these three countries portray climate change similarly or differently, and further explores how moral reasoning – a growing area of research in climate change communication (e.g. Adger et al., 2017; Markowitz and Shariff, 2012) – may shape media portrayal of climate change across different cultures. There have been few scholarly inquiries in environmental communication that specifically examine how moral reasoning is deployed in media discourse around climate change. This study aims to address this gap with a comparative analysis of moral reasoning in climate-change-related news coverage, using leading national newspapers from three countries over a 6-year period.

Alongside its material impacts, climate change is also a cultural phenomenon, whereby perceptions of, and actions in response to, climate change are understood in relation to broader social, political and cultural contexts (Nash et al., 2019; Pearson, Schuldt and Romero-Canyas, 2016). The aim of this study is to identify and interpret discursive constructions of climate change issues in news media across different national contexts. The way that climate change is discursively constructed in media coverage not only relates to how citizens are informed about climate science but also contributes to ideological cultures and associated forms of subjectivity, patterns of affect and practices of (dis)engagement (Carvalho, 2010).

Climate change reporting in the US, UK, and China

As a global phenomenon, it is important to examine the dynamics of media coverage of climate change cross-nationally. As leading political powers as well as leading emitters of greenhouse gases that contribute to climate change, the United States, United Kingdom and

China have distinct socio-political systems, environmental traits, cultural repertoires and journalistic norms. For instance, the journalistic norm of balance – through which news sources strive to represent opposing voices and perspectives in a dispute, reflecting the value of objectivity that prevails in democratic media systems (e.g. the US and UK) (Boykoff and Boykoff, 2004; Entman, 1990) – contrasts markedly with the Chinese media system, which is under the scrutiny of the party-state to maintain ideological and political unity (Duan and Takahashi, 2017). Existing studies on climate change have identified substantial variation in media coverage of climate issues across the national boundaries because a country's political system, economic development and environmental conditions influence a country's journalistic norms and the content of media coverage (e.g. Vu et al., 2019).

Many studies have compared how the scope and content of media coverage of climate change vary across different countries, particularly between the US and the UK. For instance, a corpus analysis of the UK and US media over the period from 1980 to 2007 showed that the US media used the term 'global warming' more frequently, whereas the UK press tended to emphasise 'climate change' (Grundmann and Krishnamurthy, 2010). The UK press also placed greater emphasis on the international aspects of the issue, whereas US media tended to focus on domestic aspects. Studies have also reported that UK media coverage includes more voices from environmental non-governmental organisations and interest groups, whereas US media tend to feature the voices of individual advocates (Grundmann and Scott, 2014).

Meanwhile, skeptical voices are represented in media coverage in both countries, albeit to varying degrees. Both the UK and the US have a strong commitment to economic growth, which can result in the exploitation of natural resources; yet, the disagreement over environmental protection versus economic growth is more visible in the US (Grundmann and Scott, 2014). A content analysis of the US prestige-press newspapers (Boykoff and Boykoff, 2004) revealed that despite the scientific consensus that human actions are causing climate change, the majority of press coverage offered a balance of opposing viewpoints – which, because it implies more scientific uncertainty than actually exists, has been characterised as 'false balance' with the potential to bias public perceptions of the issue (Koehler, 2016). Likewise, newspapers in the UK have also adopted a balanced approach. This balanced coverage in both countries has moved towards an interpretive approach to contextualising contrarian voices (Brüggemann and Engesser, 2017).

In addition to how climate change is represented in media coverage across countries, the amount of media coverage across countries is important to consider, as it relates to issue salience and the agenda-setting function of media. Comparative studies on climate change find that climate issues have received increasing media attention since the mid-2000s in most developed and developing countries (Boykoff et al., 2020). The number of news articles across countries peaked around some of the most prominent international climate summits, including COP15 in Copenhagen (2009) and COP21 in Paris (2015), suggesting that climate-related societal activities are important drivers for issue attention (Schäfer et al., 2014). Furthermore, studies have identified cross-national similarities in sourcing patterns for climate information, with government officials as the most cited information source (Shehata and Hopmann, 2012).

Compared with developed countries, climate change received relatively less attention in developing countries (Schmidt et al., 2013). In addition, while Western industrialised

countries tended to emphasise national security and energy security in their climate change reporting, emerging economies paid more attention to food and water security (Schäfer et al., 2016). Although media in both developed and developing countries attributed more blame to developed countries than to developing countries for causing climate change, the pattern of in-group protection was present in their coverage of causal responsibility. Moreover, there is an increasing tendency for newspapers in both developed countries and emerging economies to attribute responsibility equally to their respective in- and out-groups (Post et al., 2019).

Also important is the matter of which countries are being compared. Although a number of studies have compared media coverage of climate change across countries, most have focused on comparing the European and US contexts. Chinese media, in contrast, have received much less scholarly attention, a notable omission given the rising prominence of China in international climate politics (e.g. Rauchfleisch and Schäfer, 2018). Among the few exceptions, Wu (2009) compared the media discourses on climate change between China and the US, Australia, European countries and Japan. Chinese media were found to show increasing reporting on China's role in the global battle against climate change. Likewise, through an analysis of five mainstream Chinese newspapers in the decade from 2005 to 2015, Han et al. (2017) found that Chinese party-sponsored newspapers tended to frame climate change from the perspective of global collective efforts. A qualitative analysis of climate change coverage in Chinese news outlets from 2006 to 2007 (Tolan, 2007) further revealed that most coverage of the issue in Chinese media was translated from international coverage and reports, and that it continued to reflect the central government's defense of its own policies. Finally, in a comparative study of US and Chinese newspaper coverage, Xie (2015) found that from 2005 to 2008, there was a decrease of skeptical voices quoted or mentioned in US newspapers towards climate change, while Chinese newspapers retained a relatively non-skeptical attitude.

Moral foundations and climate change: A cross-cultural perspective

Over the past decade, there has been increasing public and scholarly interest in the framing of messages about climate change (e.g. Bernauer and McGrath, 2016; Lakoff, 2010; Nisbet, 2009). One thread of this interest focuses on how different framing strategies map onto specific moral foundations, and how individuals' moral sensibilities may shape the effectiveness of these moral messages (Markowitz and Shariff, 2012). Much of this work draws from Moral Foundations Theory (Haidt and Joseph, 2004). Moral Foundations Theory posits the existence of five basic intuitions which underlie human morality: care/harm (caring for others and the avoidance of inflicting harm), fairness/cheating (concerns about equality and the avoidance of cheating others), loyalty/betrayal (obligations to one's in-group and the avoidance of betrayal), authority/subversion (respect for social order and the protection from subversion) and purity/degradation (concerns about preserving purity and the protection from contamination). Each foundation has two poles (i.e. moral sentiments) whereby one pole is a virtue (i.e. a prescriptive moral concern) and the other is a vice (i.e. a prohibitive moral concern).

We argue that the framing of climate change in terms of these moral foundations is common in media coverage of climate change, but this practice may vary across nations

as a function of country-specific norms and practices. Journalists have long been expected to look to institutional norms and ethical codes for moral guidance. Journalists' own moral judgments may also affect the way they select and present the news (Quinn, 2007). In the context of climate change communication, there has been a growing interest in framing the issue in moral terms. The often-adopted moral frames in climate change communication revolve around the foundations of harm (e.g. disastrous effects on present and future generations) and unfairness (e.g. the uneven distribution of environmental benefits and burdens) (Markowitz and Shariff, 2012). Content analyses of newspapers (Feinberg and Willer, 2013) find that harm and care are the two major moral themes stressed in contemporary US environmental discourse, and that they resonate more with liberals than with conservatives. These findings were echoed by Fulgoni et al. (2016) large-scale analysis of news articles from partisan sources, in which liberal sources resorted to the harm foundation most often, whereas conservative sources tended to frame climate change issues in terms of the loyalty foundation. In addition, an analysis of the rhetorical strategy in Pope Francis's papal encyclical (Landrum et al., 2016) found that while the foundations of sanctity, authority and loyalty (e.g. follow the examples of religious leaders who protect the purity of natural environment) had been often ignored in previous environmental appeals, these were more effective in swaying the beliefs of climate change skeptics than were frames appealing to care and fairness (e.g. every individual has a responsibility to contribute to environmental protection for the health of others). In this vein, a survey experiment conducted with a representative sample of US adults found that exposure to Pope Francis's message framing climate change in moral terms increased agreement that climate change is a 'moral or ethical issue' – an effect that was larger among Republicans than Democrats (Schuldt et al., 2017).

Researchers have further classified the five moral foundations into two categories, namely, the binding foundations (i.e. loyalty/betrayal, authority/subversion and purity/degradation), and the individualising foundations (i.e. care/harm and fairness/cheating) (e.g. Napier and Luguri, 2013). Whereas the individualising foundations emphasise protection of individual rights and autonomy, the binding foundations emphasise a collective-oriented view of moral values. For example, the loyalty/betrayal foundation encompasses compliance with one's obligations to his/her in-group. The authority/subversion foundation entails obedience and deference in a hierarchy of social relationships (Haidt et al., 2009).

Existing empirical evidence shows that although individuals from different cultures may share the same moral foundations, the relative importance of different moral dimensions varies across cultures, such that individualising and binding foundations were differentially endorsed in Western and Eastern cultures, respectively (Graham et al., 2011). Multiple studies have found that in comparison to Westerners, participants from group-focused Eastern cultures endorsed more binding moralities, as reflected in their preference for in-group loyalty, purity and authority (Hu et al., 2013). In contrast, Westerners tend to focus more on those individualising moralities as influenced by their individualist cultural norms. For instance, among all the moral dimensions, they tend to associate immorality with harm (Buchtel et al., 2015) and highly value the fairness dimension of moral foundations. Cultures may also vary in the degree to which communicators moralise climate change in terms of different foundations, and in the degree to which their members are receptive to different moral foundations (Woods et al., 2018). Specifically,

Table 1. The news corpus (2013–2018).

News corpus	No. of articles	No. of words
UK	19,896	23,351,680
US	16,281	17,462,670
China	4537	3,451,371
Total	40,714	39,428,897

Woods et al. (2018) analysis of online comments to newspaper articles about anthropogenic climate change suggested that differential moral engagement and disengagement by media of different ideological slants also extended to their audience.

While extensive work has explored cultural differences in cognition (e.g. Nisbett and Norenzayan, 2001) and communication styles (Yuan et al., 2019) between the East and the West, there has been a paucity of research that compares the US and other Western countries. Instead, most work has focused on one single cultural context at a time, such as Germany (Bowman, 2010) or Sweden (Nilsson and Erlandsson, 2015). Their findings suggested that the five-factor model of moral foundations are applicable to their local contexts. Given the lack of research that compares morality dimensions of climate change between Western countries, as well as limited research that investigates people's attitude towards climate change from the perspective of morality, the present study focuses on the following research questions:

RQ1. How do the news media in the US, UK and China discursively define the problem of climate change?
RQ2. To that extent does the range of perspectives or viewpoints presented to establish particular definitions of climate change differ in three countries' news coverage?
RQ3. To what extent do the news media in the US, UK and China place similar or different emphases on the individualising (i.e. care and loyalty) and bonding (authority, fairness and purity) moral foundations in justifying their climate change stance?

Methods

To address these research questions, we compiled a 39.4 million-word corpus of news texts retrieved from LexisNexis. All of the news texts contain at least one of the two search phrases *climate change* or *global warming* published in six major newspapers between 1 January 2013 and 31 December 2018 (see Table 1). The six newspapers included in the analysis are *The Times* and *The Guardian* from the United Kingdom (hereafter referred to as UK corpus), *The Washington Post* (WP) and *New York Times* (NYT) from the United States (US corpus) and *China Daily* (CD) and *Global Times* (GT) from China (China corpus).

In selecting the six newspapers, we considered the following inclusion criteria. First, these newspapers all have high national circulation. Importantly, each of these newspapers has a strong online presence, providing an even wider distribution of their news content. Second, the selected newspapers are perceived as prestige press that set the agenda for both decision-makers and other news media within their respective countries.

The news content of *The Times, The Guardian*, NYT and WP is routinely tracked by politicians for policy-making, as they are considered to offer a valuable window into public opinion (e.g. Shirk, 2007; Song et al., 2019). The two English-language Chinese newspapers are both run by the state and primarily serve the interests of the Central Government. Furthermore, these newspapers define what is newsworthy and have an impact on the topic selection of other news outlets (e.g. Luther and Zhou, 2005; Song and Lee, 2019).

With the six newspapers selected, we first conducted a keyword analysis to examine the main discursive themes of all news texts, which are core to address RQ1. Corpus linguistics techniques were employed to identify keywords of the six newspapers, using the corpus analysis software Sketch Engine (Kilgarriff et al., 2014). Keywords are words that occur in a target corpus with significantly higher frequency than a reference corpus, and thereby can indicate the linguistic preferences of that target corpus in the representation of the topic under investigation (Baker et al., 2013). The British National Corpus (BNC) was used in this study as a reference corpus to generate three keyword lists. We compared the top 100 keywords in the Chinese, the UK and the US news data, an often-used threshold value for the selection of keywords (e.g. Jaworska and Kinloch, 2018). These keywords were then sorted into different semantic categories, using the corpus analysis software Wmatrix (Rayson, 2008).

Second, we employed the discourse historical approach (DHA) to critical discourse analysis (Reisigl and Wodak, 2009) when analysing collocates and their concordance lines. The corpus analytical tool WordSmith (Scott, 2012) was used. Specifically, the analysis focused on the words that co-occur with *climate change* or *global warming* within a range of five words before and after these two phrases. Next, frequencies and MI (mutual information) scores were used as the criteria to filter the collocates. MI scores indicate the degree of relationship between collocates and the two search phrases in each corpus. The top frequent collocates with a frequency of at least 5 and a MI score of above 12 were chosen for analysis (Brezina, 2018).

The DHA is a multidisciplinary approach that seeks to 'integrate as many as of the genres of discourse referring to a particular issue as possible, as well as the historical dimension of that issue' (Van Leeuwen and Wodak, 1999: 91). Three interrelated dimensions are central to the analysis of the discourse: (1) the specific content or topic of discourse; (2) the discursive strategies employed and (3) the linguistic realisations of these contents and strategies. Using the DHA to analyse collocates and their concordance lines, we sought to examine the rhetorical, pragmatic and argumentative features of the discursive construction of climate issues in the three countries' newspapers. Specifically, the analysis targeted four discursive strategies comprising *nomination, predication, perspectivation* and *argumentation* (see Table 2).

The analysis of *nomination* and *predication* seeks to answer RQ1 by respectively delineating the discursive identification of climate issues and discursive qualification of the actors, objects and actions involved. *Perspectivation* analyses the writers' positioning of different viewpoints in description or quotation of events and utterances (Wodak, 2001). The analysis of *perspectivation* seeks to compare the range of perspectives presented to establish particular definitions of climate issues among three countries (RQ2). *Argumentation* examines the means by which particular positions are legitimised through distilling the moral topoi employed (RQ 3). Within argumentation theory, the concept of

Table 2. Discursive strategies in discourse historical approach (adapted from Reisigl and Wodak, 2009).

Discursive strategy	Purpose	Questions to discursive features	Language indicators
Nomination	Discursive construction of objects, phenomena, processes and actions	How are *climate change* and *global warming* referred to linguistically?	Verb + noun
Predication	Discursive qualification of objects, phenomena, processes and actions	What characteristics or qualities are attributed to *climate change* and *global warming* in the discourse?	Adjectives and nouns
Perspectivation	Positioning the speaker's or writer's point of view and expressing involvement or distance	From what perspective or viewpoint are these labels, attributions and arguments expressed?	Reporting verbs noun phrases
Argumentation	Persuading addressees of the validity of specific claims of truth and normative rightness	By which arguments and argumentation schemes (e.g. topoi) does the medium under investigation try to justify and legitimise its attitude towards *climate change* and *global warming*?	Keywords of moral foundations based on Moral Foundation Theory (MFT)

'topos' (plural topoi) refers to 'content-related warrants or conclusion rules which connect the premises with the claims' (Wodak, 2001: 75).

Finally, the moral foundations dictionary (MFD; Graham et al., 2012) was used to compare how the three countries' newspapers placed similar or different emphases on five moral topoi (i.e. care, loyalty, authority, fairness and purity) in justification of their stance on climate change. The MFD contains word stems pertaining to the five moral foundations, and further divides them into virtue and vice word lists to indicate moral adherences versus breaches (see Table 3). We identified the collocates that contain the moral foundation words, and compared their relative frequency among the China, UK and US corpora. The collocates with significantly high frequencies in each moral foundation category were analysed qualitatively through a close examination of the concordance lines and their actual use in the news texts.

Results

To begin, we observed that overall, *climate change* was much more frequently used than *global warming* throughout the 6-year period that we analysed (see Figure 1). References to *climate change* accounted for over 80% of the total coverage by the US and the UK press, and around 90% in the two Chinese newspapers. Moreover, references to *global*

Table 3. Five-factor classification of morality (adapted from Hoover et al., 2020: 8).

Factors	Poles	Definitions
The care foundation	Care Harm	Prescriptive concerns related to caring for others and prohibitive concerns related to not harming others
The fairness foundation	Fairness Cheating	Prescriptive concerns related to fairness and equality and prohibitive concerns related to not cheating or exploiting others
The loyalty foundation	Loyalty Betrayal	Prescriptive concerns related to prioritising one's ingroup and prohibitive concerns related to not betraying or abandoning one's ingroup.
The authority foundation	Authority Subversion	Prescriptive concerns related to submitting to authority and tradition and prohibitive concerns related to not subverting authority or tradition.
The purity foundation	Purity Degradation	Prescriptive concerns related to maintaining the purity of sacred entities, such as the body or a relic, and prohibitive concerns focused on the contamination of such entities.
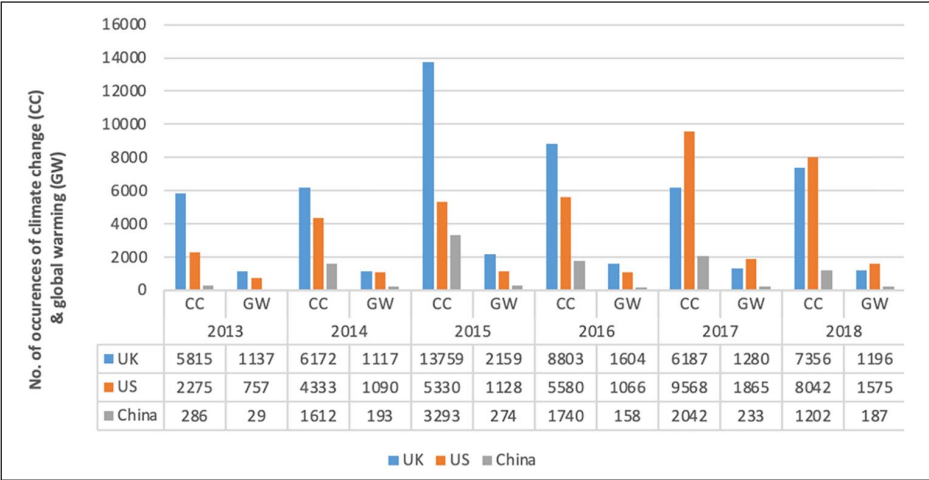
Figure 1. Frequencies of *climate change* and *global warming* in the UK, US and China corpus, 2013–2018.

warming in the US newspapers witnessed a noticeable decline from 25% in 2013 to 16.4% in 2018, whereas the China and UK data did not show such a decline. The year 2015, in both the UK and in China, witnessed the highest frequency of *climate change* and *global warming* coverage. This peak is likely due, in part, to extensive coverage of the Paris Climate Change Conference 2015, and to related coverage of climate policies and climate-related disasters. Also notable is that the frequencies of *climate change* and *global warming* in the US press doubled in 2017, a dramatic change that appeared to reflect Donald Trump's decision to withdraw from the international climate deal. In this

way, the frequencies of the two searched phrases appear to reflect the impact of key political events on press coverage of climate issues.

Keyword analysis

In terms of the top 100 keywords among three countries' news texts, the US newspapers shared more similarities with the British newspapers than with the Chinese newspapers (see Table 4). The Anglo-American corpus showed notable differences from the China corpus in five semantic categories: (1) environment and weather, (2) materials and resources, (3) politics and public domain, (4) communication and (5) science and technology.

The UK and US newspapers often referred to specific types of weather and natural disasters, such as *hurricane, storm* and *floods*, while these items were absent in the keyword list of the China corpus. Concrete words related to 'resources' (e.g. *oil, gas, coal, pipeline, fuel, greens, fossil* and *electricity*) were also highly visible in the Anglo-American newspapers. Keywords in the other three semantic categories 'politics and public domain' (e.g. *MPs, Republicans* and *vote*), 'communication' (e.g. *debate, denial* and *opinion*) and 'science and technology' (e.g. *science, scientists* and *research*) suggested that climate issues had sparked tremendous controversy among the *public* and within the government in the UK and the US. They were openly discussed and *debated* by *officials* from different political parties. Supporting and/or opposing climate policies could greatly influence *voters*' decisions in presidential *campaigns* and congressional or parliamentary *elections*. Climate change had become a prominent issue on UK's *election* agenda when *voters* ranked it as their top concern. Likewise, it was 'a subject of intense *debate* among climate *scientists* roughly for a decade' (NYT) and had long been 'a polarising topic' in the US (WP).

In the two Chinese newspapers, there was an absence of campaign- or dispute-related words in the keyword list. Instead, they showed a relative consensus on human-caused global warming in China. The more salient semantic categories in the Chinese press were (1) abstract ideas, (2) relations and (3) psychological actions. The top two keywords in the China corpus were *cooperation* and *development*. The Chinese government had placed great emphasis on regional and cross-national cooperation, and the development of relationship and partnership with different parties and countries. Such an emphasis was also closely tied with China's economic policies, such as its 'going global' strategies (e.g. *Silk Road, Belt* and *Road Initiative* and *BRICS*). Among the 174 occurrences of *cooperation* on climate change, the Chinese press frequently mentioned South-South cooperation scheme, international cooperation and China's bilateral cooperation with the US, EU, African and Caribbean countries.

Region-related keywords in the US press were largely domestic within the country (e.g. *US, California, Florida* or *Virginia*) except for the keywords of *China* and *Arctic*. Compared with the US press, the UK newspapers reported climate issues from a more international perspective: A wide range of foreign region-related keywords (e.g. *EU, Australia, China, US* and *Arctic*) appeared in the UK corpus. For example, the UK newspapers covered extensively Australia's climate policy and such environmental issues as the damages of coral species in the Great Barrier Reef. The frequency of *UN* (5959) in the UK newspapers was also much higher than that in the US newspapers (464).

Table 4. Keywords in the three countries' newspapers.

Semantic category	UK press	US press	China press
A: Abstract terms	–	–	Development, globalisation, reform
S: Social action/ Relationship	Coalition		Cooperation, relations, bilateral, multilateral(ism), promote, ties, partnership, visit, exchanges, joint, mutual
O: Materials/ Resources	Energy, emission(s), carbon, gas, coal, fossil, solar power, fuel*, electricity, oil, greenhouse, wind, water, nuclear, ice	Energy, emission, carbon, coal, gas, greenhouse, fossil, oil, fuel*, solar, dioxide, nuclear, pipeline, water, ice, electricity, plant(s)	Energy, carbon, emission, nuclear, solar
W: Environment/ Weather	Environment, pollution, temperature, reef, flood*, drought, wildfire	Environmental, planet, wildfire, hurricane, pollution, natural, storm	Environmental, pollution
G: Politics/Public domain	Government, MP(s), policy*, campaign*, industry, labour, election, politics*, vote*, public, federal	President*, Republican(s), federal, administration, official(s), Democrat*, campaign, congress, senator*, vote*, policy, politics*, election, industry, governor	Countries, international, world, infrastructure, governance, government, nations, premier
Y: Science/ Technology	Scientists, science, research, evidence, fracking, renewable, sustainable*	Science, scientist(s), expert(s), research, renewable	Sustainable*, technology*, innovation, renewable
Q: Communication	Debate, denial	Debate, opinion(s)	Agenda, talks, dialog, forum, summit
M: Places/Location	Britain, US, Australia, China, Arctic Africa	US, China, California, Arctic, Virginia, Florida	US, Asia(n), Beijing, international, Africa, regional
Z: Proper names	Trump, Obama, UN, EU, G20, Turnbull, Clinton, Cameron, Exxon	Trump, Obama, Clinton, Pruitt, Sanders, Exxon	Xi, Jinping, UN, G20, Belt, Silk, Road, Initiative, BRICS, ASEAN
X: Psychological actions/States	Target*, impact*, issue*, risk*	Issue*	Issue*, challenge*, security, efforts, strategic
I: Money/Commerce	Company*, economy, investment, deal	Trade, billion*, bill(s), company*	Trade, investment, economy*, market, financial

'*' refers to all grammatical forms of the keywords. For example, "vote" includes votes, voting and voted.

Collocation analysis

Nomination. The nomination of climate issues was analysed through comparing the patterns of verb and noun phrases collocating with *climate change/global warming*. All three countries unanimously constructed the climate issue as an environmental problem. Verbs like *fight, cope, deal, tackle, combat, mitigate, address, curb, counter* or *control* frequently collocated with the two search phrases in all three countries' newspapers. Environmental change was framed as a 'disaster' and a 'war' or a 'battle' to fight for.

As an environmental 'disaster', climate change was linked to political and scientific issues in the UK and US newspapers. The collocates *countries, policy, conference, PICC, company* and *campaign* suggested the linkage across climate and political issues, and whereas the collocates *carbon emissions, greenhouse, causes, effects, consequences* and *impact* suggested the linkage across science and climate issues. The UK and US news media frequently linked climate change debates to scientific and political issues, intertwined with conflicts among scientists, political parties, policy makers and big businesses. In contrast, Chinese newspapers reported climate issues with a firm and unanimous voice: Climate change was happening and all stakeholders across political and scientific sectors should work hand-in-hand to tackle this environmental 'disaster'.

Predication. The analysis of the predication strategy focused on the use of adjective and noun collocates that indicated the evaluative attributes of climate issues. Although the three countries' press unanimously framed climate change as a disaster to all human societies, it remained a controversy in the UK and US press regarding whether such a disaster is natural or 'human-caused'. The collocate '*human*' had higher occurrences in the UK and US corpus than in the Chinese corpus, which was associated with the heated debates around whether human activities are the main cause.

The collocate '*hoax*' occurred much more frequently in the US press than the other countries' newspapers. The US President Donald Trump mocked the science of climate change as a *Chinese hoax* in 2016. Prior to 2016, the top 10 collocates of hoax in 2013–2015 was *greatest, perpetrated, American, conspiracy, Republicans* and *liberals* in the two US newspapers. The collocate *greatest* referred to the 2012 book *The Greatest Hoax: How the Global Warming Conspiracy Threatens Your Future*, authored by a former Senator Jim Inhofe. A series of studies published in 2013 by Stephan Lewandowsky and his colleagues also drew extensive media coverage. The two collocates '*Republican(s)*' and '*Liberal*' indicated that the climate issue was contentiously debated by the two main parties in the US. Those who denied the existence of climate change were more likely to be Republicans than Democrats.

In the UK press, two adjectives *dangerous* and *catastrophic* on the top collocate list were notable. The UK press foregrounded the danger of climate change and highlighted its threat and consequences that could exert on the earth and humans. It also strongly called for prevention, as can be observed from the action verb collocates, for example, *avoid, prevent, avert* and *stop* proceed *dangerous/catastrophic climate change*. Despite the strong voice calling for climate policies, the validity of scientific research findings was also frequently questioned by climate *skeptics*.

Table 5. Sourcing patterns in UK, US and China press.

	Scientific sources (%)	Official sources (%)	Media sources (%)	Corporate sources (%)
UK	24.8	47.4	3.2	24.6
US	54.7	27.4	3.6	3.5
China	17.2	26.6	54.2	2.0

In contrast, the two Chinese newspapers rarely questioned the validity of scientific research on climate change. Rather, the Chinese press covered climate change and global warming as a proven scientific fact. There were hardly any skeptical views or disputes over climate change on the political, public and scientific agendas. One uniform voice was persistently present in the two Chinese newspapers: 'China is a strong believer in climate change. It cast no doubt or suspicion about climate change or global warming' (CD).

Perspectivation. For perspectivation strategies, we analysed the top three reporting verbs – *say**, *report** and *tell**[1] – in the collocate lists, which were indicative of direct or indirect quotations of certain actors or agents as the sources. In the two UK newspapers, 47.4% of the collocates of the three reporting verbs pointed towards official sources (see Table 5), 24.8% were academic sources and 24.6% were corporate sources. Media sources only accounted for 3.1%. Among the official sources, the two UK newspapers made frequent references not only to British domestic sources, but also to other foreign sources such as *IPCC, Trump and Australia*. The UK press also quoted sources from companies and NGOs like Greenpeace and WWF (The World Wild Fund for Nation).

Different from the UK press, the two US newspapers mainly quoted sources from experts and science reports (54.7%). Only 27.4% of the agents that preceded the reporting verbs were official sources, and around 3.5% were respectively from corporate and media sources. Also, the US newspapers largely quoted domestic sources, and foreign sources were rarely used.

The two Chinese newspapers showed stark contrast with the US and UK press in sourcing patterns. 54.2% of the sources quoted were news media, such as *Xinhua news agency*, the official mouthpieces *China Daily* and *People's Daily* and other local daily newspapers like *Beijing Daily* and *Southern Metropolis Daily*. Foreign news outlets – such as Reuters and *Guardian* – were also frequently used.

Argumentation. This analysis examined the moral topoi that underlie the news media's stance on climate change, and whether the three countries' newspapers placed varying emphases on individualising (i.e. fairness and care) and binding (i.e. loyalty, authority and purity) moral topoi. The China corpus had a much larger number of collocates related to loyalty (97.08) and authority (92.98) foundations compared with those in the UK corpus (loyalty=44.39; authority=49.32) and the US (loyalty=44.38; authority=73.16) (see Table 6). The China corpus also used more collocates related to the care foundation (144.10) than the UK (107.29) and the US corpus (118.36). In contrast, the UK corpus (21.28) and US corpus (21.03) had higher frequency of fairness-related collocates than the China corpus (10.40). The purity foundation showed the least difference as it had the smallest divergence (SD=1.53) among the three countries.

Table 6. Relative frequencies (per 1000 words) of the collocates containing the Moral Foundation words.

MFD	China	UK	US	Average	S.D.
Loyalty	97.08	44.39	44.38	61.95	30.42
Loyalty-vice	0.00	0.49	0.23	0.24	0.25
Loyalty-virtue	97.08	43.90	44.15	61.71	30.63
Authority	92.98	49.32	73.16	71.82	21.86
Authority-vice	0.53	2.10	2.02	1.55	0.88
Authority-virtue	92.45	47.22	71.14	70.27	22.63
Care	144.10	107.29	118.36	123.25	18.89
Care-vice	86.14	68.13	78.15	77.47	9.03
Care-virtue	57.96	39.16	40.20	45.78	10.57
Fairness	10.40	21.28	21.03	17.57	6.21
Fairness-vice	4.09	10.13	9.13	7.78	3.24
Fairness-virtue	6.31	11.15	11.90	9.79	3.03
Purity	24.98	24.46	22.11	23.85	1.53
Purity-vice	12.71	7.33	7.53	9.19	3.05
Purity-virtue	12.27	17.12	14.57	14.66	2.43

Moreover, the Chinese press used more virtue-related vocabulary and less vice-related words than the US and UK press. The number of collocates in the loyalty-virtue category in China corpus (97.08) was twice as much as that in the UK (43.9) and the US (44.28). The second largest difference was in the authority-virtue, which had 92.45 in the China corpus compared to the frequency of 47.22 in the UK and 73.82 in the US. Another noteworthy finding was that the UK and US corpora had relatively similar frequencies in each category among the five foundations compared with the China corpus. This suggested that the US and UK news media shared more common ground in reporting strategies on climate issues compared with the Chinese newspapers.

Topos of authority. The authority-virtue category was the most salient in the China corpus (97.08), and whereas the UK (0.49) and US (0.23) corpora used more authority-vice collocates. Collocates of *nations* and *leadership* were much more frequent in the China corpus than the UK and US. It emphasised the important role of *leadership* in tackling climate issues. The leadership collocates mostly referred to the Chinese president and presidents from the other leading countries, as can be seen from its top collocates such as *Chinese, Xi, Obama, Trump* and *French*. Another authority frequently covered in the China corpus is *The United Nations* and its climate conferences where the Chinese government called for a compliance to the UN policies on climate issues.

The collocates for *traditional* and *respect* were also more frequent in the China corpus. The principle of *no conflict, no confrontation, mutual respect* and *win-win cooperation* on climate issues were strongly advocated by the Chinese government. The word *traditional* referred to Chinese traditional culture and philosophy which emphasised the role of the Chinese press in advocating the moral obligations to fight climate change.

Excerpt 1

It seems that developed countries employ different standards when they respond to developing countries' requirements for tackling *climate change*. '**Traditional** Chinese culture teaches us that we should be strict with ourselves and lenient towards others'. (CD)

In contrast, authority-vice collocates *refuse* and *chaos* were more salient in the UK and US newspapers. The news media mostly targeted the governments' policies and criticised whether the administration fulfilled its social roles in handling climate issues. In the US corpus, the climate policies of both the Obama and Trump administrations were widely covered and criticised.

Excerpt 1

The Trump administration **refused** to join the other six nations in reaffirming a commitment to reducing greenhouse gas emissions through the Paris agreement. (NYT)

Topos of loyalty. Among the three countries, loyalty-related collocates (97.08) were most frequently used in the China corpus. The topos of loyalty revolves around the notions of forming coalitions with others and rejecting out-group members. The Chinese newspapers emphasised the coalition with other *countries* in combating climate change issues. *Countries* were encouraged to learn from and build on each other. Loyalty- and virtue-related collocates *pledged, collective* and *solidarity* suggested the strategy of allying with different stakeholders in combating climate change.

Excerpt 1

China and the EU have demonstrated **solidarity** on climate change. (CD)

Excerpt 2

One of the biggest achievements of the Paris talks has been the **collective** recognition that climate change represents an 'urgent and potentially irreversible threat to human societies and the planet' and so requires the widest possible cooperation by all countries. (CD)

In contrast, the top two loyalty-vice collocates, *enemy* and *rebellion*, in the Anglo-American newspapers indicated a lack of uniform voices, as well as an absence of solidarity among different stakeholders. The narratives of divided opinions and enemy were prevalent in the US and UK news discourse. The enemy metaphor was invoked by different stakeholders, such as climate campaigners, governments or companies, to refer to the opposing sides, accusing them for betraying the truth or the interests of the collective. For example, Guardian criticised 'enemy narrative' used by different stakeholders in dealing with the climate issues, for instance, the climate campaigners who sought to 'build an enemy narrative, bringing in oil companies, organised denial and governments' into the discourse. According to Guardian, 'the best chance for climate change to beat enemy narratives is to refuse to play this partisan game at all' (Guardian).

Topos of fairness. Both fairness-virtue and -vice collocates were more frequently used in the UK and US corpora than the Chinese corpus. The topos of fairness revolves around the notion of justice and rights. Collocates of *justice* and *rights* were used significantly more in the UK and US newspapers than in the Chinese newspapers, on both climate issues and other issues such as gay rights, human rights, animal rights, civil rights, voting rights and women's rights. Climate justice was also one of the major concerns in both UK and US media.

Excerpt 1

Climate **justice** is not just the recognition that climate change is a matter of human rights and development; it also involves recognising that the victims of global warming are not responsible for it, nor can their actions alone halt it. (Guardian)

Fairness-vice collocates of *misleading* and *fraud* had much more occurrences in the UK and US press. The Anglo-American newspapers widely criticised some stakeholders for prioritising their interests by misleading the public, violating the fairness principle. Keyword *misleading* collocated with *public, false, statements, claims, accused, information, inaccurate, science, Trump, Exxon Mobile, investors* and *company.* Both the US and UK newspapers pointed out that companies (e.g. *Exxon Mobile), politicians* (e.g. *Trump, conservatives, democrats*) and other organisations funded by fossil fuel dealers were the agents that were responsible for misleading information about climate science.

Topos of care. The frequencies of care-related collocates were the highest among the five moral foundations for all three countries, suggesting that in all three countries, the media framing of climate issues was primarily entrenched in the moral concerns of care. The topos of care revolves around the notions of compassion/indifference, and empathy/apathy.

Both care-virtue and -vice collocates had a higher overall frequency in the China corpus (144.10) than in the UK (107.28) and UK (118.35) corpora. Collocates of *fight, protection, help* and *share* were used much more frequently by the Chinese press. Fighting against climate change and protecting the environment in order to create common good to our society and communities was a recurring theme in the two Chinese press. The Chinese media emphasised the need to share a common goal in environmental protection by increasing the share of renewable energy and sustainable technology to improve disaster prevention system.

Excerpt 1

The official website of the Beijing Government at all levels should deliver policy interpretation, especially on issues of easing Beijing non-capital functions, deepening the reform, improving air quality, tackling climate change, modern city management and **protection** of people's livelihood. (CD, 2015)

Conversely, the US and UK press tended to cover the negative impact and consequences that climate issues had on the natural environment. *Threat* and *harm* were used more frequently in the UK and US press than in the China corpus. They called for a need to minimise harm on the environment, other species and our livelihood.

Excerpt 1

Climate change is becoming a **threat** to production as local grapes are not suited to higher temperatures. (Times)

Topos of purity. The overall frequency of the collocates in the purity foundation showed no significant difference among the three countries. The purity foundation underlies some of the moral pillars of environmental activism which hold that pollution arising from industrialisation are deserving of blame. The top collocates *diseases, degradation, epidemics, pandemics* were significantly more frequent in the China corpus than in the UK and US corpora. The co-occurrence of infectious *diseases, epidemics* and *pandemics* with climate change suggested that the Chinese media sought to alert the readers to the danger of environmental *degradation.* They repeatedly warned that the failure to protect our living environments would lead to a series of disease-related disasters to humans and the other species.

Excerpt 1

Additionally, new and emerging threats such as climate change and **diseases** mean that we cannot be complacent and it is possible new approaches towards panda conservation work will need to be adopted in the future to mitigate these threats. (CD, 2017)

The collocates of *pope* and *religious* were more frequent in the purity-virtue category in the UK and US corpora than in the Chinese corpus. The topos of purity is rooted in the religious notions of living in more elevated ways and staying away from contaminants. *Religious* institutions exerted considerable influence on climate issues. *Pope* Francis's stand and comment on climate issues attracted the Anglo-American news media's attention. Another noteworthy collocate '*church*' was used significantly more in the UK corpora, which referred to the Church of England, an authority that played an influential role in shaping climate policies. The high frequency of these words indicated that the US and UK shared common ground in how religious beliefs influence climate issues.

Discussion and conclusion

Given the international nature of climate change as a global phenomenon, scholars have called for more studies that examine media coverage of climate change from a cross-national perspective (e.g. Brossard et al., 2004). We answer the call in the present study by combining computer-assisted corpus linguistic analysis with critical discourse analysis to demonstrate ways in which mainstream newspapers of the US, UK and China contributed to the production of hegemonic meaning on climate issues in their respective context. The analysis revealed a number of insights. First, the findings suggested that the US and UK newspapers tended to frame climate change as a domestic issue, whereas Chinese media tended to frame it as a global issue that the world at large needs to tackle. Compared with the US press, the UK newspapers had a wider coverage on overseas countries and territories and attached more importance to the position of UN. This finding echoed findings from prior studies in that countries of higher GDP per capita are

more likely to frame climate change from the angles of domestic politics than of international relations (Vu et al., 2019). Moreover, as Washington retreated from the global battle against climate change when the Trump Administration withdraw from the Paris climate agreement, China sought to expand its influence on the development of clean energy economy across the globe. This has also permeated into their media stance on climate issues.

Second, the influence of cultural orientation on press use of moral topoi is mixed. On the one hand, the Chinese news corpus scored higher on the bonding foundations of loyalty and authority, while the Anglo-American corpora scored higher on the individualising foundation of fairness. On the other hand, the East-West difference in the bonding foundation of purity is almost negligible. Moreover, the China corpus scored even higher on the individualising foundation of care. Notably, all three countries' framings of climate issues in leading newspapers were primarily entrenched in the moral concerns of care. There was no clear distinction between Chinese and Anglo-American press in their emphasis on individualising or binding moral foundations underpinning their climate change stance.

Third, the findings showed that the Chinese media were more likely to adopt one-sided rhetoric than their Western counterparts in that both the US and UK newspapers more often adopted the balanced reporting norm to include a wider range of views on climate change. This might relate to the different journalism norms and media systems across these countries. Journalism in China is known for its practice of positive reporting, which is to highlight positive developments while downplaying negative events. Chinese media adhere closely to the Chinese government's guidelines to project one uniform voice in positioning China as the leader in the global battle against climate change.

In contrast, the Western media reflect more diverse viewpoints within the established policy contour. There are growing partisan divisions over climate change in both UK and the US. Liberals are much more concerned about global warming than the conservatives in the US. Likewise, Labour adherents in the UK are much more concerned about climate change than the Conservative supporters.

Results showed that in the UK and US news media, the coverage of climate change debates frequently witnessed the scientific and political issues intertwined with conflicts among scientists, political parties, policy makers and big business. In contrast, the two Chinese newspapers reported climate issues with a firm and unanimous voice. Moreover, the UK and US media more often adopted a balanced moral rhetoric, and substantive frames with a higher level of specificity. In contrast, the Chinese media were more likely to portray climate change as a relatively abstract rather than concrete issue. The Chinese press also used more 'virtue'-related moral vocabularies and less vice-related words than the US and UK press. The substantial variations in the media coverage of climate issues across the nations might relate to not only the political system, economic development and environmental traits at the macro level, but also the journalistic norms at the meso level. We should bear in mind, however, that journalistic norms of balance can sometimes mislead audiences by suggesting that the scientific consensus on climate change is weaker than it really is (Boykoff and Boykoff, 2004), which may lead audiences to underestimate the (strong) scientific consensus on climate change (e.g. Koehler, 2016).

   Our findings testify to the continuing relevance of the nation-state in environmental news and journalism, and the utility of cross-national studies of climate change media coverage. This study also demonstrates the analytical power of the comparative approach to the study of environmental news. The analysis of climate news using moral foundation theory allows us to study and compare the moral rhetoric underpinning climate change stance across different national contexts over time. It also helps establish a typology to discuss how the media echoes environmental issues and controversies. It should be noted that the dictionary-based word count approach to analysing moral topoi does not adequately take into account the semantic relations of the words. Future research should further extend into the words, both contextually and semantically. Communicative spaces should also be nurtured such that people across different national contexts can think and talk about their shared moral concerns, how they understand the science underlying the problem, and what they can do, individually or collectively, to address it. We hope that the study of news discourse can stimulate a deeper engagement with climate change.

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Note

1. The * symbol includes all grammatical forms of the word. For example, tell* includes tells, told, telling and tell.

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