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“Climate change” vs. “global warming”: A corpus-assisted discourse analysis of two popular terms in *The New York Times*

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Abstract: “Climate change” and “global warming” are two popular terms that may be often used interchangeably in news media. This study proposes to give a corpus-assisted discourse study of the representations of climate change and global warming in *The New York Times* (2000–2019) in order to examine how they are actually used in the newspaper. The findings show both similarities and differences in their representations in terms of the associated topics/themes, the particular ways of framing, and the perspectivization strategy employed. It is argued that a corpus-assisted discourse study of a large sample of news articles presents a more accurate picture of the actual use of the two terms in news media.

Keywords: climate change; corpus-assisted discourse study; global warming; *The New York Times*

1 Introduction

While “global warming” and “climate change” have become two popular terms in recent years to describe the climatic phenomenon caused by changes in atmospheric concentrations of greenhouse gases (Lorenzoni and Pidgeon 2006), they are often used interchangeably as if they refer to the same phenomenon (Boykoff and Boykoff 2007; Lineman et al. 2015; Penz 2018; Schuldt et al. 2011; Whitmarsh 2009). Some researchers prefer to use “climate change” (e.g. Jaworska 2018; Koteyko et al. 2013; Leiserowitz 2006), while others choose the term “global warming” (e.g. McCright and Dunlap 2000; Olausson 2009; Ytterstad 2015). In some studies, both terms are used as keywords to extract news articles for the study of climate change (e.g. Dayrell and Urry 2015; Knox and Jacques 2016; Schmid-Petri

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et al. 2017). Previous studies have also demonstrated that the two terms may trigger similar affective responses in the US, Britain, and other parts of the world (Lorenzoni and Pidgeon 2006; Villar and Krosnick 2011).

Nevertheless, some other studies argue for the necessity to make a distinction between the two terms (Shi et al. 2020; Whitmarsh 2009). The term “climate change”, originally called “climatic change”, was first coined by Plass (1956) who investigated a strong relationship between carbon dioxide and the temperatures and climate of Earth’s surface in history. The term “global warming” was brought into focus later as Broecker (1975) developed a model to predict the rising temperatures due to the increases of carbon dioxide in the atmosphere. Due to their different origins, the two terms are clearly distinguished in some scientific reports (e.g. The Intergovernmental Panel on Climate Change report) and some academic research. “Global warming” is defined as an increase in the average Earth’s temperature constantly (Lineman et al. 2015; Shi et al. 2020), while climate change is conceptualized as all forms of climatic and weather variability, involving hotter summers, colder winters, higher rainfall, and increased drought (Lorenzoni and Pidgeon 2006; Schuldt et al. 2011; Whitmarsh 2009). Previous studies have further demonstrated that the interpretations of the two terms may vary with people’s political affiliations (Villar and Krosnick 2011), their gender identity (Greenhill et al. 2014), their knowledge and experience (Benjamin et al. 2017), or their beliefs (Akerlof and Maibach 2011).

While some previous studies rely on surveying and interviewing in exposing public understanding of the two terms (e.g. Villar and Krosnick 2011; Whitmarsh 2009), this study is going to give a corpus-assisted discourse study (CADS) of the actual use of the two terms in *The New York Times* (NYT). The primary purpose is to give a close examination of the use of the two terms in this English newspaper. Previous studies on US news media’s representations of climate change (CC) or global warming (GW) tend to center on several themes, such as the climate skepticism (Antilla 2005; Schmid-Petri et al. 2017; Stecula and Merkley 2019), journalistic norm and media bias (Bohr 2020; Boykoff 2007; Boykoff and Boykoff 2004, 2007), politicization and polarization (Bolsen and Shapiro 2017; Chinn et al. 2020; Feldman et al. 2015). They have identified some important patterns in the representations of CC and GW, such as the prevalence of skepticism, the presence of “false balance”, and the prominent feature of politicization and polarization of viewpoints from different political parties. However, there is little information about whether CC and GW are represented in the same way in the same US news media.

2 Corpus-assisted environmental discourse studies

Given the surge in attention given to climate change in recent years, there is a growing demand for the incorporation of automatic text analysis techniques into the analysis of the large volume of climate change texts (Boykoff and Roberts 2007; Grundmann and Scott 2014; Schmidt et al. 2013). In a review of automatic text analysis techniques for the study of climate change discourse, Salway (2017) makes a distinction between two general trends: (1) the automatic classification of texts in terms of subtopics and frames; and (2) corpus-assisted discourse analysis. While the former can allow the efficient processing of data on a mass scale, it treats texts as a “bag of words” and “information about word order and higher-level linguistic structures are ignored” (Salway 2017: 156). Corpus-assisted discourse analysis underlines using corpus linguistics (CL) methods in discourse analysis, such as frequency list, keywords, clusters, collocates, and concordances (Baker 2006; Liu and Zhong 2020). On the one hand, it allows the use of computer-assisted corpus-analytic tools in the processing of large samples of texts and identifying important linguistic patterns; on the other hand, it highlights the incorporation of discourse analytic methods and theories in the descriptions and interpretations of the findings generated by corpus-analytic tools (Baker and McEnery 2015; Baker et al. 2008; Cheng 2013; Liu and Ma 2021). Using CL methods in discourse analysis can allow the efficient analysis of a large sample of texts, provide empirical evidence for testing research assumptions, generate findings that cannot be acquired through mere manual analysis of a small sample of texts, reduce the researcher bias in data selection and interpretation, and make the analytic procedure replicable (Baker 2006; Baker and McEnery 2015; Friginal and Hardy 2020; Liu and Lin 2021). It has given rise to corpus-assisted environmental discourse studies on a number of topics, such as climate problems and carbon-related concepts (e.g. Bevitori 2010; Nerlich and Koteyko 2009), environmental destruction (e.g. Alexander 2010; Liu and Li, 2017; Liu and Zhang 2018; Poole 2016), animals and the nature (e.g. Sealey and Oakley 2013), sustainability (e.g. Orna-Montesinos 2015) and ecotourism (e.g. Jaworska 2017; Ruffolo 2015).

Previous studies have also resorted to automatic text analysis techniques to compare the actual use of the two terms on social media and identified some significant differences in the choice of the two terms (Jang and Hart 2015; Lineman et al. 2015; Shi et al. 2020). In a big data analysis of the use of the two terms on Twitter, Jang and Hart (2015) find that compared to “blue states”, the “red states” in the US prefer GW to CC and tend to associate GW with hoax frames. Shi et al. (2020) also conduct a big data analysis of the discourses associated with CC and GW on

Twitter and find that CC “demonstrated a more scientific perspective and showed an attempt to condense climate discussions rather than diffuse the topic by frequently addressing sub-topics simultaneously”, whereas GW “triggered more political responses and showed a greater connection with phenomena” (Shi et al. 2020: 1). Besides, CC is more dominant than GW in public discussions in recent years. However, as Salway (2017) argues, these studies treat a text as a “bag of words”, and run the risk of missing many other aspects of the meaning arising from the sequencing of words in grammatical structures (Salway 2017: 155). However, Grundmann and Krishnamurthy (2010) give a corpus-based study of the US and the UK news media from 1998 to 2007 and find that the US media tend to use GW more frequently, whereas the UK media prefer to use more CC. Besides, the UK media tend to focus on the international aspects of the issue, while the US media tend to focus on domestic aspects. The UK media are inclined to cite voices from environmental and non-governmental organizations and interest groups, while the US media tend to highlight voices of individual advocates. In a more recent study, Grundmann and Scott (2014) also discover that the US media preferably discuss impacts and issues of the climate, while the UK media focus more on the dangers. Besides, more skeptical voices are found in the US newspaper. Nevertheless, few studies have given a critical examination of the use of the two terms in the same newspaper, and this study is going to fill the gap by conducting a corpus-assisted discourse analysis of the use of the two terms in NYT.

3 Methodology

3.1 Data collection

This study focuses on *The New York Times*, a newspaper that is known as a “newspaper of record” (Cotter 2001: 416) in the US and is important in influencing media agenda in other countries. Two large corpora have been built by collecting the news texts with CC or GW in their titles in the NYT from the electronic database Lexis-Nexis. The time-span set for data collection is from January 1, 2000 to December 31, 2019. Previous studies on CC have found that climate issues have received increasing attention since the mid-2000s in most developed and developing countries (Song et al. 2021). All the collected news texts are further examined manually to make sure that they are closely related to GW or CC. The GW corpus consists of 363 news texts (279,839 tokens), while the CC corpus consists of 1,088 news texts (1,285,183 tokens). Therefore, CC was used much more frequently than GW during the examined period. Figure 1 shows the number of news texts

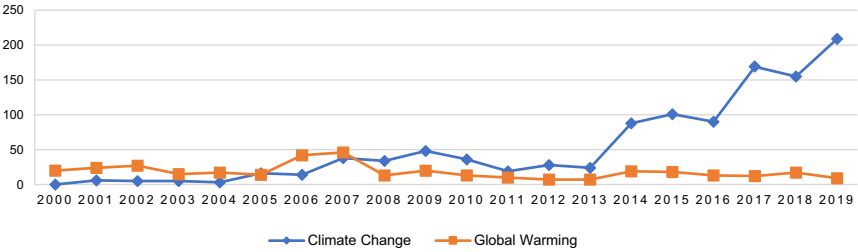


Figure 1: The number of news reports collected for each year.

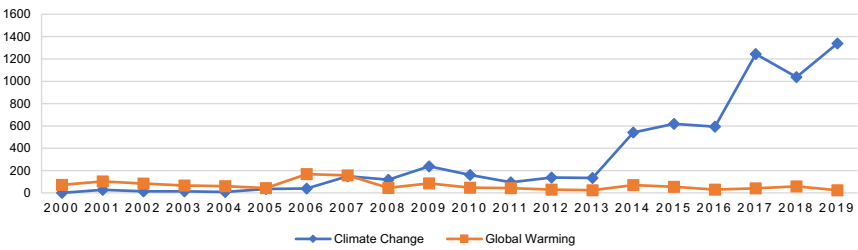


Figure 2: The frequencies of two terms in each year.

collected each year, and Figure 2 shows the raw frequencies of the two terms in the two corpora.

As Figure 1 shows, NYT features fewer uses in CC before 2005 (Bohr 2020; Feldman et al. 2015; Schmid-Petri et al. 2017). Before 2008, GW was more frequently used than CC in NYT, but this trend has been reversed since 2008. Compared with the growing coverage of CC, the coverage of GW was relatively stable and comparatively few after 2008. The first surge of attention to CC during 2007–2010 can be attributed to several activities, such as the release of the Fourth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC), the release of an award-winning documentary by the former Vice President Al Gore, and the “Climategate” scandal (Bohr 2020). The coverage of CC reached its first peak in 2009, which can be attributed to COP15 in Copenhagen (2009). The coverage of CC has shown a dramatic increase since 2014 and reached its second peak in 2015, which can be attributed to COP21 in Paris (2015). Since then, the coverage of CC has been doubled due to the former US President Donald Trump who questioned the real existence of CC and made it a controversial issue.

3.2 Analytic methods and procedure

This study gives a corpus-assisted discourse analysis of the representations of CC and GW in NYT in terms of three aspects: (1) the topics/themes associated with CC and GW; (2) the particular ways of framing CC and GW; and (3) the perspectivization strategy taken towards CC and GW. Perspectivization strategy is a method to position writers' viewpoints to express involvement and distance (Reisigl and Wodak 2016). It is usually reflected by the use of deictics, direct, indirect, free indirect speech, etc. We start with the identification of the topics/themes associated with the coverage of CC and GW. The corpus-analytic tool Wmatrix 3.0 is used for the analysis of the most prominent and preferential topics/themes (Liu 2017). Wmatrix 3.0 distinguishes itself from other corpus-analytic tools for the UCREL Semantic Analysis System (USAS) it incorporates. USAS divides the English vocabulary into 21 semantic domains which are further divided into 232 semantic categories (SMCs). Wmatrix 3.0 can do automatic semantic analysis and corpus comparison. It can produce a key SMC list by comparing one corpus with a specialized or general reference corpus. The key SMC list can rank these statistically significant key SMCs in terms of their log-likelihood values. The more their key values are, the more statistically significant these key SMCs are. In order to identify the most prominent themes/topics of the two corpora, this study first compares the two corpora respectively with the British National Corpus (BNC) Sampler written corpus in Wmatrix and produces two key SMC lists. Although it has to be acknowledged that an American sampler Written corpus is preferred here, the choice of American and British does not seriously affect the results because the semantic analysis categorizes these words in terms of meanings rather than spellings in Wmatrix. Then we focus on the top 20 key SMCs in each list to identify the shared topics/themes of the two corpora. After that, the two corpora are compared with each other to identify their preferential key SMCs. For the convenience of analysis, we still focus on the top 20 key SMCs in each corpus. The specific functions of each key SMC can be further examined through a close examination of the most frequently used tokens in each key SMC (L'Hôte 2010; Rayson 2008).

It is followed by a close examination of the particular ways of framing CC and GW in the two corpora (see Grundmann 2021). According to Entman (1993), to frame is to “*select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described*” (Entman 1993: 52, italics in original). The particular ways of framing CC and GW can be examined through their strong collocates

(Baker et al. 2008). Different statistic measures can be used to measure the strength of collocation (Baker 2006), and the log-likelihood (LL) values are used in this study to rank the collocates of CC and GW. With the corpus-analytic tool WordSmith 7.0, this study focuses on the top 100 collocates of CC and GW in their respective corpora to identify which collocates contribute to the four aspects of framing the issue: (1) problem definition; (2) cause; (3) consequence; and (4) solution/action.

Nevertheless, the analysis of framing in terms of their collocates may not present an accurate picture about the exact stance of the newspaper towards the (un)certainly of CC or GW in view of the journalistic norm of balanced reporting (Boykoff and Boykoff 2004). In order to examine to what extent the newspaper adheres to the journalistic norm of balanced reporting and (dis)aligns with the scientific consensus on the existence of CC or GW, this study gives a further analysis of the perspectivization strategy adopted towards the (un)certainly of CC and GW. Perspectivization refers to how the news reporters position themselves towards others' viewpoints and express involvement or distance in discourse (Reisigl and Wodak 2016), and it can manifest at all levels of discourse (Khosravi-Nik 2010). The concordance lines of some collocates with a contradictory evaluation of the existence of CC and GW are further examined to reveal the specific perspectivization strategies taken towards these statements.

4 Findings

4.1 Analysis of topics/themes

Table 1 shows the top 20 key SMCs of both corpora. Among them, 17 can be identified in both corpora, including W4 ("Weather"), A2.1+ ("Change"), Y1 ("Science and technology in general"), W5 ("Green issues"), Z99 ("unmatched"), W3 ("Geographical terms"), O1.3 ("Substances and materials: Gas"), O4.6+ ("Temperature: Hot/on fire"), Q2.1 ("Speech: Communicative"), G1.1 ("Government"), W1 ("The universe"), O4.6 ("Temperature"), F4 ("Farming & Horticulture"), A2.2 ("Cause & effect/connection"), N5.1+++ ("Entire; maximum"), A13 ("Degree"), and X5.2+ ("Interested/excited/energetic"). They show that the representations of CC and GW share many similarities in the choice of topics/themes.

An examination of the most frequent tokens in these shared key SMCs reveals the presence of three themes: (1) environment; (2) politics; and (3) science. The majority of the key SMCs belong to the theme of "environment", including W4 (e.g. *climate, weather, drought*), A2.1+ (e.g. *change, changes, changing*), W5 (e.g. *environmental, environment, pollution*), O1.3 (e.g. *gas, carbon-dioxide, air, gases*),

Table 1: Top 20 key SMCs in the two corpora.

Rank	CC			GW		
	Tag	LL	SMC	Tag	LL	SMC
1	W4	14,444.79	Weather	W4	4,867.86	Weather
2	A2.1+	4,967.33	Change	O4.6+	3,949.05	Temperature: hot/on fire
3	Y1	3,289.33	Science and technology in general	O1.3	3,014.7	Substances and materials: gas
4	W5	3,168.83	Green issues	Y1	2,680.99	Science and technology in general
5	Z99	2,677.07	Unmatched	W3	2,279.73	Geographical terms
6	W3	2,627.75	Geographical terms	W5	2,232.59	Green issues
7	O1.3	2,528.37	Substances and materials: Gas	Z99	1,708.21	Unmatched
8	O4.6+	2,342.64	Temperature: Hot/on fire	Q2.1	1,202.25	Speech: Communicative
9	Q2.1	2,232.85	Speech: Communicative	O4.6	1,036.07	Temperature
10	G1.1	2,012.46	Government	A2.1+	926.56	Change
11	W1	1,487.96	The universe	W1	815.62	The universe
12	O4.6	896.87	Temperature	G1.1	636.24	Government
13	F4	872.02	Farming & Hoticulture	A13	564.63	Degree
14	A13	824.38	Degree	F4	531.73	Farming & Horticulture
15	A2.2	782	Cause & Effect/ Connection	A2.2	493.97	Cause & Effect/ Connection
16	A15–	621.23	Danger	X5.2+	384.92	Interested/excited/ energetic
17	N5.1+++	596.31	Entire; maximum	Z3	345.97	Other proper names
18	A5.1---	532.96	Evaluation: Bad	N5.1+++	300.87	Entire; maximum
19	O1.2	464.5	Substances and materials: Liquid	A9–	237.65	Giving
20	X5.2+	453.84	Interested/excited/ energetic	W2	234.49	Light

O4.6+ (e.g. *warming, heat, fire*), W1 (e.g. *world, planet, solar*), W3 (e.g. *global, earth, forests*), O4.6 (e.g. *temperatures, temperature, Fahrenheit*), F4 (e.g. *farmers, agriculture, agricultural*), N5.1+++ (e.g. *extreme, extremes*), and X5.2+ (e.g. *energy*). The prominence of this theme is not surprising in view of the fact that both corpora are concerned with environmental issues. Therefore, both corpora underline the change in climate, weather, and temperature, the release of greenhouse gases, the impact on agriculture, and extreme weather. The theme “politics” can be perceived

from G1.1, which consists of such tokens as *president*, *government*, *state*, *country*, *nations*, and *officials*. They underline the significance of government in the representations of the two issues. The key SMC Y1 suggests the presence of the theme “science”. Its most frequent tokens are *scientists*, *science*, *scientific*, *technology*, *technologies*, and *science*. They suggest that both corpora make frequent references to science in the representations of the two issues. However, Y1 ranks higher than G1.1 in both corpora, suggesting that “science” is more highly foregrounded than “politics”.

Nevertheless, a comparison of the two corpora with each other also reveals their preference for some themes and topics (see Table 2). CC features the preference for a variety of topics/themes, including “politics” (G1.2, G1.1, G2.1–), “economy” (I1 and I1.1), “food” (F1), “education” (P1), “drinks and alcohol” (F2), “work and employment” (I3.1), “flying and aircraft” (M5). The preference for “politics” suggests that the representations of CC tend to be more politicized than the representations of GW in NYT. Besides, the emphasis on the topics of “food”, “drinks and alcohol”, “economy”, and “work and environment” actually indicates that the representations of CC tend to highlight the economic and environmental impacts of CC. This can also be seen from other key SMCs with negative meanings, including E4.1– (e.g. *suffer*, *suffering*, *suffered*), and A1.1.2 (e.g. *damage*, *devastating*, *destruction*). By contrast, GW shows the preference for a limited number of topics/themes, including “science and technology” (Y1), “gas emissions” (O1.3 and “emissions” in A9–), “substances and materials” (O1), “temperature change” (O4.6), “energy” (X5.2+), and “media” (O4.3). It may be attributed to fewer uses of GW in the recent years. The preference for “science and technology” suggests that GW tends to put more emphasis on scientific consensus than CC. This will be further illustrated in Section 4.3. The preference for “gas emissions”, “substances and materials”, and “energy” also sheds light on its preference to highlight the cause and solution of GW. This can also be seen from its preference for other key SMCs which underline the action taken towards GW, including N5.1 (e.g. *limits*, and *limit*), N5– (*reduce*, *reducing*, *reductions*), N3.1 (e.g. *measures*, *measure*, *measured*), N3.8– (e.g. *slow*, *slowdown*, *slowing*), and A1.7+ (e.g. *regulate*, *limit*, *curb*). The preference for “media” (O4.3) can be attributed to the fact that GW tended to draw more media attention in the last two decades. This is in contrast to the use of CC and GW on Twitter, where Shi et al. (2020) find that GW tends to be more politicized and concerned about the general phenomenon, while CC prefers to foreground scientific perspective and refer to specific topics and issues.

Table 2: Top 20 preferential key SMCs in both corpora.

Rank	CC			GW		
	Tag	LL	SMC	Tag	LL	SMC
1	Z8	367.67	Pronouns	O4.6+	738.99	Temperature: hot/on fire
2	W4	339.36	Weather	O1.3	299.61	Substances and materials: gas
3	A2.1+	297.04	Change	W3	134.79	Geographical terms
4	G1.2	186.36	Politics	Z3	125.45	Other proper names
5	I1	65.46	Money generally	Y1	96.98	Science and technology in general
6	M5	50.81	Flying and aircraft	O4.6	96.38	Temperature
7	F1	47.8	Food	A9–	69.09	Giving
8	P1	46.48	Education in general	N5.1	51.7	Entirety; maximum
9	S1.1.1	38.81	Social actions, states, and processes	B3	50.63	Medicines and medical treatment
10	Z1	36.76	Personal names	Z99	39.2	Unmatched
11	F2	34.4	Drinks and alcohol	N5–	37.19	Quantities: little
12	G2.1–	32.76	Crime	N5	29.65	Quantities
13	E4.1–	30.82	Sad	O4.6–	27.67	Temperature: cold
14	I3.1	28.8	Work and employment generally	N3.1	27.28	Measurement: general
15	I1.1	28.27	Money and pay	W5	26.84	Green issues
16	K1	28.26	Entertainment generally	N3.8–	26.62	Speed: slow
17	G1.1	27.58	Government	X5.2+	23.8	Interested/excited/energetic
18	A1.1.2	25.28	Damaging and destroying	A1.7+	21.7	Constraint
19	H1	23.61	Architecture, houses, and buildings	Q4.3	21.64	The Media: TV, Radio and Cinema
20	S5	21.1	Groups and affiliation	O1	21.4	Substances and materials generally

4.2 Analysis of framing

An examination of the top 100 lexical collocates finds that they can be divided into four categories: (1) problem definition; (2) cause; (3) impact; and (4) solution/action (see Table 3). A number of collocates can be identified for both CC and GW, and they are marked in bold. These shared collocates suggest that CC and GW are represented in a much similar way in the NYT. As regards “problem definition”, both CC and GW are constructed as contentious issues, because these collocates communicate opposite meanings. Some underline the issue as real (i.e. *real*,

Table 3: Semantic preferences of *climate change* and *global warming*.

Types	<i>Climate change</i> (CC)	<i>Global warming</i> (GW)
Problem definition	issue (124), real (70), hoax (47), debate (45), questions (41), deny (30), reality (30), deniers (28), denial (26), skeptics (21), discussing (15)	debate (23), problem (21), issue (21), real (18), consensus (13), reality (9), skepticism (8), debating (6), skeptics (6), uncertain (5), unequivocal (4), hiatus (4), hoax (4), controversial (4), deny (4)
Cause	human (136), caused (99), energy (71), emissions (42), carbon (35), causes (31), gas (27), greenhouse (21), coal (16), induced (15), power (13), oil (13), plants (4)	human (23), caused (22), pollution (21), made (20), energy (18), causes (14), carbon (13), cause (11), contribute (10), greenhouse (8), automotive (4), coal (4), contributor (4)
Impact	effects (211), risks (94), threat (89), impact (83), consequences (55), impacts (54), security (42), related (36), serious (34), affect (32), concern (31), poses (29), concerned (27), catastrophic (24), posed (23), threatens (16), ravages (11)	effects (29), threat (28), linked (14), potential (11), impact (11), concern (8), man (7), poses (6), dangers (6), concerns (6), blame (5), dire (4), chaos (3), unrelated (3), doom (3)
Solution/Action	fight (122), action (114), address (110), fighting (62), combat (55), addressing (53), adapt (34), tackle (30), tackling (23), mitigate (21), combating (20), dealing (20), counteract (18)	fight (30), combat (21), solutions (16), address (15), act (15), fighting (13), curb (11), slow (10), limit (10), battle (8), unchecked (7), limiting (7), slowdown (6), addressing (6), solving (5), mitigate (4), tackling (3)

reality), while others question the certainty of its existence (i.e. *hoax*, *debate*, *deny*, and *skeptics*). In view of “cause”, these shared collocates underline both human causes (i.e. *human*) and non-human causes (i.e. *greenhouse*, *carbon*, *coal*). With regard to “impact”, these collocates highlight the serious impacts and threats of CC and GW, including *effects*, *threat*, *impact*, *concern*, and *poses*. In terms of “solution/action”, these shared collocates highlight the fight against the issue (i.e. *fight*, *fighting*, *combat*, *tackling*, *address*, and *addressing*) and the mitigation of the issue (i.e. *mitigate*). In other words, both CC and GW are framed as contentious issues, caused by both human and non-human factors, with serious consequences and in need of addressing and mitigation actions.

Their preference for other collocates suggests their divergence in framing the two issues. In terms of “problem definition”, while CC shows a strong collocation with *issue* (124), GW shows a strong collocation with both *problem* (21) and *issue* (21). An issue refers to a situation that requires a discussion or a debate, whereas a

problem involves a negative situation that requires an instant solution. Therefore, the nomination of CC or GW as an issue underlines that it is a topic in which different people might have different viewpoints, while the framing of GW as a problem suggests that it must be solved. The representations of GW thus tend to be more negative than the representations of CC. The strategic difference in the choice of the two words can be detected in the following example from NYT:

- (1) The president and his aides often described climate change as a “serious *issue*,” but rarely as a serious *problem*. (NYT, 03/06/2002)

The difference can also be identified in the collocates related to “solution/action”. While *solutions* (16) and *solving* (5) occur as strong collocates of GW, they do not appear as strong collocates for CC. Besides, there is more consensus on the certainty of GW than on the certainty of CC. CC shows a strong collocation with *hoax* (40), *deniers* (28), and *denial* (26). They underline the uncertainty or non-existence of CC. However, GW shows a strong collocation with *consensus* (13) and *unequivocal* (4), which underlines the consensus on GW.

As regards the “causes” of CC and GW, while both CC and GW underline human causes, CC tends to put more emphasis on the anthropogenic causes than GW. This can also be seen from the predication strategy for CC and GW. Predication strategy is a strategy to attribute features to entities (Reisigl and Wodak 2016). It can be reflected in the form of adjectives, appositions, prepositional phrases, etc. CC tends to be pre-modified by such expressions as *human-caused* (51), *human-induced* (10), and *human-driven* (3). However, GW is seldom pre-modified by such expressions as *human-caused* (3), *human-induced* (2), and *human-driven* (2). As Taylor (2003: 455) suggests, “attributive adjectives tend to characterize a thing in terms of a stable, inherent property, whereas predicative adjectives tend to denote more temporary, circumstantial properties”. It suggests that NYT tends to underline human causes as an inherent property of CC, as in the following:

- (2) President Vladimir V. Putin has publicly scoffed at the science of ***human-caused*** *climate change*. (NYT, 14/12/2014)

In terms of the “impact” of CC and GW, they show differences in both the nature and severity of the impacts. CC tends to be concerned with national security, as can be seen from the strong collocate *security* (42). However, *security* does not occur as a strong collocate of GW. Besides, CC tends to collocate with such tokens which dramatize the negative impact of CC, including *serious* (34), *catastrophic* (24). However, they do not appear as strong collocates with GW. Even though GW also shows a strong collocation with other tokens like *dire* (4) and *doom* (3). Their frequencies are comparatively low.

With regard to the “solution/action”, while NYT underlines the necessity to address and mitigate the issue, it also underlines the adaptation strategy to CC, as can be seen from the strong collocate *adapt* (34). Mitigation strategy refers to “activities to reduce or prevent carbon emissions”, while adaptation strategy concerns “activities to adjust economic and social systems to the effects of climate change” (Günay et al. 2021: 1). This is in contradiction to previous studies which claim that news reporting on CC rarely covers adaptation (Boykoff and Roberts 2007; Ford and King 2015; Liu et al. 2008; Moser 2014). However, *adapt* does not appear as a strong collocate of GW. Instead, as mentioned above, NYT also underlines the solution of the problem of GW, as can be seen from the strong collocates *solutions* (16) and *solving* (5). Therefore, while mitigation strategies have been emphasized for both CC and GW, adaption strategy has also been emphasized for CC, solution strategy for GW.

Figure 3 shows the percentages of the total frequencies of the collocates in the four categories when they are compared with the total frequencies of GW and CC in their respective corpus. It shows that CC shows the preference for “impact”, while GW shows the preference for “solution/action”, and “cause”. This further supports the findings in Section 3.1.

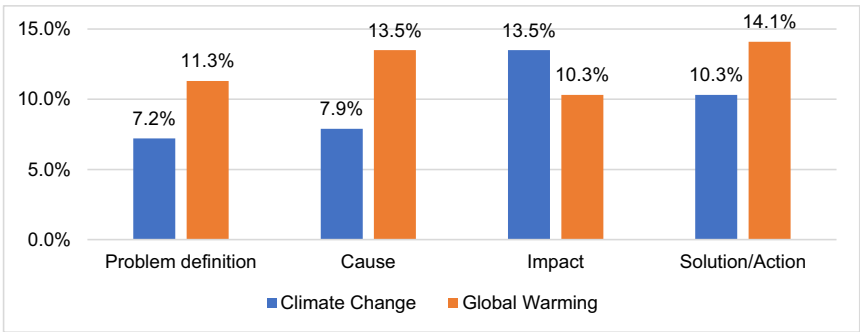


Figure 3: Percentages of five semantic preferences in the corpus.

4.3 Analysis of perspectivization

This section gives a close examination of the perspectivization strategy adopted by the NYT in representing the (un)certainty of CC and GW. The concordance lines of the collocation of GW/CC with two collocates with contradictory meanings (i.e. *real* and *hoax*) are further examined. As Boykoff and Boykoff (2004) argue, the

adherence to the norm of balanced reporting in US prestige press has resulted in biased coverage of “anthropogenic contributions to global warming and resultant action” (Boykoff and Boykoff 2004: 125). This is what they call “false balance”. Therefore, an examination of the perspectivization strategy in the representations of the (un)certainly of CC or GW can further expose how the contradictory viewpoints are coherently organized and whether “false balance” can still be identified in NYT. A distinction between *attribution* and *averral* can be made in examining these concordance lines (Partington 2012; Sinclair 1988). *Attribution* refers to the explicit attribution of what is being said to an external source, while *averral* refers to the statement of the viewpoints by the newspaper itself. As Example (3) shows, the statement that CC is real is attributed to *hundreds of scientists* rather than the news reporter. Therefore, it is an example of *attribution* rather than *averral*.

- (3) Hundreds of scientists are also **telling** Mr. Trump in a new letter that climate change is *real* and needs to be addressed [...]. (NYT, 05/12/2016)

An examination of the collocation of *real* (70) and CC finds that 60 (86%) address whether CC is real or not. All of the 60 concordance lines underline CC as real, and all the statements are attributed to external sources rather than averred by the news reporters themselves. Five groups of external sources can be identified, including “science” (16), “common people” (15), “politics” (13), “business” (4), and “Religion” (1). Examples are as follows:

- (4) During his seven and a half years in office, Mr. Obama said, *a majority of Americans* have come to **believe** “that climate change is *real*, that it’s important and we should do something about it”. (**Common people**) (NYT, 08/09/2016)
- (5) *Exxon Mobil* has **acknowledged** climate change is *real* since the mid-2000s. (**Business**) (NYT, 24/08/2017)
- (6) *Democrats* have long **agreed** that climate change is *real* and ought to be addressed, but they have never made it a decisive issue before. (**Politics**) (NYT, 29/04/2019)
- (7) We Are Conservatives and *We* **Believe** Climate Change Is *Real*. (**Politics**) (NYT, 21/04/2018)
- (8) But if *the pope* can **convince** some people that climate change is a *real* and serious problem, that’s a good thing. (**Religion**) (NYT, 22/09/2015)

- (9) Among the targets of the suits was Exxon Mobil, *whose own scientists found*, as most scientists have, that climate change was *real* and that human behavior was contributing to it. (**Science**) (NYT, 11/01/2018)

Therefore, “science”, “common people” and “politics” occur as the three dominant groups of sources. Their similar frequencies can be attributed to the journalistic norm of “balanced” reporting (Boykoff 2008; Boykoff and Boykoff 2004), which requires the relatively equal recognition to multiple sides of contentious issues (Bennett 1996). Therefore, NYT still features the balanced representations of the voices from politics, science, and common people in its representations of CC as real, even though Boykoff (2007) claims that this “false balance” is less noticeable after 2005.

While adhering to the journalistic norm of “balanced” reporting, the news reporters also indicate their stance towards these statements through reporting verbs. The most frequently used reporting verbs in these examples include *say** (8), *agree** (5), *acknowledge** (4), *convince** (3), *believe** (5), *know** (2), *tell** (2), and *understand** (2). Among them, *acknowledge**, *accept**, *know**, *agree**, *believe**, *understand**, and *endorse** are mental process verbs (Halliday 1994), and some of them carry the implicature that the represented statement is true, such as *acknowledge**, *accept**, *know**, and *understand** (Haarman and Lombardo 2009).

NYT’s explicit stance can also be revealed through its use of *hoax*. An examination of the 49 concordance lines of the collocation of *hoax* and CC finds that 46 (94%) underline that CC is a hoax. However, all of them are attributed to the politicians in the US, the former US President Donald Trump in particular. Besides, NYT also shows disalignment with these statements in three ways. First, scare quotes are often used in these examples to show that these are the words used by the attributed sources and that the news reporter does not share the responsibility for these words (Fairclough 1992, 1995), as in the following:

- (10) *Mr. Trump* has **called** human-caused climate change a “*hoax*”. (NYT, 10/11/2016)

Reporting verbs are also used to indicate the news reporter’s disalignment with these viewpoints. The most frequently used reporting verbs in these concordance lines are *call** (15), *think** (7), *claim** (3), *argue** (3), *denounce** (1), *mock** (1), and *deride** (1). Most of them are verbal process verbs (Halliday 1994) and suggest that what is stated is personal and malicious, as in the following:

- (11) *He* often **mocks** the established science of human-caused climate change and **dismisses** it as a *hoax*. (NYT, 02/08/2016)

- (12) But nowhere is the difference as stark as it is on climate change, which *Mr. Trump* has **mocked** as a *hoax*. (NYT, 05/07/2017)

Finally, the newspaper's dealignment with these statements can also be perceived through their overt negative evaluation of these statements, as in the following:

- (13) And a determined faction even **argues** that climate change is a *hoax*, as President Donald Trump has *falsely* stated at various times. (NYT, 19/07/2019)
- (14) *Ted Cruz's argument* that climate change is a *hoax* to justify a government takeover of the world is *absurd*. (NYT, 20/04/2016)

In these examples, the claim that CC is a “hoax” is often negatively evaluated by such expressions as *falsely* and *absurd*. They suggest that the represented statements are not true. In other words, the news reporter does not share the same view with the attributed sources.

The same is true for the collocation of GW and *real* (18). An examination of all the concordance lines finds that 13 out of 18 (72%) instances state whether GW is real or not. 12 of them underline GW as real, and only 1 occurrence underlines GW as not real. Examples are as follows:

- (15) *A panel of top American scientists declared* today that global warming was a *real* problem and was getting worse. (NYT, 07/06/2001)
- (16) But if Bush says *our plan* is to **acknowledge** that global warming is *real* and create incentives and voluntary commitments, that will be wholly unpersuasive to Europe. (NYT, 08/06/2001)

Similar to the representations of CC, the sources attributed include “politics”, “science”, “common people”. These statements are often introduced by the reporting verbs and some expressions which also carry the implicature that what is stated is a matter of fact, as can be seen from the expressions like *declare**, *acknowledge**, *the mounting evidence*, and *actually the mainstream view*.

Hoax (4) does not appear as a frequent collocates of GW. This is also in contradiction to the statement that GW frequently collocates with *hoax* (Shi et al. 2020). Like CC, the external sources are also attributed to the politicians in the US.

- (17) *The Republican presidential contenders regard* global warming as a *hoax* or, at best, underplay its importance. (NYT, 07/09/2011)
- (18) *Ron Paul of Texas calls* global warming “the greatest *hoax* I think that has been around for many, many years”. (NYT, 07/09/2011)

Therefore, NYT still adheres to the journalistic norm of “balanced” reporting by citing contrarian viewpoints (Boykoff and Boykoff 2004). However, it also seeks to correct “false balance” through showing explicit and implicit alignment with the scientific consensus on the existence of CC and GW and disalignment with these viewpoints that challenge or question the existence of CC and GW (Brüggemann and Engesser 2014, 2017; Schmid-Petri et al. 2017).

5 Conclusion

To sum up, a corpus-assisted discourse study of the representations of CC and GW in NYT reveals both similarities and differences in their representations. The analysis of the topics/themes associated with CC and GW finds that both show the preference for the themes of environment, politics, and science. Nevertheless, the representations of CC tend to be more politicized, while GW shows more preference for science. Meanwhile, CC features the preference for a richer variety of topics associated with the impacts of CC, whereas GW prefers to underline a limited number of topics concerning the causes of GW and the action taken towards it. The analysis of framing reveals that CC and GW tend to be framed as contentious issues, caused by both human and non-human factors, with serious impacts and in need of some actions to address and mitigate it. CC is framed as more contentious as GW. More emphasis is put on the human causes of CC than the human-causes of GW. The impacts of CC are framed as more serious than the impacts of GW. While mitigation strategy is emphasized for both CC and GW, an adaption strategy is highlighted for CC, but a solution strategy is suggested for GW. The analysis of perspectivization strategy finds that while NYT still adheres to the journalistic norm of “balanced reporting”, it corrects the “false balance” by showing explicit and implicit alignment with the scientific consensus on CC and GW and disalignment with these viewpoints which question the scientific consensus on the issue. Future studies can further investigate the use of these two terms in different US news media and overcome the limitation of this study, i.e. GW is less frequently researched in the present study since it is infrequently used in recent years. It would be more desirable to examine whether GW has been gradually replaced by CC in the US news reports.

This study shows the benefits of a corpus-assisted discourse analysis approach in the study of the representations of CC and GW. By giving an extensive examination of a large number of news articles, it provides empirical evidences for the actual use of the two terms in NYT. The use of different corpus analytic tools and methods provides different entry points for the further analysis of the data, thus allowing the analysis of the corpora at different levels (Baker et al. 2008).

The incorporation of the theories and methods from discourse analysis can present a more fine-grained description and interpretation of the findings generated by the corpus-analytic tools, and it will overcome the weaknesses of pure automatic computer-assisted text analysis on a large scale (Salway 2017). Although this study further supports the findings of some previous studies in some aspects, it also provides some findings which are inconsistent with the findings of previous studies. Although some studies suggest US news media fail to balanced reporting (Brüggemann and Engesser 2014, 2017; Shi et al. 2020), our finding still demonstrates that US news media still prefer “balanced reporting” but show supportive attitudes towards the scientific consensus. This can be attributed to the different methodologies employed and the different media platforms examined. Future studies on other news media are required to examine whether they show different patterns in the representations of CC and GW and how these different news media affect public understandings of CC and GW.

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