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**Abstract**

*Climate change is the single most pressing existential threat facing humanity, and while the scientific consensus is unassailable, how this knowledge is communicated to and circulated by the public suggests that – in the minds of the public, at least – the science is not yet settled. While there are many reasons that might underpin this perception, given the role of newspapers as conveyors of information in the public interest, how information about climate change is articulated becomes a matter of importance in terms of leveraging changes in consumer behaviour and voter priorities. In this paper, using below-the-line comments of two British national daily online newspapers by readers responding to articles on climate change related topics over a period of six years, from 2014 to 2019 inclusive, as corpora, I explore how the matter of climate change is understood and articulated by applying linguistic analyses to generate profiles characterising the discourse of each corpus. This study lends broad support to earlier research by demonstrating that the readership of the politically right-leaning newspaper tends towards an ‘attack discourse’ and general scepticism, even hostility, towards the scientific consensus, while the readership of the politically left leaning paper evidence support for the consensus. The paper concludes by considering some of the implications of these findings for scientific communications about climate change.*

**Key words:** *Climate change discourse, corpus linguistics, discourse analysis, newspaper comments*

## **1. Introduction**

Climate change is one of the most contested topics in recent decades, and media representations of it are matters of global concern for the broadcasting of accurate information and for making policy and action decisions. Consequently, this is a topic attracting academic interest (e.g., Ahchong & Dodds, 2011; Shaw, 2013). Earlier studies suggest media representations of climate change fall between the factually accurate and the ideologically informed (e.g., Boykoff & Boykoff, 2007; Lockwood, 2008). The latter systematically casts doubt on validated evidence and sows disinformation about climate change (Elsasser & Dunlap, 2013; Sperber, 2003), and is a well-established strategy to thwart meaningful policy changes (Supran & Oreskes, 2017).

Studies have linked the readership of newspapers to different demographics and political positions, and political inclinations to particular

perspectives on climate change. For example, those on the right of the political spectrum were found to associate with discourses undermining anthropogenic responsibility for global warming (Jacques et al., 2008). Representations of climate change in online media legitimately attract academic attention (Boykoff, 2007, 2008; Carvalho & Burgess, 2005). Corporate media is a significant source and amplifier of the frames the public use to make sense of complex and contested issues (Bednarek & Caple, 2014), and the frames expressed through the content of above-the-line news articles have been well documented (Nerlich et al., 2011; Schäfer et al., 2014). However, to date, public discourse about climate change as expressed in comments below the online news article has attracted less attention.

With the advent of Web 2.0 and user-generated content, many online newspapers leveraged the tradition of 'letters to the editor' to become an opportunity for readers to leave their own comments 'below the line' (BTL) of the focus article (Wright et al., 2019). Readers of the content would help generate content and future revenue options. Arguably, many online publishers may also have seen this as an opportunity to promote the emergence of 'participatory journalism' (Borger et al., 2013) among their readerships. Of the relatively few studies that have focused on the content of BTL comments sections of online newspapers, it has been generally found that while the ideals of 'participatory journalism' may indeed be attained, overall BTL comments often reinforce prejudices among readers, and influence social norms in potentially negative ways (Hsueh et al., 2015).

Nevertheless, the BTL comments space offers a virtual discursive community within which commentators articulate their interpretation of and responses to focal articles and other readers' comments, and thereby participate in the generation and circulation of social norms and discourses (Graham & Wright, 2015). As a consequence, BTL comments offer key insights into how self-selecting members of the public understand and engage with the news and events of the day. While the comments sections may indeed offer engaged members of the public an open forum for the exchange of ideas and the promotion of informed debate, as was the case in the more traditional *letters to the editor*, BTL comments differ from this tradition insofar as they comment directly on the articles to which they are attached, and the content of the posts are typically casual. However, comments have also been characterised by their incivility and sarcasm, composing what has been dubbed an 'attack discourse' (Anderson & Huntington, 2017). One anticipates that with respect to contested and polarising topics such as climate change, an 'attack discourse' may be even more pronounced than one would find associated with less controversial topics. Indeed, this was confirmed by Jaspal et al. (2012) in their study of BTL comments in the *Daily Mail*, a UK daily, to articles related to climate change. Arguably then, this form of discourse has 'some way to go to match the optimism about the potential of such sites for open, deliberative, discursive exchange' (Richardson & Stanyer, 2011, p. 1001).

BTL comments are the textual articulations of the author's perspective, worldview and understanding around focal topics. Consequently, the comments section of popular online newspapers lends itself to be sampled as a textual microcosm of popular discourses. The present work contributes to the on-going discussion about public engagement with complex scientific and policy communications by presenting an analysis of two BTL corpora. These were sampled from the comments attached to climate change-related articles

published in two politically divergent non-tabloid UK newspapers for the period 2014 to 2019 inclusive. In the present study, the practices of ‘attack discourse’ as reproduced and maintained relative to climate change are examined, and the patterns of deployment BTL are highlighted. Insights obtained through this study are intended to help inform the production of counter-discourses that anticipate and respond to such ‘attacks’, thereby opening up space for engaging the public meaningfully in one of the most critical scientific communication challenges of our time.

The following section locates the present study within other studies into language and discourses in popular news, and discusses the paper’s aims. After the methods and materials are introduced, the study’s findings for each stage of the analysis are presented and discussed, and the paper concludes by reflecting on the implications for studying public discourses on climate change.

## **2. Climate Change and Popular Discourses Above and Below the Line**

News media are powerful organs for informing and shaping public information and for circulating dominant discourses and value frames (Bednarek & Caple, 2014). Press articulations of climate change discourse have already attracted analytic studies (e.g., Doulton & Brown, 2009; Fleming et al., 2014; Hobson & Niemeyer, 2012), and while the science of climate change is itself mostly settled with high consensus about causes and impetus (e.g., van der Linden et al., 2014), news media still insist on a ‘balanced’ reporting of climate change, conferring a fraudulent legitimacy to those with vested interests against evidence-based scientific representations (Russill & Nyssa, 2009).

Most discourse analytic studies of news media representations of climate change have focused on the articles above-the-line, while few have attended to the BTL comments sections as sources of public perceptions. Nevertheless, here too, language acts as a ‘semiotic code’, imposing ‘a structure of values, social and economic in origin, on whatever is represented’ (Fowler, 1991, p. 4), and thus warrants study. Some have already seen the potential. For example, Richardson and Stanyer (2011) studied patterns of argumentation and rhetoric deployed by readers interacting with online news media, and Brezina (2018) studied BTL comments at the *Guardian* and the *Daily Mail* and compared perceptions about East European immigrants. Indeed, Jaspal et al. (2012, p. 387) observe that readers’ comments ‘provide an ideal case study for the rhetorical aspects of social and political contestation’, and even ‘complements existing analyses of media representations of climate change [by examining] how media representations are taken up and transformed in the social domain (i.e., in layperson discourse)’.

While the BTL microcosm is still relatively untapped, two studies illustrate its significance in bringing public perceptions of key issues to light. These analysed the articulation of the so-called ‘climategate’ email hack in the UK popular press, using comments from the *Daily Mail* attached to news articles concerning the event. Jaspal et al. (2012) studied the impact of this event of public perceptions of climate change as expressed by *Daily Mail* readers, while Koteyko et al., (2013) developed this further by comparing perceptions before and after the event. Applying key word in context (KWIC) and

frequency analyses, both studies concluded that the event had had a negative impact on public perceptions of climate change and of the science particularly. Even though such well-publicised events are known to skew the focus both above- and below-the-line, despite being of limited temporal duration (Hamilton & Stampone, 2013), regular public articulation of climate change discourses BTL has received little attention to date.

To address this, the present study on BTL perceptions and constructions of climate change takes its lead from studies applying corpus linguistic methods to analyse discourses in the news media (e.g., Baker, 2006; Baker et al., 2008; Bednarek & Caple, 2014; Potts et al., 2015). In this paper, sampled comments on climate change-related articles from two British national online non-tabloid newspapers are the focal corpora, and there are two objectives. First, to generate insight into meanings and salience in public discussions about climate change. Here, I ask about how those who read and comment on news articles about climate change frame and make sense of such articles. This is realised by generating a unique profile for each corpus to facilitate an exploration of how climate change is represented. The second objective is to track the linguistic use of ‘climate change’ and ‘global warming’ concepts in BTL comments and the public discourses such use suggests. Here I explore whether there are differences between how these phrases inform receptivity to articles on climate change among the newspaper reading and commenting public. This is addressed by examining how concept use informs participation in public discourses on climate change. Together, these objectives support the aim of identifying attack discourse patterns and countering these to enhance scientific communications about climate change.

### **3. Methods and Materials**

As noted, this study pursues two objectives. First, I aim to develop insight into how members of the public who read and comment on either of the two sampled newspapers frames and make sense of above-the-line articles on climate change. To achieve this, I generated a list of keywords unique to each newspaper corpus, and then compared how the keywords for one corpus correlate to the second corpus in turn. This returned a general sense of each corpus, and the way that terms salient to one corpus were put to use in the second.

The second objective is to evaluate the responses from each readership to the two most commonly deployed phrases to denote the atmospheric greenhouse effect, i.e., ‘climate change’ and ‘global warming’, and therefore whether the receptivity of articles on this topic may be influenced by the choice of language used. Here, the analysis examined measures of association with each term for both newspaper corpora, supplemented by a detailed concordance examination of how these terms were used BTL.

Both objectives use the same corpora, which were compiled as follows. Data were collected from BTL comments from the *Guardian* and the *Daily Mail* for a six-year period of time from 2014 to 2019. According to the *Press Gazette*, in July 2019 the *Daily Mail* had the second largest circulation of all purchased British papers (1,164,319), second only to the *Sun* (1,265,990), while the *Guardian* has the 20<sup>th</sup> largest (or fifth lowest) circulation (130,484) of all British newspapers<sup>1</sup>. However, these papers broadly reflect the political right

and the political left views in the UK, respectively, and samples from both therefore increase a reasonable cross-section of public opinion (e.g., Brezina, 2018). The two papers selected here also represent the so-called ‘broadsheet’ newspapers, in contrast to the ‘tabloid’ papers, which tend to be characterised by sensationalist stories, and lack depth in their coverage of ‘harder’ news stories. *The Sun* is one such example of a tabloid. Methods and materials are discussed next.

The two corpora were compiled by using a bespoke Python script to extract public-facing BTL text-based comments on newspaper articles related to climate change. The size of the *Guardian* corpus is almost three times that of the *Daily Mail* corpus at 13,755,355 and 5,551,237 tokens respectively. The median number of unique words (i.e., types) differs, with the *Guardian* corpus at 33,243 and the *Daily Mail* corpus at 20,785. While sentences are longer in the *Guardian* corpus than in the *Daily Mail* corpus (47.52 to 31.83 characters respectively), the standardised type/token ratio (TTR) suggests a comparable lexical range (*Guardian* 46.59%, *Daily Mail* 46.06%).

Following the two objectives noted above, the analysis first generated a profile of the aboutness, or the unique character, of each corpus, consistent with Gabrielatos’ (2018) proposed exploratory ‘way into’ a corpus. By identifying the words that characterise a corpus, and which make it distinct from a comparable corpus, the ‘nature’ or what the corpus is about becomes more intelligible. This is akin to topic modelling in text mining. The *Words* tool in the #LancsBox ‘corpus toolbox’ (Brezina et al., 2020) was used to identify what makes each sample corpus unique, relative to each other. The list of terms unique to each corpus constituted that corpus’s keywords, and these were then examined for salience relative to the term ‘climate change’, given that these corpora were sampled from comments below the line of climate change-related news articles. Each term’s collocates were examined, to highlight the different meanings each term had by the words it attracted, and the strength of that attraction. To capture this range, measures of association (MI<sub>3</sub>, z-score) and dispersion (DP<sub>norm</sub>) were applied to derive the strongest and the most certain collocates, respectively, and those that were most evenly distributed across the span of the corpus. Due to space limitations, only the first five terms from each corpus were examined in detail.

The second objective of this study seeks to explore how the terms ‘climate change’ and ‘global warming’ are articulated and represented by the politically right- and left-leaning sectors of the population. Previous studies have demonstrated phrase selection (and use) reflects patterns of the user’s political association (e.g., Schuldt et al., 2011), and this is explored here, using the *Daily Mail* and the *Guardian* corpora as representing these political orientations respectively. Word searches were undertaken and the relative strength of association was again analysed using MI<sub>3</sub> (mutual information) and the z-score tests. Findings were then explored further using concordance analysis.

A randomised sample of 100 concordance lines was selected from sentences in which the phrase ‘climate change’ or ‘global warming’ occurs. These lines enabled a more detailed examination of how key phrases were situated with respect to sentence structure and the articulation of any meaning. Each sample, 400 in total (100 per phrase per corpus), was examined and allocated to one of four descriptions pertaining to whether the concordance line suggested the author’s position is one acceptance, uncertainty or outright

denial of the scientific consensus. Where no clear meaning was discerned, this was marked as ‘unclear’.

#### 4. Determining the ‘Aboutness’ of Each Corpus

As discussed previously, each corpus was compared to the second using the *Words* tool. Doing so generates lists of those terms which are statistically unique to each corpus relative to the other. Table 1 lists these unique terms for the *Guardian* corpus, and Table 2 lists the terms unique to the *Daily Mail*. Each list is sorted by descending relative frequency, and associated dispersion (*Disp*), using the measure  $Dp_{norm}$ . This step highlights the character of each corpus, providing insight into how above-the-line articles on climate change are framed and made sense of by their respective readership, and thereby contributes to attaining the first of the two objectives motivating this paper.

Collocation is a measure of association strength among words relative to a key term. By calculating patterns of associations among words, it provides insight into how terms of interest are used in language and how they acquire meaning. To capture different aspects of collocated terms, two measures of association were applied. The first, the mutual information cubed (MI<sup>3</sup>) measure, derives those terms that co-occur uniquely, even exclusively, and rarely. This is a strong association because it measures the amount of non-randomness present in a collocation, and is counter-balanced by a second measure less constrained by uniqueness of association, the *z-score*. This compares the probability that two terms collocate with the probability that the collocation is by chance alone. To avoid selecting terms that occur frequently, but with a limited distribution across the corpus, the normalised Deviation of Proportion ( $Dp_{norm}$ ) measure was used to correct for dispersion, giving a greater balance between term frequency and overall salience relative to the corpus (Gries, 2008). Values near zero suggest that the key frequency is directly proportional to the degree to which it is evenly distributed throughout the corpus (Brezina, 2018). The closer to zero, the more evenly distributed the term is. These steps give a pen sketch of each corpus, from which descriptions of the worldviews each represents can be offered. This provides a snapshot of the main concerns which characterise each corpus.

In Table 1, columns four and five show how frequently the terms which characterise the *Guardian corpus* also appear in the *Daily Mail* corpus. Because profanity is banned in the *Daily Mail* comments section, there is no mention of the term ‘shit’ under the *DM* columns of Table 1, and hence these appear as 0.00<sup>2</sup>.

Type	Freq 1 (G)	Disp 1 (G)	Freq 2 (DM)	Disp 2 (DM)	Statistics
guardian	3.70	0.12	0.23	0.12	3.83
consumption	3.33	0.14	0.48	0.06	2.93
economic	4.33	0.05	0.85	0.08	2.88
renewables	2.45	0.18	0.26	0.20	2.74
species	6.19	0.13	1.78	0.22	2.59
shit	1.54	0.07	0.00	0.00	2.54
fossil	9.07	0.13	3.04	0.14	2.49
growth	5.19	0.08	1.51	0.16	2.46

africa	1.60	0.09	0.08	0.46	2.40
action	4.22	0.14	1.21	0.15	2.36
nuclear	5.28	0.27	1.69	0.16	2.34
energy	12.73	0.12	4.89	0.16	2.33
emissions	8.99	0.06	3.43	0.04	2.25
capitalism	2.24	0.20	0.49	0.17	2.17
scale	2.64	0.08	0.69	0.12	2.15

**Table 1.** Keywords in the Guardian (G), with their correlates in the Daily Mail (DM) by statistics of relative frequency

In Table 2, the corresponding frequencies of terms unique (that is, key) to the Daily Mail are given, and the corresponding frequencies that these terms appear in the Guardian corpus are given in columns four and five.

Type	Freq 1 (DM)	Disp 1 (DM)	Freq 2 (G)	Disp 2 (G)	Statistics
dm	6.05	0.12	0.02	0.38	6.90
she	19.56	0.46	3.32	0.21	4.76
her	15.88	0.44	3.05	0.22	4.17
harry	3.08	0.61	0.05	0.23	3.89
gore	4.61	0.27	0.48	0.23	3.80
charles	2.82	0.51	0.13	0.11	3.38
lol	4.49	0.08	0.64	0.10	3.36
bbc	3.50	0.42	0.38	0.14	3.27
scam	3.22	0.38	0.31	0.15	3.01
hypocrites	2.37	0.44	0.16	0.15	2.91
idiots	4.15	0.22	0.77	0.08	2.90
man	14.31	0.16	4.29	0.08	2.89
meghan	1.88	0.70	0.00	0.00	2.88
private	4.87	0.26	1.06	0.02	2.85
labour	4.60	0.56	1.09	0.22	2.68

**Table 2.** Keywords in the *Daily Mail*, with their correlates in the *Guardian* by statistics of relative frequency

When Table 1 and Table 2 are compared, aside from references to the newspapers concerned ('guardian' and 'dm'), which are subsequently removed from further analysis, terms pertaining to 'consumption', 'economic', and 'renewables' appear frequently in the *Guardian*, while terms like 'she', 'her', and 'harry' are frequent in the *Daily Mail*. The latter are generic personological references, while the former concern issues, devoid of gender and personalisation, and which reference concerns readily associated with climate change. Terms more frequently used in the *Daily Mail* corpus are topic agnostic, and could belong to almost any discussion in a popular newspaper. Aside from a personological reference to 'gore' (Al Gore), it is difficult to even discern whether the *Daily Mail* corpus concerns above-the-

line topics of climate change at all, and could be referring to any news article. This lends support to observations that the *Guardian* tends to attract more measured and considered contributions (Graham & Wright, 2015; Wright et al., 2019).

Switching focus now to Table 2, which lists the collocates to the keywords in the *Daily Mail* corpus, there is a marked shift away from references meaningfully relevant to climate change. All keywords, except for 'gore' (Al Gore and his advocacy for climate change mitigation), are generic and topic agnostic. Given the absence of a meaningful reference to the topic, and space limitations, no further exploration of the *Daily Mail* key terms is provided. As a consequence of the topic-agnostic keywords prevalent in the *Daily Mail*, the strategy adopted here is to examine the associations with the keywords unique to the *Guardian* in the *Guardian* first, and then to take these same five keywords from the *Guardian* and to examine how these are associated in the *Daily Mail*, even though these are not characteristic of the latter corpus. In so doing, insight into how these words are used and the concepts with which they are affiliated across both corpora becomes clearer. These steps are represented in Tables 3 and 4 respectively.

Space limits constrain detailed analyses to the first five key terms associated with each corpus, and how these are used within the broader context of the corpora, which gives insight into the aboutness of each. Because frequency does not equate to saliency, statistically significant terms warrant testing for lexical importance. Two measures of association were used to explore collocates, the MI<sub>3</sub> (*mutual information*) score, which returns a mix of high-frequency function words and low-frequency content words, and the *z-score*, which returns terms that have a higher probability of being associated than by randomness alone, and captures low-frequency content words (Baker, 2006). The relative frequencies of content and function words for each of Tables 1 and 2 are examined in greater detail in Tables 3 (the *Guardian*) and 4 (the *Daily Mail*). The tables are arranged by the descending MI<sub>3</sub> value.

Term	Collocate	MI <sub>3</sub>	Z-score
consumption	meat	24.20	265.44
	reduce	22.65	197.68
	conspicuous	20.99	268.64
	energy	20.97	106.92
	population	20.06	87.59
economic	growth	27.25	513.95
	system	22.91	191.18
	model	22.52	209.72
	social	21.82	174.36
	political	20.64	112.26
renewables	cheaper	20.42	152.50
	energy	20.11	92.41
	nuclear	20.11	107.49
	switch	19.01	122.48
	storage	18.94	104.15
species	other	24.15	192.48
	extinct	23.92	292.68
	endangered	21.87	238.54
	many	20.95	92.57



	invasive	20.81	206.24
fossil	fuels	32.66	1,609.87
	burning	27.24	508.26
	industry	25.78	330.07
	companies	23.69	212.51
	use	22.96	151.94

**Table 3.** Key terms unique to the *Guardian* corpus with collocates and MI3 and z-scores with respect to the *Guardian* corpus

In Table 3, the first five terms of the *Guardian* corpus as previously listed in Table 1 are reproduced here, and for each term the intersection between the most frequent function and lowest frequency content words is calculated. As can be seen, in the *Guardian* corpus, terms associated with ‘consumption’ (e.g., ‘meat’, ‘energy’), are also associated with ‘conspicuous’, a quality of consumption that commentators suggest should be ‘reduce[d]’ per ‘capita’. In Table 3, the terms most strongly associated with consumption are items which are consumed (‘meat’, ‘energy’) along with adjectives (‘conspicuous’) and correctives (‘reduce’).

Node	Collocate	MI3	Z-score
consumption	conspicuous	21.77	505.95
	reduce	18.19	122.02
	meat	16.13	74.17
	fuel	16.11	70.83
	capita	15.67	102.17
economic	growth	18.35	117.86
	political	17.08	75.75
	hardship	16.52	124.92
	migrants	15.16	85.49
	policies	14.33	50.59
renewables	heavily	16.19	111.90
	also	10.78	18.49
	because	10.55	15.43
	other	10.28	15.43
	many	10.15	14.72
species	endangered	20.35	245.96
	extinction	19.16	127.32
	other	18.17	69.75
	human	17.09	60.79
	dominant	16.84	114.06
fossil	fuels	29.86	1,294.18
	burning	25.19	461.25
	use	19.60	98.26
	industry	19.14	103.05
	companies	18.46	94.67

**Table 4.** Key terms unique to the *Guardian* corpus with collocates and MI3 and z-scores with respect to the *Daily Mail* corpus

When these key *Guardian* corpus terms are compared to their occurrence in the *Daily Mail* corpus, as per Table 4, to some degree, this pattern is also reflected in the collocates with ‘consumption’ found in the *Daily Mail*. With

both, there is an emphasis on reducing and changing patterns of consumption, as suggested by the common use of the associates ‘conspicuous’ and ‘consumption’. The resources consumed are identified (‘fuel’/ ‘energy’ and ‘meat’), even though the specific terminology varies between the *Guardian* use of ‘energy’ and the *Daily Mail* use of ‘fuel’. This variance may be a reference to fossil-based fuels rather than to renewable energy.

The next most significant term in the *Guardian* when compared to the *Daily Mail* was ‘economic’, with which ‘growth’ is strongly associated in both corpora. Surveying subsequent collocates highlights differences between the two however, with the *Guardian* tending to associate ‘economic’ with ‘system’, ‘model’, and relations to society, whereas in the *Daily Mail*, economics and politics (either as politics or as policies), hardship and migrants tend to be strongly associated. The term ‘renewables’ is more prevalent in the *Guardian* corpus, and many of the associates can be identified as consistent with the terms of debate concerning renewable energy supplies. For example, in the *Guardian* I find issues about nuclear energy (as an alternative to fossil fuels) being addressed, issues around investment, how steeper costs are associated with fossil fuels compared to renewables, and the necessity to ‘switch’ to renewables as part of a national energy policy framework. When compared to collocates for ‘renewables’ in the *Daily Mail* corpus, I see a clearly different set of terms, primarily an association between the nodal term and terms such as ‘heavily’ and ‘many’, ‘other’, ‘because’ and ‘have’, but the significance of these requires further study to determine.

The fourth significant term in the *Guardian* (see Table 3) refers to ‘species.’ The collocates overlap considerably between the two corpora, with the *Guardian* including terms like ‘other’, ‘extinct’, and ‘endangered’, and the *Daily Mail* (see Table 4) favouring ‘endangered’, ‘extinction’, and ‘other.’ Hereafter, there is a divergence with the *Guardian* collocating ‘many’ and ‘invasive’, while the *Daily Mail* collocates ‘human’ and ‘dominant’. The *Guardian* seemingly favours a less anthropocentric focus including references to ‘other’ (non-human?), ‘extinct’ and ‘endangered’ species, as well as references to ‘many’ and ‘invasive.’ The *Daily Mail* corpus introduces terms like ‘human’ and ‘dominant’, perhaps reflecting humanity’s status on the planet.

The fifth statistically significant term in the *Guardian* corpus (Table 3) is ‘fossil.’ As with ‘species’, there is a significant overlap between the collocates for this term in each corpus. Unsurprisingly, ‘fossil’ collocates significantly with ‘fuels’ and with ‘burning,’ but ‘industry’ and ‘companies’ collocate more strongly with ‘fossil’ in the *Guardian* corpus than in the *Daily Mail*, the latter favouring ‘use’ before ‘industry’ and ‘companies’. Nevertheless, both corpora follow broadly similar patterns of collocates with these terms, and appear to be commensurate with discussions relevant to climate change.

From the foregoing discussion, the difference in the character or ‘aboutness’ of the two corpora is clear: the *Guardian* seemingly addresses issues relevant to climate change policies and actions, while the *Daily Mail* appears to predominantly reference celebrities. Moreover, there is a distinct lack of personalised incivilities and negative judgements in the former than in the latter (compare Tables 1 and 2), and the latter appears not to be characterised by a meaningful engagement with the topic of climate change. Nevertheless, when I examine the keywords unique to the *Guardian* corpus, even though these are not given prominence in the *Daily Mail* corpus, there

are overlapping patterns of associations between the two corpora. This lends itself to the interpretation that terms relevant to climate change attract a cluster of similar concepts, suggesting a commonality of framing and sense-making among the readership of each newspaper. Despite political differences, such commonality in framing key issues about climate change offers a potential opportunity for developing cross-political scientific communications.

## 5. Climate Change Discourses Below the Line

The unique character, or aboutness, of each corpus is only part of the story however. From the previous section, meanings and salience relative to climate change appear more pronounced in the corpus sampled from the *Guardian* than they do for samples from the *Daily Mail*. But this does not show how each corpus reflects specific aspects of the climate change discourse. To highlight this, two specific phrases (*climate change* and *global warming*) are selected to see how these are represented within each corpus, and two methods are recruited to do so. The first uses the MI3 and z-score measures of association for each of the search terms ‘climate change’ and ‘global warming’ to highlight the most salient collocates in each of the two corpora. Thereafter, concordance analysis is used to locate the phrases within the context of use. Given the significant volumes of data returned, a random sample of 100 concordances is selected for each phrase and each corpus. This sample of 400 random concordance lines is analysed in more detail.

### 5.1 Measures of Association: ‘Climate Change’

Table 5 summarises the first 30 collocates associated with the phrase *climate change* from the *Guardian* corpus. In the table, function words have been removed, and collocates are sorted by descending strength of the MI3 measure of association. Multiple variations on the same root are allowed since lemmatisation was not used.

Position	Node	Freq Coll	Freq Corp	MI3	Z-score
R	deniers	630	2,681	25.12	238.36
L	global	779	12,703	23.80	131.19
L	man	478	3,620	23.50	154.31
R	denial	356	1,796	23.23	164.23
L	caused	354	2,225	22.90	146.25
L	anthropogenic	242	776	22.77	170.64
L	action	366	2,975	22.62	130.14
L	effects	310	1,840	22.60	140.96
R	real	386	4,431	22.28	111.48
R	happening	284	2,060	22.06	121.63
R	denier	226	1,076	22.00	134.79
L	warming	480	10,958	21.92	85.53
L	believe	358	4,771	21.85	99.16

R	threat	228	1,271	21.80	124.86
L	cause	276	2,783	21.50	100.95
R	issue	293	3,452	21.45	95.80
L	denying	163	634	21.35	126.94
L	deny	189	1,084	21.22	112.03
L	causes	189	1,141	21.15	109.11
L	tackling	109	230	21.07	141.58
L	induced	119	306	21.04	133.85
R	problem	329	8,058	20.73	68.05
L	intergovernmental	61	73	20.22	140.97
L	combat	84	192	20.21	119.36
L	tackle	105	384	20.17	105.13
L	address	129	879	19.87	84.68
L	catastrophic	121	739	19.84	86.78
L	dangerous	129	911	19.82	83.12
L	panel	78	223	19.67	102.69
L	combating	38	56	18.55	100.19

**Table 5.** First 30 collocates with ‘climate change’ in the *Guardian*, sorted by descending MI3 values

The table reads from left to right, so, referencing the first row in Table 5, I see that to the right (R) to ‘climate change’, the word ‘deniers’ collocates 630 times, from an overall occurrence in the corpus of 2,681 times. 23.5% of all its occurrences collocate with ‘climate change.’ This strong association is reflected in the MI3 (25.12) and z-scores (238.36), which is also the strongest in this corpus with the phrase. Here, the phrase ‘climate change’ collocates most strongly with ‘deniers’ which, because it is to the right (R), is likely to be of the form ‘climate change deniers’. On the strength of association, it seems reasonable to interpret this as the construction of an out-group of climate change deniers, from which the *Guardian* commentators distance themselves, an in-group perhaps. This also may suggest broad endorsement of the scientific consensus on anthropogenic climate change within this corpus. Indeed, the common salience of the six most strongly collocated terms supports a wide engagement with matters of consensus on climate change causality.

Following this first cluster of six strongly associated collocates, the next cluster appears to include terms that confer the ontology and imminence of climate change, i.e., it’s ‘real’ [MI3 = 22.28] and that it is ‘happening’ [MI3 = 22.06], and the third cluster seems to refer to climate change consequences and potential mitigating strategies. When measured by the MI3 metric, references to the impacts and effects of climate change appear to predominate (e.g., ‘effects’ [22.60], ‘threat’ [21.80], and ‘problem’ [20.73]) as do strategies for responding (e.g., ‘action’ [22.62], ‘tackling’ [21.07], ‘intergovernmental [panel on climate change]’ [20.22], and ‘combating’ [18.55]).

Using the z-score measure of association with ‘climate change,’ the scores arranged in descending value show a divergence from those terms favoured by the MI3 metric. While the two measures show favoured terms aligned with

matters of causation (responsibility and denial, etc.), terms associated with imminence are less accentuated by the z-score. Instead, terms are emphasised that are more aligned with actions and responses ('tackling' [141.58], 'intergovernmental [panel on climate change]' [140.97], and 'action' [130.14]), followed by terms referring to impacts ('effects' [140.96], 'threat' [124.86], and 'catastrophic' [86.78]).

There is apparent convergence between the two measures of association around 'climate change'. Strong associations in this corpus collocate climate change and matters of causality, consensus and scale. Associations with impacts, action, and imminence are also featured highly. A corresponding analysis of how 'climate change' is used in the *Daily Mail* corpus is summarised in Table 6, again showing the first thirty collocates and sorted by decreasing MI3 values.

Position	Node	Freq Coll	Freq Corp	MI3	Z-score
L	man	1,025	4,723	25.76	230.92
L	made	965	4,157	25.68	232.02
L	global	853	9,035	24.03	135.54
L	warming	714	8,933	23.27	113.18
R	caused	332	1,527	22.51	131.55
R	deniers	245	750	22.22	139.39
R	natural	337	2,013	22.17	115.65
R	real	372	2,812	22.12	107.30
L	believe	413	3,968	22.07	99.43
R	hoax	210	786	21.48	116.39
R	happening	197	1,139	20.67	89.94
L	people	419	12,790	20.45	51.28
R	scientists	286	4,245	20.39	65.12
L	deny	124	480	19.91	87.90
R	scam	146	1,028	19.52	69.80
R	weather	198	2,745	19.42	56.30
R	always	197	2,938	19.30	52.30
L	money	217	5,182	18.90	42.99
L	human	158	2,054	18.87	52.12
R	religion	102	610	18.72	63.58
R	myth	82	349	18.58	68.06
L	manmade	61	155	18.48	76.50
L	evidence	143	2,153	18.37	78.75
R	lie	91	766	17.90	50.11

L	anthropogenic	52	174	17.62	61.35
R	zealots	50	167	17.51	60.22
L	intergovernmental	27	29	17.37	78.75
R	lobby	39	128	16.82	53.66
R	fanatics	38	120	16.80	54.03
R	crusaders	16	25	15.32	50.16

**Table 6.** First 30 collocates with ‘climate change’ in the *Daily Mail*, sorted by descending MI3 values

In Table 6, the strongest association using the MI3 metric collocates ‘climate change’ with ‘man’ [MI3 = 25.76] and ‘made’ [MI3 = 25.68], ‘global’ [MI3 = 24.03] and ‘warming’ [MI3 = 23.27]. What collocates with ‘climate change’ here appear to be references to it as a noun, ‘man made global warming,’ such that it is perhaps the focal object of discussion. The z-score offers an alternate perspective and shows that ‘deniers’ is strongly associated, so one might conclude that, in the *Daily Mail* corpus, ‘climate change’ collocates with terms that posit it as the topic of concern, with the specification of ‘deniers’ as a group identity.

However, in Table 6, other collocates are also strongly associated with ‘climate change’, but these appear to cast doubt on the scientific consensus around its origins, and even the phenomenon itself. For example, I find terms such as ‘hoax’ [MI3 = 21.48, z-score = 116.39] and ‘scam’ [MI3 = 19.52, z-score = 69.80], ‘myth’ [MI3 = 18.58, z-score = 68.06] and even ‘lie’ [MI3 = 17.90, z-score = 50.11], all of which are strong associations, and located to the right of the search term, suggesting phrases such as ‘climate change *hoax*’ or ‘climate change *myth*’, and so on. In addition to these patterns, four further terms are worth noting in the context of expressions of doubt, and seemingly levelled at the groups associated with climate change. Terms such as ‘religion’, ‘zealots’, ‘fanatics’, and ‘crusaders’ again all collocate to the right of the search term, suggesting possible phrasing such as ‘climate change *religion*’ and ‘climate change *crusaders*’. These terms imply an evangelical faith on the part of those who propose anthropogenic causes to climate change, while the term ‘lobby’ implies a political form of leverage. Taken together, this corpus appears to compose an out-group identification of people with (hidden) agendas.

Finally, there is a third cluster of collocates which associated with ‘climate change’, and reference ‘weather’, ‘natural’, and ‘always’, all of which are collocated to the right of the search term. This may suggest a trend to attribute climate change to naturally occurring weather events that have *always* happened, a perspective that diverges from the scientific consensus.

## 5.2 Measures of Association: ‘Global Warming’

The above analysis is now repeated, substituting ‘global warming’ for ‘climate change’, and the first 30 results from the *Guardian* are summarised in Table 7.

Position	Node	Freq Corp	Freq Coll	MI3	Z-score
L	anthropogenic	219	776	23.91	267.53
L	man	276	3,620	22.69	154.82
R	climate	566	31,726	22.67	103.25
R	change	497	25,465	22.42	101.63
R	caused	216	2,225	22.33	154.92
L	made	287	5,243	22.32	133.17
R	not	551	54,661	21.77	73.60
L	cause	143	2,783	20.22	90.98
L	causing	106	1,160	20.19	105.24
R	hoax	75	418	20.17	124.62
R	happening	92	2,060	18.75	67.86
L	scientists	133	6,371	18.72	54.54
L	due	99	2,643	18.71	64.23
L	catastrophic	62	739	18.52	77.05
L	effects	79	1,840	18.25	61.61
L	theory	77	1,777	18.19	61.11
L	consensus	75	1,677	18.16	61.32
L	runaway	36	215	17.95	83.38
L	causes	61	1,141	17.82	60.65
L	linked	47	568	17.70	66.62
L	pollution	69	2,035	17.52	50.89
L	deny	53	1,084	17.29	53.98
L	guide	24	131	16.91	71.24
L	pause	30	262	16.87	62.79
L	combat	25	192	16.53	61.18
R	scam	28	280	16.48	56.63
R	experiencing	23	197	16.14	55.52
R	acidification	25	281	15.98	50.42
L	contributor	18	156	15.41	48.83
L	anthropomorphic	11	58	14.71	49.08

**Table 7.** First 30 collocates with ‘global warming’ in the *Guardian*, sorted by descending MI3 values

The collocate ‘anthropogenic’ is the most strongly favoured term by ‘global warming’ [MI3 = 23.91, z-score = 267.53], and given its left positioning is readable as ‘anthropogenic global warming’ (aka AGW). In Table 7 there

appear to be more terms favoured which refer to matters of causation than in Table 5. These include ‘contributor’, ‘cause’, ‘caused’, ‘causing’, ‘causes’, ‘due’, and ‘linked’, all but ‘caused’ are located to the left of the search term, suggesting references to the causation of global warming. There is indeed a significant emphasis on this theme when ‘global warming’ is used, and it attracts collocates which confer authority, such as ‘theory’ and ‘consensus’, along with terms expressing doubts, such as ‘hoax’ and ‘scam.’ The question of origins and legitimacy appears to be more strongly attracted to ‘global warming’ than to ‘climate change’ in the *Guardian*. However, other collocates suggest a preoccupation with impacts, such as (ocean) ‘acidification’, ‘catastrophic’, and ‘runaway,’ and ‘combat’ is the only evidence of response. This analysis is repeated with the *Daily Mail* corpus and the results are summarised in Table 8.

Position	Node	Freq Coll	Freq Corp	MI3	Z-score
L	made	594	4,157	24.56	201.47
L	man	603	4,723	24.45	191.54
R	climate	779	20,510	23.44	114.21
R	change	715	15,790	23.44	120.56
R	scam	193	1,028	21.71	132.09
L	caused	192	1,527	21.12	107.23
R	hoax	144	786	20.83	112.68
R	global	301	9,035	20.50	65.96
R	myth	95	349	20.21	111.97
L	believe	206	3,968	20.05	69.71
R	real	168	2,812	19.66	67.89
L	anthropogenic	64	174	19.50	107.03
R	biggest	106	916	19.29	76.33
L	cause	132	1,895	19.19	65.30
L	scientists	169	4,245	19.09	54.60
L	causing	96	878	18.92	70.53
R	cooling	97	1,010	18.76	66.27
R	happening	91	1,139	18.31	58.29
R	causes	69	631	17.97	59.80
L	catastrophic	42	177	17.65	69.43
L	manmade	40	155	17.63	70.71
L	people	171	12,790	17.55	28.44
L	evidence	87	2,153	17.20	39.50
R	religion	57	610	17.19	50.08



L	co2	97	4,022	16.77	31.07
R	natural	77	2,013	16.77	36.05
R	weather	77	2,745	16.32	30.24
L	fake	53	980	16.19	36.15
R	swindle	15	26	15.96	65.03
R	hoaxers	15	31	15.71	59.51

**Table 8.** First 30 collocates with ‘global warming’ in the *Daily Mail*, sorted by descending MI3 values

There is reasonable consistency between Tables 6 and 8, with collocates regarding origins featuring prominently in the latter as well. However, Table 8 also shows strong associations between ‘global warming’ and collocates suggesting doubts and accusations of deception, such as ‘scam’ and ‘hoax’. This is a strongly represented theme in Table 8. There are a number of collocates such as ‘scam’, ‘fake’, ‘hoax’, ‘religion’, ‘myth’, ‘hoaxers’, and ‘swindle’, and together these constitute 23% of the thirty terms retrieved. While doubt is evident in Table 6, this seems to be more prevalent in Table 8, in association with ‘global warming.’ The reasons for a stronger association between such terms and ‘global warming’, rather than ‘climate change’ are unknown.

Of interest, in the *Guardian*, there are more collocates associated with taking action or responding. These seem to take the appearance of metaphors of warfare and fighting, potentially positioning climate change (and global warming) as an ‘enemy’, perhaps even enlisting a wartime spirit as a mode of response. There is no analogy in the *Daily Mail* corpus, but this makes sense if remedial action is contingent on an initial consensus about the legitimacy of the threat.

As a way of making sense of the collocates to ‘global warming’, the findings can be clustered into four themes, viz.: origins (e.g., man made, anthropogenic, etc.); advocates of different perspectives (e.g., deniers, zealots, etc.); validity (e.g., evidence, scam, hoax, real, etc.); and impacts and responses (e.g., tackle, runaway, etc.). While some general comments can be offered about each corpus, and inferences made about the discourses each seems to articulate and participate in, only so much can be deduced from frequencies, measures of association and dispersion, and the rank ordering of strong and certain collocates alone. From the collocation analyses above, each corpus does seem to lend itself to a coherent description of a position relative to the matter of climate change, and this has already been referred to. To explore these proposed positional descriptions further, the terms ‘climate change’ and ‘global warming’ are again examined using concordance analysis, which locates these phrases within their lexical context.

Concordance analysis enables ‘many instances of use of a word or phrase’ to be brought together so that the analyst can ‘observe regularities in use that tend to remain unobserved when the same words or phrases are met in their normal contexts’ (Hunston, 2002, p. 9). It is a method of surfacing latent patterning of words or phrases, and contributes to a richer and more nuanced understanding of how climate change discourses are produced and circulated within the corpora of BTL comments.

### 5.3 Concordance Analysis

Concordance analysis was applied to both corpora for both phrases ‘climate change’ and ‘global warming’ to discern what, if any, differences are manifest in the way these phrases are used. In the *Daily Mail*, ‘climate change’ returned 7,977 concordance lines while the *Guardian* returned 9,156, and for ‘global warming’, the *Daily Mail* returned 4,339 and the *Guardian* 3,377. Even though the number of concordance lines will be an effect of the overall size of the corpora, and the *Guardian* is significantly the larger of the two, it will be impossible for a human analyst to make sense of patterns from this many concordance lines. There are methods for reducing the analytic burden, such as sorting the last word to the left or the first word to the right of the node, but to obtain a sense of how these phrases are used in each corpus, the lines need to be randomly sampled.

This was the approach taken here. 100 randomly sampled concordance lines from each corpus for both ‘climate change’ and ‘global warming’ were selected, and each line was examined to evaluate the commentator’s apparent position relative to the consensus about the anthropogenic drivers of climate change. Each line of the samples was coded according to whether the commentator appeared to agree (‘accepting’) or disagree (‘deny’) with the consensus, or whether the commentator expressed indecisiveness or doubt about the consensus (‘undecided’), or whether the sampled concordance line did not appear to take a position (‘unclear’). Examples of each of these codes from both corpora for both ‘climate change’ and ‘global warming’ are given in Table 9, where the italicised term refers to the focal concordance term.

Code	Examples
<i>Accept</i>	<p>‘the missing heat (fingers crossed). Man-made <i>climate change</i> is a fact. Lets put it in’</p> <p>‘different ethnicity are treated differently. I agree <i>Climate Change</i> is existential. But how can you boycott’</p> <p>‘on guys Sorry but we cannot stop <i>climate change</i>, we can only learn to adapt to’</p> <p>‘to ignore warnings about the effects of <i>climate change</i>. People are warned endlessly and fail to’</p> <p>‘the money. That will tell you when <i>global warming</i> becomes a true crisis. Can one get’</p> <p>‘science that underpins the theory of anthropic <i>global warming</i>, It isn’t particularly new or intellectually’</p> <p>‘for increased hazards and cost associated with <i>global warming</i>. Who told you otherwise your barber?’</p> <p>‘because they must know it. I accept <i>global warming</i> and the obligation to move beyond carbon’</p>
<i>Deny</i>	<p>‘us that it 's all due to <i>global warming</i>! Wotta load of cobblers- he should get’</p> <p>‘hardly make a dent in the alleged <i>global warming</i> is now thankfully expired. A new treaty’</p> <p>‘still so true today: “Follow the money”. <i>Global warming</i> is simply another attempt at wealth transfer-’</p> <p>‘at colleges devoted to the throne of <i>global warming</i>. These guys are frantic trying to come’</p>

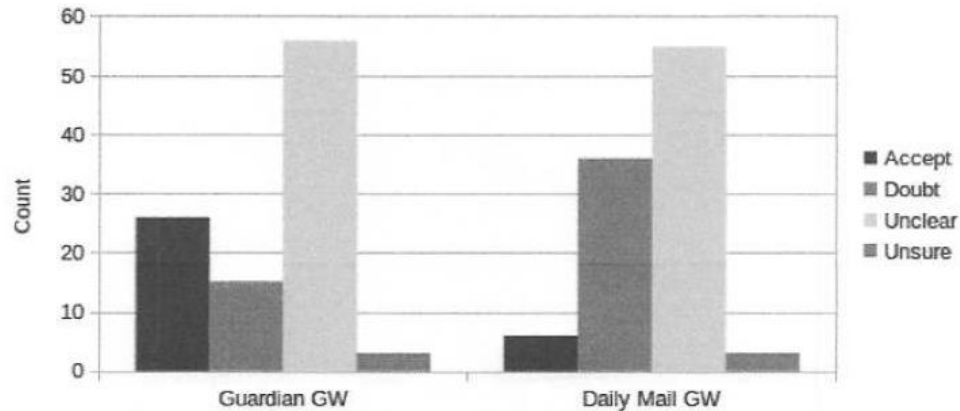
	<p>'is showing. No proof of man-made <i>global warming</i> here. Nice read on the history of</p> <p>'believe only the scientists who perpetuate the <i>climate change</i> argument unlike those who get no air'</p> <p>'we shall stick to ours. Man made <i>climate change</i> is a complete hoax. Another one that'</p> <p>'small group making a fortune out of <i>climate change</i> attached to the Government. Lets have some'</p> <p>'A big failure. This global warming, sorry <i>climate change</i> is perfect for them to spout on'</p>
Undecided	<p>'over just a few decades. Even if <i>climate change</i> is man made, why are the changes'</p> <p>'of native habitat and am not a <i>climate change</i> denier. HOWEVER, Los Angeles has always been'</p> <p>'activity. No doubt in my mind that <i>climate change</i> is a reality but it's easy'</p> <p>'of civilization. And if you believe in <i>climate change</i> or not the number of people on'</p> <p>'always fall back on the far future. <i>Global warming</i> may be happening[ I am open minded'</p>
Unclear	<p>'of his tree and the problem of <i>global warming</i> has only become an issue since mankind'</p> <p>'Global Cooling, but there is one for <i>global warming</i>. From 1965 to 1979, a total of</p> <p>'term, not found in scientific discussions of <i>global warming</i>. And why do we need a consensus'</p> <p>'saying "the scientific method supports man-made <i>global warming</i>." Why? Because you cannot impose a null'</p> <p>'made CO2 is a significant factor in <i>climate change</i> three things are obvious - CO2 isn't'</p> <p>'climate change is the early disappearance of <i>climate change</i> sociologist and scientists. It may well be'</p> <p>'higher. Meteorologists may not be "experts in <i>climate change</i>" but they're likely to know a'</p> <p>'they receive to tell us all that climate change is happening <i>Climate change</i> is happening but'</p>

**Table 9.** Codes used to establish position taken with respect to climate change/ global warming

Four hundred samples of concordance lines were reviewed and each was allocated to one of the four codes to note the commentator’s apparent position relative to the consensus on climate change. When the speaking position of the commentator relative to climate change or global warming could not be determined, this was coded as ‘unclear’. The approach taken was conservative: if a determination could not be made, the line was marked as unclear. As a result, this code tended to be the most frequently used across each of the four samples, while explicit declarations of being undecided were coded the least frequently.

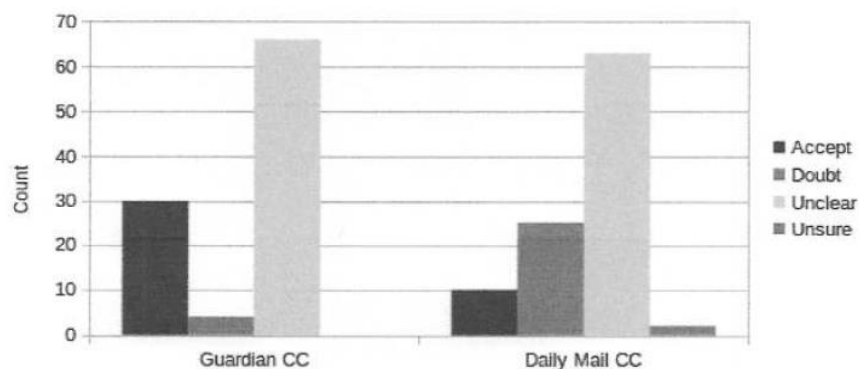
Across the *Daily Mail* corpus, there are no noticeable differences in the coded incidence of denial regardless of the specific term used. The incidence of denial is similarly unaffected in the *Guardian*, although a slight difference

was noted in the coded incidence of acceptance when comparing the term ‘global warming’ (GW) and ‘climate change’ (CC). The latter phrase seems to reflect fewer codes for acceptance and a correspondingly higher incidence of coding for ‘unclear’. What is apparent however, is the higher incidence in the *Daily Mail* corpus of positions which suggest denial, regardless of whether ‘global warming’ or ‘climate change’ is used, when compared to the *Guardian*. This pattern is illustrated in Figure 1.



**Figure 1.** Incidence of codes by corpora

This pattern becomes more apparent in Figure 2 when the terms are combined. The incidence of coded denial in the *Daily Mail* is significantly higher than the coded incidence of acceptance in that corpus, but is also much higher than a comparable coding for denial in the *Guardian* corpus. Indeed, the raw count for the incidence of codes for acceptance in the *Daily Mail* corresponds almost exactly to the number of codes for denial in the *Guardian* (16 and 19, respectively). Another way of putting this is quite simply that 56 *Guardian* commentators unambiguously expressed acceptance of either GW and/or CC, while only 16 *DM* commentators did. The left-leaning commentators appear to use the terms interchangeably, while the right did not (Schuldt, et al., 2011). The coded incidence of ‘unclear’ is higher in the *Guardian* corpus than in the *Daily Mail*, indicating that the position taken by the commentator was harder to attribute.



**Figure 2.** Relative incidence of coding by corpora when terms are combined

## 6. Discussion and Conclusions

This paper has explored how climate change and global warming are construed by below-the-line commentators on articles about climate change over a six-year period in two British national online newspapers, the *Daily Mail* and the *Guardian*, reflecting the right and left end of the UK political spectrum, respectively. In this concluding section, the findings and implications of this analysis for further study are discussed.

The first of the two objectives motivating the present study was to gain insight into meanings in circulation within public discussions about climate change, and whether there are distinctions in these between the political ends of the UK spectrum, as represented by the two newspapers. Although when the corpora were compared, there was a significant difference in the size in favour of the *Guardian* sample, to compensate for this difference in size, relative<sup>3</sup> rather than absolute values were calculated for all comparisons between the corpora. The analysis presented here intended to generate a profile describing the general character, the ‘aboutness’, of each corpus, and this was obtained by comparing the most frequently occurring terms in each corpus. 30 of these key terms were then analysed with respect to their measures of association and dispersion across the corpus. Five of these key terms were then subsequently analysed in greater detail for their associated terms to develop insight into how climate change concepts are framed.

When compared in such a manner, there was a marked significance in the frequency of words used in the *Daily Mail* corpus which are consistent with a so-called ‘attack discourse,’ as characterised by incivility and sarcasm (Anderson & Huntington, 2017). This finding supports previous studies on BTL comments among *Daily Mail* readers, both with respect to climate change science (Jaspal et al., 2012), and immigration (Brezina, 2018). Consistent with the current study, Brezina found that *Guardian* corpus keywords were ‘more neutral and related to the theoretical aspects’ of the topic (i.e., immigration), while ‘keywords found in the DM [*Daily Mail*] corpus predominantly point to negative aspects’ (Brezina, 2018, p.93). These findings are also consistent with those of Graham and Wright (2015), and Wright et al. (2019) who found comments in the *Guardian* newspaper tended to support the scientific consensus on climate change, as well as tended to be more deliberative in nature and tone than in the *Daily Mail* corpus. These findings, taken in the round, may lend provisional support to Jaques et al. (2008) who argued that right-wing perspectives tend to be more associated with denials of human culpability in the causes of climate change and global warming than do left-wing perspectives.

When the patterns of the first 30 collocates for each corpus are compared, it seems to be reasonable to interpret the *Guardian* corpus as seemingly in agreement or supportive of the consensus of climate change. There are strong associations with collocates such as ‘global’, ‘caused’, ‘man’, and ‘anthropogenic’. Indeed, the establishment of a counter-identity, the ‘deniers’, engaged in ‘denial’ is highly prominent. The corpus seems to reflect concerns about impacts and significance, with collocates including references to actions and to making changes, consistent with the need for human behaviour and institutions to change (Carvalho, 2007). The *Daily Mail* corpus also shows a pattern of strong associations with collocates that suggest causality, and description (‘man’, ‘made’, ‘global’, ‘warming’) and ‘deniers’ is also elevated

here. However, collocates such as ‘natural’, ‘weather’, ‘believe’, ‘hoax’, ‘scam’, ‘always’, and so on are strongly associated with ‘climate change’, suggesting less agreement with the consensus, and impugning that the matter is a lie or a con-trick, that it is a *natural* phenomenon of variable *weather* that has *always* happened. Moreover, the ‘attack discourse’ seems to be evidenced in the use of descriptions of those who do support the consensus about the origins of climate change as ‘zealots’, ‘crusaders’, ‘fanatics’, etc. This tone was completely absent from the *Guardian* corpus.

In summary, the *Daily Mail* corpus presents an overall profile (an aboutness) that suggests a suspicion about the science and the scientific consensus, doubt that human activity drives climate change, and accusations that global corrective action is a wealth-transfer and global government conspiracy. These characteristics are evidenced by a significant emphasis in the corpus on attributions of hypocrisy, especially towards celebrities who endorse the scientific consensus, such as Al Gore and Leonardo di Caprio, to name two, and such attributions may be linked to the absence of any expressions about taking action. This trend contrasts markedly with the *Guardian* corpus. This is characterised by a greater engagement with issues reasonably associated with anthropogenic climate change and the scientific consensus. This was evidenced by a higher relative frequency of references to economic models, consumer behaviour, meat production and consumption, population levels, energy sources, politics, and impacts when compared with the *Daily Mail* corpus. While there was evidence of some denial and doubt about the scientific case for the anthropogenic drivers of climate change, these were in the minority, whereas in the *Daily Mail* corpus, such claims were very much in the majority.

However, what was also found was that when the keywords unique to the *Guardian* corpus were examined within the context of the *Daily Mail* corpus, despite not being themselves prominent in the latter, some overlapping patterns of associations between the two corpora became evident. For example, with respect to terms such as ‘consumption’, and ‘species’, etc., these terms attracted a cluster of similar associations, regardless of the corpus within which these terms were prevalent. This suggests that despite political differences among the readers of each paper, this common framing of key issues about climate change may offer a potential opportunity in how cross-political scientific communications about this topic are developed.

The second objective explored the receptivity of the readership of each newspaper to the key phrases ‘climate change’ and ‘global warming’. Both phrases were included here because while both ‘climate change’ and ‘global warming’ are seen as serious problems by the public (Villar & Krosnick, 2011), some studies suggest a relationship between how the phenomenon is worded, and the public’s representations thereof. For example, in social media contexts ‘global warming’ was more likely to be associated with human causation, and more frequently accompanied by ‘hoax’ framing (Jang & Hart, 2015). Other studies suggest that the phrase ‘climate change’ tends to be more associated with natural events (Whitmarsh, 2009). In the US, Schuldt et al. (2011) found that, unlike the left who tend to use both phrases interchangeably, those on the political right tended to more frequently express doubt and to challenge evidence of human origins when the wording ‘global warming’ was used than when ‘climate change’ was. To the extent that the papers sampled here reflect this political range in the UK, this study supports these findings. Here, the left

(represented by comments BTL in the *Guardian* paper) was found to be largely neutral in their responses to both phrases. While there was evidence of doubt, the relative influence of each phrase on the responses of those towards the right (as represented by BTL comments sampled from the *Daily Mail* paper) was far more pronounced.

Looking at this pattern in detail, it is apparent that the *Guardian* corpus included collocates associated with 'global warming' that suggest doubt concerning the scientific legitimacy of the consensus. Unlike the associations with 'climate change,' collocates like 'pollution', 'hoax', 'scam', 'theory' and 'pause' (see Table 7) only associate with 'global warming.' But this pattern is less obvious when considering the *Daily Mail* corpus. In this corpus, it seems that regardless of whether the phrase 'climate change' or 'global warming' was used, both evidenced strong associations with scepticism, e.g., 'hoax' (and 'hoaxers'), 'scam', 'swindle', 'myth', 'lie', 'zealots', and so on (see Tables 6 and 8). Of note also is that neither phrase is associated with an increase in the frequency of 'hoax' framing, primarily because such framing is already frequent and well distributed throughout the corpus. This finding corroborates earlier studies locating climate change scepticism predominantly among the political right (Elsasser & Dunlap, 2013; Ereaut & Segnit, 2006; Segnit & Ereaut, 2007).

As Bednarek and Caple (2014) argue, the news media are powerful organs for informing and shaping the nature of information that the public draw on to reach conclusions. How do members of the public engage with the need to adopt meaningful changes to support mitigating and adapting to climate change? How effective are such strategies in winning 'hearts and minds?' In this study, the BTL commentariat has been treated as a linguistic community, a virtual microcosm of public opinions on key topics of the day. A snapshot was taken of public discourses over a six-year period around climate change and the scientific consensus of its origins and drivers, by sampling BTL comments from two online newspapers, representing the range of UK mainstream politics. The findings presented here largely support previous studies on the political representations of climate change, and the findings here echoed the tendency for the political right and left to diverge on matters regarding the scientific legitimacy of climate change. In the corpora sampled here, this was evidenced by the marked prevalence of such doubts characterising the comments in the *Daily Mail* when compared to the *Guardian*, a more left-wing paper. These expressions became even more pronounced when the use and representations of the phrase 'global warming' were examined. That the *Daily Mail* enjoys the highest circulation of UK national daily newspapers, second only to the *Sun* which itself is explicitly populist and right-wing, our study suggests that narratives sceptical of scientific consensus on the anthropogenic roots of global warming may likely be shared by a significant percentage of UK newspaper readers. Discourses reproducing denialism, scepticism, accusations that the scientific consensus about the causes of climate change is a conspiracy, hoax or scam, and other dismissive and trivialising comments about the threat posed by climate change are powerful antidotes to taking the necessary action to respond meaningfully and timeously.

Of course, this study will unlikely reflect the full spectrum of perspectives among BTL commentators, because it is reasonable to assume that in both corpora there will be individual commentators who deviate from the dominant

profile described here. No doubt there are climate change sceptics in the *Guardian* and advocates in the *Daily Mail*, and only a more granular analysis will tease such nuanced patterns out. The period covered in this study was selected to avoid the short-term skewing of discursive trends arising from high-profile events, such as the spurious ‘climategate’ hack. Despite this step, that so much public discourse, as represented by the UK right-wing press, remains ardently sceptical and dismissive is a cause for concern if meaningful actions are to be taken which engage the majority of the UK public. Future studies on how such scepticism can be effectively countered are important, not to silence debate but to avoid stifling action. Recent events suggest that one need not ‘believe in’ climate change for it to increase the intensity and frequency of storms, floods, and wildfires. While the scientific consensus around anthropogenic climate change is clear and unassailable, how this knowledge is circulated among members of the public who are distracted by celebrity and consumption, and who attack climate change science rather than question the status quo, remains a significant problem for scientific communications. How can communications about (unpopular and informed) science break through a (popular and uninformed) resistance to such information? Clearly, this remains a challenge beyond the scope of the current enquiry, but raises relevant issues about how such themes can be more successfully articulated across different political alliances.

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## ***Notes***

1. <https://www.pressgazette.co.uk/national-newspaper-abcs-guardian-sees-smallest-circulation-decline-for-july-2019/> Accessed December 19<sup>th</sup>, 2020
2. As the term ‘shit’ is proscribed by the *Daily Mail* as profanity, it has been removed from the list of five terms considered here, and is henceforth excluded from all analyses.
3. Relative values were calculated as a percentage of occurrences per corpus.

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