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RESEARCH ARTICLE



“Climate Change” or “Global Warming”? The (Un)Politicization of Climate in Chinese Social Media Platform

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ABSTRACT

Though previous research shows the terminology and framing way that political elites choose can influence public climate attitudes, the association between term preferences and politicization of climate change is understudied. This study focuses on how different social groups in China use terminologies and frames and how the wording and framing choices affect public climate opinions. Using manual and computer-assisted content analysis of the highest viewed videos and users' comments on Bilibili, we found government accounts tended to use climate change (CC) and associated climate problems with politics, while individuals were likely to use global warming (GW) and understood climate mainly from its potential impacts. Post-video comments under the CC-titled videos were about climate politics, while comments under the GW-titled videos focused on humanity and earth. Meanwhile, users' comments to specific video frames had certain emotional patterns. We characterized the differences of CC- and GW-titled videos and comments as politicization and unpoliticization respectively. Our findings suggest that the preferences of terminologies and associated frames among different social groups can affect public opinions and facilitate (un)politicization of climate change in China. This study sheds light on how communication strategies could significantly spin public understanding of important public issues.

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Introduction

The politicization of climate change has become increasingly intense over time (Chen et al., 2022; Chinn et al., 2020; McCright & Dunlap, 2011). Referring to the prominence of political actors in coverage, politicization of climate change has long been criticized for reducing public support for mitigation policy and casting doubt on the existence of a scientific consensus (Bolsen et al., 2014; Chinn et al., 2020). Thus, people attempt to depoliticize climate change by emphasizing science-based trajectories and respecting professionalism (Marquardt & Lederer, 2022). Despite extensive research highlighting the tensions between politicization and depoliticization of climate change, our understanding of the factors influencing individuals' politicized or unpoliticized perceptions of climate issues remains limited.

Previous work suggests that political elites use the power of terminologies and frames to shape public climate beliefs (Lakoff, 2010; Schuldt et al., 2011), which indicates latent political intentions behind the choice of linguistic strategies. For instance, climate change (CC) and global warming (GW) are a pair of terms that are often used interchangeably in communicating climate change,

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even though they may emphasize different aspects of climate issues (Whitmarsh, 2008). In the United States, Republicans tend to use the term global warming (questioning the authenticity of global warming) more often than climate change and associate global warming with hoax frames. This rhetorical strategy aligns with the Republican objective of fostering public doubt on global warming.

However, our knowledge about how the two terms interact with the politicization of climate change is limited. Specifically, is there any difference in using climate terms between political and nonpolitical actors? Are the two terms associated with specific frames regarding climate politics? Do terminologies influence the politicized public understanding of climate change?

We also lack an investigation of the terminology effects in different cultural contexts. Cultural schema plays an important role in influencing people's thinking of certain concepts (Hunzaker & Valentino, 2019). It not only exists in different ideological groups but is embedded in distinct countries. However, previous studies predominantly illuminate politicized phenomena and explore what CC and GW mean differently for liberals and conservatives in the United States. It is imperative to assess the effects of climate terms in the global context.

The present study aims to answer these questions through an analysis of Bilibili, a youth-dominated video-sharing social media platform in China. As the world's second largest economy and the biggest emitter of greenhouse gasses, China occupies a central position in the global climate change debate. Combined with manual and computer-assisted content analysis, we examined China's interpretation and response to this critical issue, explored the choice of terminology and frames, and evaluated their influence on public opinion. Our study sheds light on the online landscape of climate discussions in China and reveal how terms and frames affect public understanding of climate change.

Literature review

The politicization of climate change

Over the past three decades, the degree of politicization surrounding climate change has reached new heights (Chinn et al., 2020). This politicization emerges when political actors selectively cite evidence to cast doubt on climate change, aligning their stance with partisan interests and ideological divisions (Bolsen & Druckman, 2015). Politicized coverage of climate issues will shift public attention from scientific information to controversial events, hostile conflicts, and political debates. Consequently, it will undermine public willingness to combat climate change (Chinn et al., 2020).

Framing has been proved as a key tool in understanding how politicization influences public attitudes toward climate change (Bolsen & Druckman, 2015). Frame producers/sponsorship, frame patterns, and framing effects are central dimensions for disentangling the politicization of climate change. Chen et al. (2022) found that the climate discourse on Twitter was highly politicized from 2018 to 2021, with notable participation from politicians, partisans, and nationalists. Nisbet (2009) argued that due to nuanced framing preferences among conservatives and liberals, framing may reinforce the American partisan polarization on climate change perceptions. Similarly, Bolsen et al. (2014) substantiated that politicizing science reduced public support for nuclear power.

Building upon previous studies demonstrating the significant impact of terminology on citizens' climate beliefs (Schuldt et al., 2011), this study aims to examine the extent to which the two terminologies, GW and CC, function as powerful tools in intensifying the politicization of climate change. Since the two terms imply disparate connotations (Whitmarsh, 2008), trigger different emotions (Lineman et al., 2015), and affect environmental beliefs distinctively, they are often harnessed by political elites to cultivate polarized policy preferences (Schuldt et al., 2011). However, the relationship between the two terms and the politicization of climate change has not been fully examined. Specifically, (1) Which term do political and nonpolitical actors prefer to use? (2) How do the two terms diverge in their framing ways? (3) When terms are combined with specific frames, what effects do the two terms have in terms of public responses and emotions?

We argue that the effects of frames and terms can only be understood in certain cultural contexts. Because frames are part of culture, the receivers interpret framing devices with cultural phenomena that they are already familiar with (Van Gorp, 2007). Being defined as shared knowledge or meaning, cultures exist on varying levels, from family and organizations to national cultures (Hunzaker & Valentino, 2019). However, despite the extensive related work on partisan groups within western contexts, there is very little discussion about the politicization of climate issues and the effects of terms and frames in non-western countries. Given that China is playing an increasingly important role in the global combat against climate change, the present study aims to unravel the terminology spin and provide insights into how wording and framing choices significantly shape public opinion formation.

The politics behind the climate frames

The preference for climate terminologies and frames

Different stakeholders typically adopt distinct framing strategies to interpret and publicize a social issue. Diverse actors including governments, citizens, experts, communities, NGOs, and businesses often hold different interests and interpretations of climate change (Nerlich et al., 2010). Here, we categorize participants into three major groups: the state, organizations, and individuals. We argue that they are representative and significant in studying climate discussion in China, based on the following rationale:

Firstly, within China, the State is the dominant power in environmental governance (Beeson, 2010). Official decisions are often made by administrative officials and experts without the incorporation of public opinion. Moreover, the construction of environmental infrastructure and policy implementation highly relies on the central administrative authority and cross-regional coordination, rendering the State the most important and primary actor in interpreting environmental issues.

Simultaneously, organizations (e.g. NGOs, commercial companies, and institutions) and individuals also play vital roles in shaping public understanding of environmental issues. According to Sullivan and Xie (2009), organizations and individuals are major actors in the virtual network of environmental activism. Organizations usually have significant resources and mobilization ability, while individuals such as experts and opinion leaders can influence public opinions and actions.

Secondly, governments, organizations, and individuals engaged in climate discussions usually exhibit distinct linguistic characteristics. For instance, China's official environmental discourse typically reflects administrative rationality, characterized by administrative management, expert recognition, and supervision. Nevertheless, civil environmental discourse tends to align more closely with democratic pragmatism, emphasizing the pursuit of social justice and government accountability (Dai & Zeng, 2022). Organizations normally adopt rhetoric strategies to justify their claims, facilitate advocacy, and acquire legitimacy (Ihlen, 2009).

Given these differences among various participants, examining their preferences for climate terminologies and framing patterns is rather necessary. Existing studies have predominantly focused on frame comparisons of climate change across different countries and regions or political parties (Jang & Hart, 2015). Given China's important position in global climate governance, studies on how Chinese various participants differ in their terminology and framing preferences will supplement our knowledge outside western contexts. Thus, we derive the first research question:

RQ1. To What extent do different participants vary in preference of **the terms** (GW vs. CC) and **frames** in China?

Frames of climate change and public attitudes

Given that frames in a message can direct individuals' attention toward specific aspects of the decision-making process (Druckman, 2001), it means that disparate frames associated with GW

and CC could influence how people interpret climate change. Many studies have employed framing theory to investigate framing effects primarily from a psychological perspective, often focusing on individual-level effects (Schuldt et al., 2011). The framing effects on collective consciousness, particularly within diverse groups, have rarely been studied. By examining user-generated content on social media, such as videos and comments, we may be able to capture framing patterns at a collective level. In the meantime, a comparison of frames under the GW and CC terms may further reveal how frames shape people's understanding of climate issues.

As an integral component of public opinion, emotions matter for climate change (Norgaard, 2011). Examining their roles in climate change communication has important implications for encouraging public reflection and deliberation on climate risks (Roeser, 2012). Emotions are highly linked to subsequent judgments and decision-making involving environmental risks (Slovic, 2000). If the emotions associated with thinking about climate issues are uncomfortable or socially unacceptable, individuals may lack the awareness of risks and the motivation to act (Roeser, 2012). Previous studies have examined how various emotions, including fear, anger, and anxiety, impact public perceptions of a wide range of risks (Sjöberg, 2007). Assessing public emotions offers valuable insights for forecasting public engagement in climate issues.

Framing ways play a significant role in evoking emotional responses and shaping public opinions regarding contentious social issues (Lecheler et al., 2015; Myers et al., 2012). Many previous studies have identified recurring frames used by news outlets when addressing climate issues, as well as the emotions linked to different climate frames. One of the most used frames is "impact frame," presenting "what will happen as a consequence of climate change" (p. 273) and discussing its negative, positive, or debated effects (Trumbo, 1996). These impact frames often effectively elicit feelings of sadness and fear (Nabi et al., 2018).

Additionally, Nisbet (2009) identifies other important frames pertinent to climate change, namely, the "scientific frame," which introduces the history, causes, and relevant scientific knowledge of climate change. Furthermore, the "action frame" (also referred to as the public accountability and governance frame) advocates for more public participation, responsiveness, and governance to address climate crises. Scholars have demonstrated that the general public, especially those with limited related knowledge and abilities, tends to trust scientists on controversial scientific issues (Critchley, 2008). Action frames can also foster young people's hope and agency in the face of climate change (Tayne et al., 2021).

Lastly, the fourth frame revolves around the presentation of climate politics, highlighting the political conflicts and international cooperative efforts associated with climate change. Myers et al. (2012) found that depicting climate change as a threat to national security would evoke feelings of anger. Given the extensive body of prior research on frames and the relationships between emotions and frames, we propose the second research question and anticipate the following associations:

RQ2. What are the major frames in post-video comments under the CC and GW comparison?

H1. Climate videos with impact frames will lead to users' comments containing more words with sadness and fear emotions.

H2. Climate videos with scientific frames will lead to users' comments containing more words with the trust emotion.

H3. Climate videos with action frames will lead to users' comments containing more words with anticipation and joyful emotions.

H4. Climate videos with political frames will lead to users' comments containing more words with anger and disgust emotions.

Method

Studying Bilibili's videos and comments

We focused on climate-related post-video discussions on Bilibili, a leading video-sharing platform in China. As “China’s YouTube” (Economist, 2021), Bilibili has 1.7 billion daily views and 272 million monthly active users (Bilibili, 2023). Most importantly, knowledge-sharing videos constitute a large portion of Bilibili’s content and dominate the platform. In 2020, Bilibili launched a section for technology and science knowledge sharing, named “Knowledge Zone (知识区).” Indeed, many previous studies focused on Bilibili to study the correlations between science communication strategies and viewers’ behavioral, emotional, and cognitive engagement (Schneider, 2021; Zhang et al., 2023).

We chose videos as our research subject for two reasons. Firstly, studies have demonstrated the effectiveness of videos in enhancing people’s perception of climate disasters compared to transcripts (Goldberg et al., 2019). Additionally, Bilibili enables viewers to post comments under videos by sharing their thoughts about this video and discussing it with other viewers. The affordance of posting comments allows scholars to study the impact of video content on viewer engagement (Dubovi & Tabak, 2021). Thus, Bilibili serves as a showcase of how Chinese youth discuss and engage with scientific issues, particularly climate change.

Data collection

Our data collection and analytic process is shown in Figure 1. We used two keywords “climate change” and “global warming” respectively to search for videos on Bilibili on 17 September 2021. To focus on the most popular and widely disseminated videos, we employed a self-defined Python web crawler to extract the top 1000 most viewed videos under the CC and GW webpages respectively. The technique follows the method suggested by prior research (Park et al., 2021). To ensure that video content aligns with either CC or GW, videos in the dataset had to meet at least one of the following criteria: CC or GW was mentioned in (1) the video’s title; or (2) the video’s tags; or (3) the video’s introduction provided by the producers. We contend that the sample videos were representative instead of being sorted randomly, as we repeated the retrieval process multiple times from September to November 2021, with no obvious differences between results.

Then, we preprocessed the data manually. We removed the duplicate and unrelated videos. Our dataset consisted of 1,212 most viewed videos (CC = 740, GW = 472) in total. Then, we

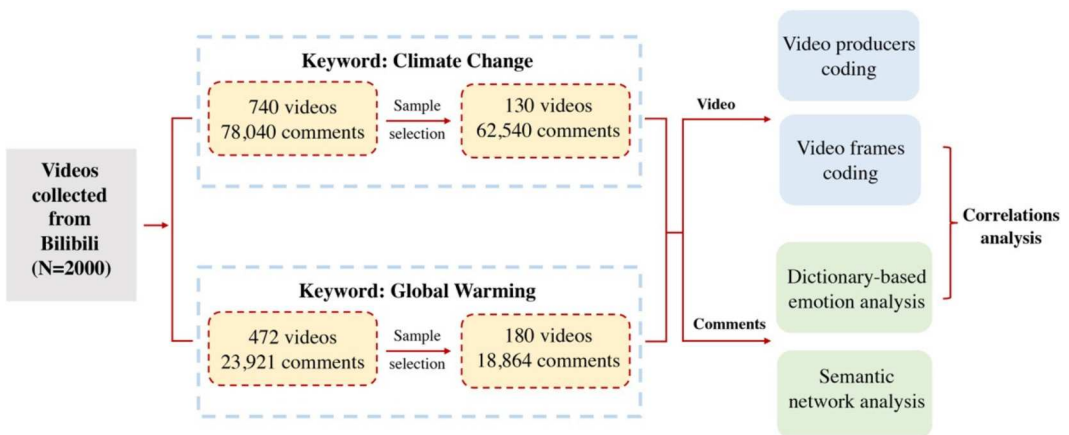


Figure 1. A summary of the study’s data analysis.

downloaded all comments from these videos, gathering 78,040 comments from videos labeled CC and 23,921 comments from videos labeled GW. Since our study aims to investigate how terminologies and framing ways affect public discussions, we chose to focus on videos with higher comment counts. We reordered the 1,212 videos by the number of comments and included videos whose comments constituted 80% of the total comments. The final dataset included 130 CC-labeled videos with 62,540 comments and 180 GW-labeled videos with 18,864 comments.

Manual content analysis

In the context of climate change, we reviewed literature focusing on climate change frames and chose to focus on the following frames informed by this scholarship: impact, scientific, action, and political frames. Some of the frames were adapted from Nisbet (2009). Table 1 outlines the definitions of frames used in this study and includes video examples for each frame. In practice, the frame was quantified by the type of main characters that appeared in the video and the video’s theme. For example, a video showing a presidential speech on climate change would be classified as adopting a political frame. But if the political leader was urging people to take climate action in the video, it would be categorized as using an action frame.

Based on the discussion of three important types of participants mentioned above, we focused on: (1) government accounts including state media and official groups (e.g. People’s Daily, CGTN, and Guancha), (2) organizational accounts including NGOs, commercial institutions, and media outlets with non-governmental backgrounds (e.g. WWF and North American Student Daily), (3) individual accounts including scientists and popularizers of science and nonprofessional users (e.g. FDU Zhao Bin and Dr. Dai’s Lab). We provide the coding scheme for the types of participants in Appendix I.

Table 1. The definitions of frames and video examples.

Frame category	Definition	Example
Impact frame	(1) Imagining or exaggerating the outcomes of climate change. (2) Introducing the relationships between natural disasters (e.g. melting glaciers, epidemic, animal extinction, rising sea-level, and extreme weather) and climate change.	How severe Australia’s bushfires actually are (澳大利亚山火有多严重) It’s too hot! One billion marine animals in Canada are dying from heat (天太热! 加拿大10亿海洋动物被活活热死)
Scientific frame	Explaining causes, history, and the future of climate change from the professional and scientific perspectives.	Fudan Zhao Bin: Why should we talk about the biodiversity crisis when species diversity has not decreased? Let’s read Nature & Science together! (【复旦赵斌】明明物种多样性并未减少, 为啥还说生物多样性危机呢? 一起读Nature & Science 032)
Action frame	Call people to take real actions or propose possible solutions to combat climate change.	Leonardo DiCaprio’s Climate Summit Speech At The UN (莱昂纳多在联合国就全球气候变暖发表演讲)
Political frame	(1) Emphasizing political, economic, and cultural conflicts in climate change among different countries. (2) Governmental leaders’ climate change statements, policies, and activities, such as international climate-centered negotiations, meetings, and conferences. (3) Environmental protests and youth climate movements.	Macron appealed to American States: Don’t listen to the federal government! Continue to implement the Paris Agreement (马克龙号召美国各州: 别听联邦政府的! 继续执行巴黎协定!) How strong are China’s climate actions? Lijian Zhao gave two examples (【直通外交部】中国气候行动的力度有多大? 赵立坚举了两个例子)

Two independent coders manually coded the account types and video frames. We executed Cohen's Kappa tests for account types and each category of video frames on the whole sample. After two rounds of training sessions, the intercoder reliabilities indicated substantial agreements between the two coders (Table 2). If there were disagreements between two coders, they would negotiate on the controversial ones and decide the categorization together.

Sentiment analysis and semantic network analysis

We applied semantic network analysis to identify the major frames in comments on CC and GW videos. Semantic network is usually an undirected network mapping semantic relationship. In public opinion research, the analysis of semantic units and relationships in networks is useful for decoding how the collective discourse is generated, produced, and exchanged (Yang & González-Bailón, 2017). Most importantly, the semantic network offers an efficient approach to analyzing large-scale discourse and extracting central topics using probabilistic algorithms. Given our sample size and research objectives, we employed semantic network analysis to monitor public discussions surrounding climate issues.

The process of constructing semantic networks in this study involved several steps: Firstly, we preprocessed the comments from CC and GW videos. To balance the different sizes of comments between CC and GW videos, we chose to include words that appeared at least 150 times for CC and 75 times for GW in our final datasets. Secondly, we used Python to generate matrices based on the co-occurrence relationship of words in each comment. Thirdly, we visualized these matrices using Gephi and calculated the modularity score of semantic networks using Gephi's built-in algorithm. To capture the representative characteristics, we only included the clusters whose proportion was over 5% in the whole network. Finally, we reconstructed CC and GW semantic networks based on these representative themes accordingly (Figures 4 and 5). See Appendix II for detailed GW and CC network information.

To examine how people express emotions in response to videos with different frames, we relied on the 2017 National Research Council Canada (NRC) Emotion Lexicon (version 0.92) to conduct word-level sentiment analysis in comments. This lexicon comprises 14,200 frequently used words in over 100 languages and their associations with eight basic emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust). The NRC Lexicon is widely utilized for detecting public emotions on social media platforms (Loureiro & Alló, 2020).

However, some commonly appeared emotional words on Bilibili, such as naysayers (杠精) and blacklist (拉黑), are not included in the NRC Lexicon. Additionally, the unique platform culture sometimes alters the original meaning of words. To address this, we manually collected emotional words used by Bilibili users and annotated their emotional attributes. The supplemented lexicon is contextualized for identifying emotions of climate-related comments on Bilibili (see Appendix III for the supplemented lexicon).

To test the validity of the supplemented lexicon, we randomly selected 200 comments from the dataset. We applied ChatGPT to conduct sentiment analysis and compared the outputs of ChatGPT and the NRC emotional lexicon. The results suggest an acceptable agreement between the outputs

Table 2. Reliability coefficients.

	Climate change	Global warming
Impact frame	0.84	0.75
Scientific frame	0.79	0.62
Action frame	0.61	0.71
Political frame	0.85	0.80
Others	0.60	0.67
Video producers' attribute	0.90	0.82

of the two methods (The percent agreements are over 60% for anger, disgust, fear, joy, and sadness). More details are available in Appendix IV.

Results

Terminologies and frames under the CC and GW comparison

Out of the 310 videos, 98 (31.6%) were published by governmental accounts, 172 (55.5%) were from individual accounts, and the rest 40 (12.9%) were from organizational accounts. To examine the terminology and framing preferences among different groups (RQ1), we analyzed the distribution of account categories under two terms. According to the Chi-square result, there was a significant difference in terminology usage between governmental accounts and individual accounts ($\chi^2 = 64.452$, $df = 1$, p -value $< .000$). Figure 2 illustrates that CC was much more prevalent among government accounts compared to GW. Around 80% of the videos shared by government accounts were labeled with CC, while 77.3% of the videos uploaded by individual accounts were labeled with GW. Organizational accounts applied two terms relatively equally, with 47.5% of videos labeled CC and 52.5% labeled GW.

The findings also showed a significant difference between political frames and impact frames under the CC and GW comparison ($\chi^2 = 56.169$, $df = 1$, p -value $< .000$). Among CC-labeled videos, most videos (68 out of 130 videos, 52.3%) applied the political frames, whereas for videos termed GW, nearly half (77 of 180 videos, 42.8%) were associated with the impact frames. Between the usage of political frames and scientific frames among CC- and GW-labeled videos, there was also a statistically significant difference ($\chi^2 = 52.415$, $df = 1$, p -value $< .000$).

Furthermore, different social groups tend to use varied frames (Figures 2 and 3). Under CC (Figure 2), most of the political frames were produced by governmental accounts ($N = 51$) focusing on international relations and national interests. Firstly, these frames often involved discussions of politicians' statements and actions in response to the climate crisis. Secondly, political perspectives were evident in the descriptions of environmental protests in western countries. Thirdly, positive coverage of China's domestic actions and progress was also prevalent.

Referring to CC-labeled videos, individual accounts showed a great preference for impact frames ($N = 10$) and scientific frames ($N = 9$). Organizational accounts predominantly used scientific frames ($N = 5$) and action frames ($N = 5$) for CC. Accounts established by scientific research institutions preferred to adopt scientific frames, while accounts established by non-governmental organizations favored action frames to motivate the public to take real actions.

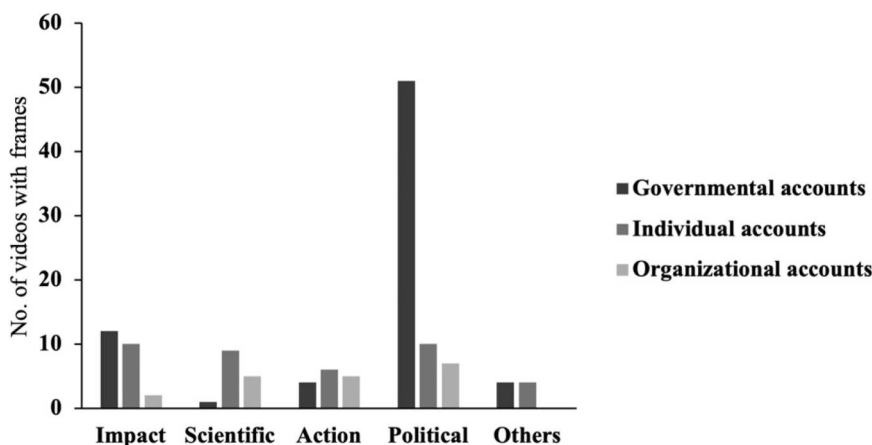


Figure 2. The number of frames applied by three types of accounts in CC.

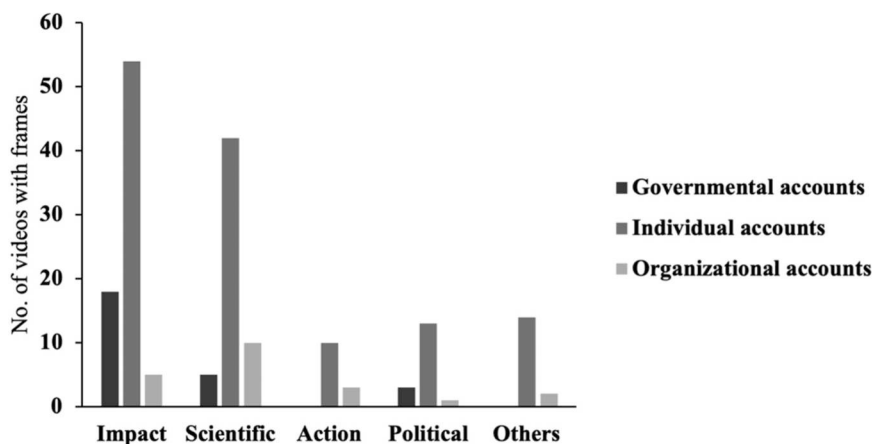


Figure 3. The number of frames applied by three types of accounts in GW.

Under GW (Figure 3), governmental accounts showed the most preference for impact frames ($N = 18$), and their videos primarily focused on negative consequences of global warming for other countries. Individual accounts also preferred to portray GW using impact frames ($N = 54$) and

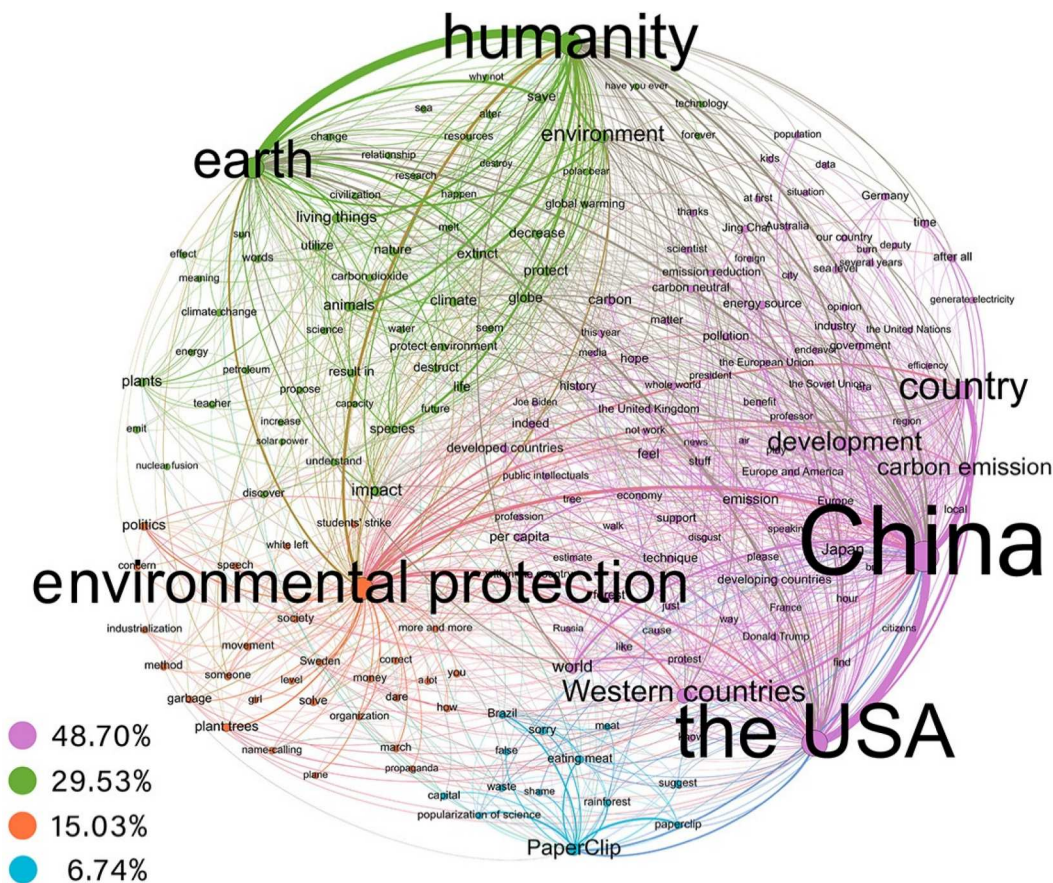


Figure 4. The semantic network of comments under videos labeled with climate change.

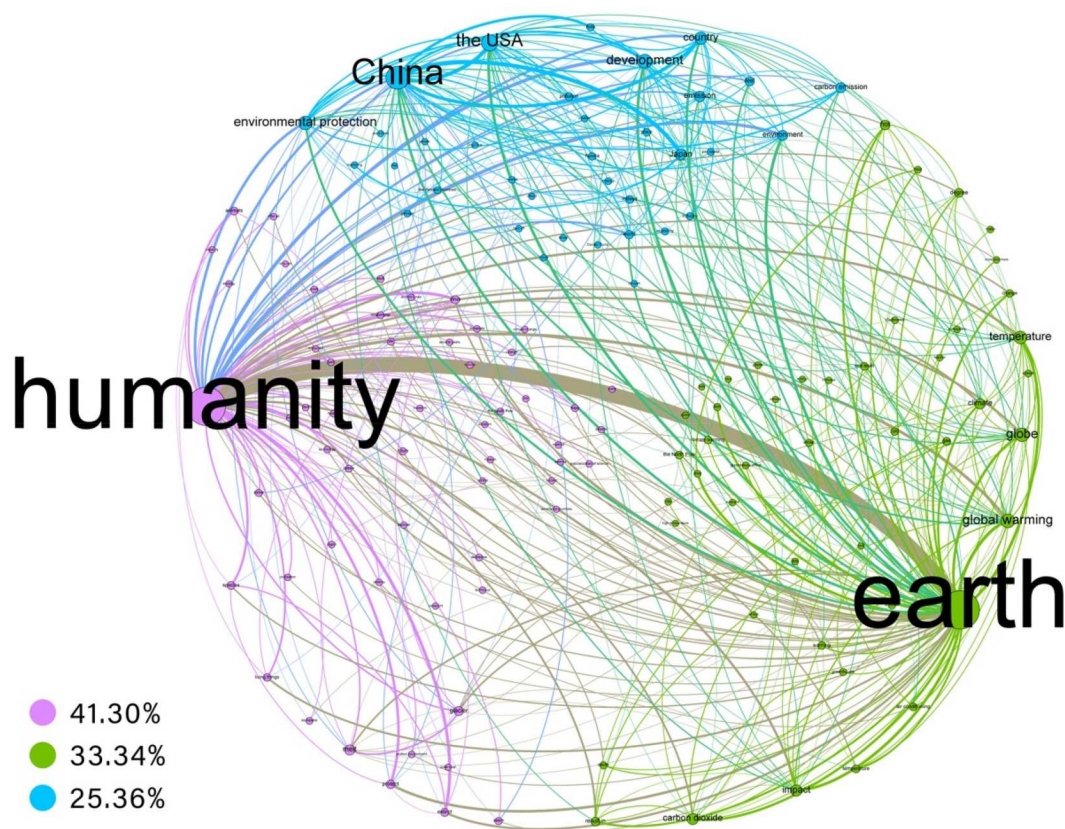


Figure 5. The semantic network of comments under videos labeled with global warming.

scientific frames ($N = 42$). Most videos using impact frames highlighted devastating consequences of GW for the earth and humankind. In videos using scientific frames, some popularizers of science debunk rumors about global warming. Similarly, organizational accounts prefer to link GW with scientific frames ($N = 10$) and impact frames ($N = 5$).

Semantic network of comments

To address RQ2 concerning the major differences in the comments to videos under the CC and GW comparison, we applied semantic network analysis to study the comments. The results reveal distinct patterns in the comments under the two terms (Figures 4 and 5). A modularity analysis further illustrates the specific difference between the two semantic networks (refer to Table 3). The prominent frames emerging from the CC network include *China-US* (48.70%), *earth human* (29.53%), *environmental protection* (15.03%), and *PaperClip* (6.74%). In contrast, major frames emerging from the GW network are *humanity* (39.58%), *earth* (31.94%), and *China-US* (15.03%).

Frames under climate change (CC)

China-US. Climate politics is at the heart of public debates under CC. The *China-US* frame is the largest corpus regarding politics and international relations. The nodes *China* (degree = 181) and *the USA* (degree = 148) ranked first and second respectively in the whole network. The nodes, such as *western countries*, *carbon emission*, and *development* are related to discussions about the US withdrawal from the Paris climate deal and carbon emission rights.

Table 3. Modularity analysis of CC and GW semantic networks.

Network	Cluster (proportion of the network)	Most frequent five words	Degree	Eigenvector centrality	Cluster color
Climate change	China-US (48.70%)	China	181	1.000	Purple
		the USA	148	0.902	
		country	83	0.653	
		Western countries	61	0.528	
		development	53	0.523	
	Humanity & earth (29.53%)	humanity	128	0.824	Green
		earth	110	0.764	
		environment	41	0.437	
		impact	26	0.335	
		living things	21	0.174	
	Environmental politics (15.03%)	environmental	122	0.812	Orange
		protection			
		politics	17	0.248	
		plant trees	15	0.254	
		solve	10	0.213	
	PaperClip (6.74%)	garbage	10	0.215	Blue
		PaperClip	39	0.294	
		sorry	11	0.010	
		eating meat	11	0.133	
		Brazil	9	0.101	
Global warming	Humanity (39.58%)	paperclip	8	0.092	Purple
		humanity	109	0.995	
		melt	13	0.292	
		glacier	10	0.247	
		protection	8	0.195	
	Earth (31.94%)	virus	7	0.166	Green
		earth	109	1.000	
		global warming	26	0.498	
		globe	25	0.492	
		temperature	22	0.451	
	China-US (15.03%)	impact	18	0.195	Blue
		China	57	0.689	
		the USA	34	0.522	
		development	26	0.469	
		environment protection	25	0.445	
		country	21	0.429	

Environmental politics. The *Environmental politics* frame centers around the world-renowned Swedish teenage environmentalist, Greta Thunberg. Words such as *Sweden* and *girl* paired with *movement* and *school strike*. Notably, these words are closely associated with negative words such as *political correctness*, *curse*, and *baizuo* (the white left-wing).

Humanity & earth. With less focus on politics compared to the above-mentioned frames, words connected to the *earth & human* frame include *biology*, *plants*, *sea*, *resource*, *animal*, and *polar bear*. These words reflect commenters' awareness of the challenges posed by climate threats.

PaperClip. Words associated with the *PaperClip* frame are *smear*, *capital*, and *apology*, indicating public negative feelings towards PaperClip. PaperClip is a commercial account dedicated to popularizing science. In their video *How to Quickly Destroy the World's Forests*, PaperClip connected Chinese shoppers' meat, eggs, and milk purchases with the massive destruction of the Amazon rain-forest, sparking angry protests on the Chinese internet.

Frames under global warming (GW)

Humanity. The GW semantic network significantly differs from the CC network. The *humanity* frame, emphasizes more on the fate of humanity under the shadow of GW and the fear of the future,

rather than on politics. Words such as *melt*, *glacier*, *species*, *polar bear*, *civilization*, *extinction*, *devastation*, and *virus*, indicate threats to human welfare and worries about human destiny.

Earth. The nodes *temperature*, *centigrade*, *rise*, *hot*, *cold*, *summer*, and *winter*, depict public perception of climate problems. In addition, words such as *carbon dioxide*, *greenhouse effects*, *methane* are tightly linked to *cause* and *influence*, indicating that people mostly attribute climate crises to greenhouse gas emissions.

China-US. Although the *China-US* frame appeared in both the CC and GW networks, the content of discussions varies. While the former emphasizes deteriorating international relations in climate negotiations, the latter focuses on climate negotiation and cooperation itself. Another notable difference is the proportion of the *China-US* frame in CC (48.70%) which is much higher than in GW (15.03%), indicating that political discussions are less prominent under the GW network.

Emotional response to video frames

To answer RQ3 regarding the public's emotional responses to the frames presented in videos, we used linear regression models for analyses under the comparison between the CC- and GW-labeled videos (Tables 4 and 5).

Similar patterns emerged in both CC- and GW-labeled Videos. Firstly, political frames tend to be positively associated with anger and disgust. Under CC-labeled videos, both action frames ($\beta = .0168$, $SD = .0082$, $p < .05$) and political frames ($\beta = .0210$, $SD = .0070$, $p < .01$) are directly related to higher levels of anger. Additionally, these frames (action frames: $\beta = .0191$, $SD = .0086$, $p < .05$; political frames: $\beta = .0204$, $SD = .0074$, $p < .01$) also stirred feelings of disgust. Similarly, under GW-labeled videos, political frames were positively associated with anger ($\beta = .0217$, $SD = .0069$, $p < .01$) and disgust ($\beta = .0200$, $SD = .0072$, $p < .01$). These emotions were mainly directed towards foreign leaders' speeches on climate change (e.g. Donald Trump, Joe Biden, and Emmanuel Macron), criticisms of China's growing consumption of meat, milk, and eggs, and international political debates on environmental justice and national responsibility.

Secondly, impact frames were linked to fear and sadness in both CC- and GW-labeled Videos. For CC-labeled videos, impact frames were significantly related to increased fear ($\beta = .0226$, $SD = .0073$, $p < .01$) and sadness ($\beta = .0168$, $SD = .0055$, $p < .01$). Similarly, in GW-labeled videos, impact frames were significantly associated with heightened fear ($\beta = .0351$, $SD = .0094$, $p < .001$) and sadness ($\beta = .0119$, $SD = .0068$, $p < .01$). Moreover, for GW, both impact frames ($\beta = -.0110$, $SD = .0047$, $p < .05$) and scientific frames ($\beta = -.0010$, $SD = .0049$, $p < .05$) were negatively related to feelings of joy.

Thirdly, CC-labeled videos incorporating scientific frames ($\beta = .0150$, $SD = .0073$, $p < .05$) and political frames ($\beta = .0152$, $SD = .0063$, $p < .05$) were positively correlated with public trust. Public trust was associated with content depicting scientists' efforts to popularize climate-related knowledge.

Discussion

This study aims to unravel how climate change is discussed and communicated in youth-centered Chinese social media, with a specific focus on the choices of terminologies and frames, and evaluating their impacts on public understanding and emotional responses. Most remarkably, our study reveals different patterns in the preference of climate terminologies and framing strategies among various participants on Bilibili. The finding aligns with previous studies demonstrating that different groups tend to favor particular frames (Jang & Hart, 2015; Schuldt et al., 2011). However, the patterns of term and framing usage are completely different from partisan uses in the United States: In the Chinese youth-dominated cybersphere, climate change is not a neutral wording that sounds

Table 4. Emotional responses to frames in CC-labeled videos.

	Climate change							
	Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
Impact	.0068 (.0077)	.0064 (.0058)	.0139 (.0081)	.0226** (.0073)	−.0034 (.0055)	.0168** (.0055)	−.0011 (.0049)	.0054 (.0068)
Scientific	.0045 (.0082)	.0113 (.0062)	.0100 (.0086)	.0132 (.0079)	−.0017 (.0059)	.0043 (.0059)	.0004 (.0052)	.0150* (.0073)
Action	.0168* (.0082)	.0054 (.0062)	.0191* (.0086)	.0038 (.0079)	.0023 (.0059)	.0048 (.0059)	−.0010 (.0052)	.0137 (.0073)
Political	.0210** (.0070)	−.0030 (.0053)	.0204** (.0074)	.0067 (.0067)	−.0033 (.0050)	.0021 (.0050)	−.0005 (.0045)	.0152* (.0063)
Other				Reference category				
(Intercept)	.0434 *** (.0066)	.0396*** (.0050)	.0350*** (.0070)	.0431*** (.0064)	.0357*** (.0048)	.0413*** (.0048)	.0279*** (.0042)	.0517*** (.0060)
Adjusted R ²	.1158	.0111	.0486	.1026	−.0110	.1249	−.0304	.0510

Note: Standard errors are shown in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Emotional responses to frames in GW-labeled videos.

	Global warming							
	Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
Impact	.0039 (.0054)	-.0061 (.0045)	.0032 (.0058)	.0351*** (.0094)	-.0110* (.0047)	.0119** (.0068)	-.0022 (.0032)	-.0097 (.0060)
Scientific	.0032 (.0056)	-.0050 (.0047)	.0027 (.0060)	.0049 (.0097)	-.0010* (.0049)	-.0099 (.0070)	-.0008 (.0033)	-.0032 (.0062)
Action	-.0011 (.0074)	-.0069 (.0061)	.0016 (.0079)	-.0194 (.0128)	-.0060 (.0064)	-.0173 (.0093)	-.0068 (.0043)	.0025 (.0081)
Political	.0217** (.0069)	-.0092 (.0057)	.0200** (.0073)	.0138 (.0120)	-.0114 (.0060)	-.0045 (.0087)	-.0040 (.0040)	-.0006 (.0076)
Other				Reference category				
(Intercept)	.0483*** (.0050)	.0498*** (.0041)	.0411*** (.0053)	.0610*** (.0086)	.0410*** (.0043)	.0642*** (.0062)	.0271*** (.0029)	.0625*** (.0054)
Adjusted R ²	.0580	-.0063	.0364	.1958	.0122	.1421	-.0005	.0164

Note: Standard errors are shown in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

less emotional (Romm, 2013), but a label that has led to the politicization of climate change. Instead of a term mixed with hoax frames (Jang & Hart, 2015), global warming is an expression that can be used to depoliticize climate issues.

Here, we theorized the differences between CC- and GW-titled videos as *politicization* vs. *unpoliticization*. At the video level, CC-titled videos prefer to frame climate change from a political perspective, showing a high degree of politicization. On one hand, these videos call for climate justice, often criticizing developed countries for escaping responsibility for historical carbon emissions and shifting the burden of emission reduction to developing countries. On the other hand, these videos highlight China's commitment to carbon neutrality and emphasize China's contribution to global carbon emission reduction. The GW-titled videos, however, tend to adopt a less politicized stance, primarily employing impact frames and scientific frames to show the devastating consequences of GW for the planet and humanity and influencers debunking scientific misinformation.

Likewise, in the comment level, public responses to CC- and GW-titled videos also suggest differences between politicization and unpoliticization. The semantic network analysis shows that the predominant frame within the CC network is "China-US" (48.70%). This frame often involves political issues related to the United States, such as the US withdrawal from the Paris Climate Agreement and US efforts to shift the burden of carbon emissions to developing countries. Conversely, the major frames within the GW network are humanity (39.58%) and earth (31.94%), which primarily center on ecological and humanitarian aspects.

Our analysis of public emotional responses also shows how frames politicize climate issues by evoking specific emotions. Echoing prior studies on utilizing emotional responses to engage people on climate change (Wong-Parodi & Feygina, 2021), we substantiate the effects of emotion-laden videos on emotional contagion and climate attitudes. Similar to previous findings, for both CC- and GW-labeled videos, political frames are positively associated with anger and disgust, while impact frames are associated with fear and sadness (Myers et al., 2012; Nabi et al., 2018). As an indispensable political emotion, anger can affect people's processing and motivated reasoning of information (Weeks, 2015), which may result in public disbelief in climate change. However, as sadness and fear can facilitate people to take pro-environmental actions, GW-labeled videos may reduce the risk of politicizing climate issues.

The video- and comment-level differences between CC- and GW-labeled videos further signal how terminology usage intertwining national culture shapes climate change debate (Hoffman, 2015; Schuldt et al., 2011). Notably, governmental social media accounts tend to use the term CC and frame climate change in a political context that emphasizes international conflicts and portrays western countries as irresponsible, triggering associations with controversial climate issues and reducing public willingness to engage in climate actions. In contrast, individual accounts prefer to use the term GW, resulting in the unpoliticization of climate change. This approach focuses on the scientific and humanistic aspects of climate change but neglects the political foundations of tackling climate change.

Our study suggests the importance of considering cultural contexts when communicating climate change (Hunzaker & Valentino, 2019). Given that different countries have cultural schemas about climate disasters, we should be mindful of using "climate change" to denote climate issues in developing countries, as people may connect "climate change" with international political conflicts over climate issues and generate anger and grievance feelings, since "climate change" is a term preferred by policy-makers (Whitmarsh, 2008). While it is crucial for both developed and developing countries to share the environmental burden and pursue environmental justice, fueling negative emotions toward western countries may not be an effective solution in addressing climate issues, since politicizing climate issues may reduce public perception of risks and climate policy support (Linde, 2020; Hart et al., 2023).

This study also indicates that "global warming" is more conducive to promoting a more inclusive online space for discussing climate change. It has the potential to increase people's attention to the ecological and scientific dimensions of climate change. However, it tends to overlook the issues of

global environmental justice and the urgent need for nation-states to take on historical and contemporary responsibilities. Consequently, the use of the term GW neglects more fundamental questions essential for addressing climate change, such as equality, justice, and sustainable development (Marquardt & Lederer, 2022).

Implication

Our study has important theoretical and practical implications for communicating climate change among Chinese young users as well as in the global context more broadly. First, while most previous studies center on examining the trends of politicization in the western world, we first substantiate that the existence of politicized and non-politicized climate phenomena in the Chinese online sphere. These findings confirm the differences in cultural schemas across countries (Hunzaker & Valentino, 2019). This study yields a clear picture of what CC and GW mean for Chinese young users, which are completely different from conclusions made within American contexts.

Another contribution is our analytical framework for politicized scientific topics. Through investigating who uses certain terms and frames and how (non-)politicized frames affect public semantic and emotional responses, we gain insights on how different social groups view and present climate issues and shape public climate opinions. Prior studies either only observed politicized science trends (Chinn et al., 2020) or assessed the potential effects (Bolsen et al., 2014), but our framework provides a comprehensive understanding of the drivers and consequences of politicization of climate change.

Our study also brings a fresh perspective by critically examining the politicization of climate change. While most previous works often criticize politicized science (Pepermans & Maesele, 2016), we contend that a deliberative and beneficial communication of climate change should integrate climate politics, science, and humanity. Politicization touches on fundamental and political aspects of climate change, making climate discussions more diverse and intensive, and includes more actors (Forsyth, 2004; Marquardt & Lederer, 2022). However, politicization may hinder efforts to address the issue without undue political intervention, evoke negative emotions towards western countries, and foster overconfidence in China's climate governance capabilities. This overconfidence could, in turn, disrupt global cooperation in addressing climate change.

Therefore, it is imperative to encourage science and humanity perspectives to counterbalance politicization. At the same time, these perspectives need to develop their own unique critical power, explaining climate issues in the general context of developmental rights, democracy, and environmental justice. This becomes particularly pertinent given China's active involvement in the carbon peak and neutrality commitments (Teng & Wang, 2021). The fight against climate change demands global cooperation based on nation states' interests, willingness, and technical capabilities. Hence, the harmonious relationship between politics, science, and humanity should be further emphasized.

In the practical sense, our findings suggest the significance of considering cultural contexts and using persuasive messaging strategies to counter the harmful effects of (un)politicization of climate change. For instance, it is recommended to use global warming and impact frames to yield ecological consensus. Moreover, people should consider the social and cultural contexts when choosing terminologies to communicate climate problems, as "specific terms and concepts used in risk information may have quite different meanings for varying social groups" (Kasperson et al., 1988).

In addition, social media platforms should curate diverse climate information in alternative ways to prevent radicalization and enhance mutual understanding. The fact that participants on Bilibili prefer different terminologies and frames, indicates the chance of balance guaranteed by diversity and interests. Social media should encourage the co-existence and interactions between governmental, organizational, and individual accounts, breaking down barriers between political and apolitical perspectives.

Limitations and future research

This study has several limitations. First, to what extent the results of this study are generalizable to understand how Chinese society interprets and responds to climate issues, remains to be further confirmed. With 86% of video producers and audiences younger than 35 years old (Bilibili, 2023), Bilibili lacks a broad enough representation of all demographics in China. Also, given that nationalist sentiment is prevalent on Bilibili which may lead to defending national interest when combating global challenges, the results of this study cannot completely reflect how people living in China (un)politicize climate issues (Schneider, 2021). Studies testing the results on other social media platforms with more diverse demographics, a larger sample size, and more diverse ideologies may provide more empirical evidence to support our findings.

Meanwhile, we only examined the most-viewed videos on Bilibili and captured the differences in discussions under CC- and GW-labeled videos, relatively neglecting the effects of video frames and multi-modalities on public discussions. Future studies need to collect samples over a long period and do more granular analyses, such as showing how public understanding of climate terminologies varies across time and assessing the effects of frames and multi-modal visual elements.

Finally, the methodology applied in the study leaves much space for improvement. Combining NLP techniques with statistical significance calculations to understand the dynamics of climate discussions, this exploratory research only roughly shows that there are significant differences between the distribution of emotional words under different frames and terms. Additionally, regarding the specific tasks, we focused on the usefulness of the output rather than accuracy (Öhman, 2021). When analyzing document-level or more diverse texts in the domain of climate change, researchers should apply machine learning tools to aim for higher accuracy and establish the causality between frames and public emotions through strict experiments.

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