"Ask Google": The role of the search machinery in the construction of knowledge about climate change

Dafne Calvo*, María Iranzo-Cabrera**, Raquel Tarullo***

* University of Valencia, Dept. of Language Theory and Communication Sciences (dafne.calvo@uv.es)
** University of Valencia, Dept. of Language Theory and Communication Sciences (maria.iranzo-cabrera@uv.es)
*** University of Valencia, Dept. of Language Theory and Communication Sciences (maria.t.tarullo@uv.es)

Abstract

The increased media attention to climate change is closely tied to the development and accessibility of web and social media platforms. These networked channels have partially replaced traditional media as information intermediaries and provide a direct voice to climate change stakeholders, some denialists or skeptical about the seriousness of the climate emergency. This research investigates the actors involved and their visibility in search engines to better understand how Google algorithms structure the communication in Spanish surrounding this issue. The searches and results about climate change in six Spanish-speaking countries have been observed using a mixed methodology based on digital methods and discourse qualitative analysis. Many searches directly engage with the debate about the veracity of climate change. Traditional media or well-established sources in each country's market tend to have better positioning in Google. However, most of the content is opinion articles, which facilitates the perception of climate change as a debatable topic.

Keywords: Climate change; communication; Disinformation; Skepticism; Google; Search engine algorithm.

Introduction

In this article, we aim to explore Google's «knowledge infrastructure» to gain insights into how climate change is understood. As Plantin et al. (2018), we consider this search engine to serve as a gateway to a wealth of knowledge, facilitating deep exploration and discovery. Climate change is particularly relevant in today's cultural and technological context. While the impact of social networks on citizen empowerment projects has been widely discussed, the role of search engines has received less attention. We believe studying search engines is essential for comprehensively understanding climate change dispute. Furthermore, exploring this topic reopens discussions about the responsibility of technology companies to disseminate critical information and prevent the flow of misinformation on key social welfare issues, such as climate change.

Scholars have focused on the coverage of climate change by the mainstream media since the 1990s (Boykoff, 2013). Early investigations revealed limited and seasonal coverage, often tied to annual climate summits held since 1992 (Francescutti et al., 2013), with the scientific community and the political sphere being the primary sources of information (Teso Alonso et al., 2018). However, the relative importance of environmental news within the media agenda has changed in the last decade due to institutional reports sounding the alarm about climate concerns, such as the IPCC report on the climate emergency. Additionally, the emergence of new movements with prominent protests, such as Fridays for Future and Extinction Rebellion, has shifted media attention.

However, the development of the discourse on climate justice has run parallel to the climate change questioning (Farrell, 2016; Zhang & Skoric, 2018), which seeks to undermine the concept of social consensus through the denial of climate change itself (Cook, 2016; Zhou & Shen, 2022). Skeptical voices have gained prominence in mainstream media, challenging the consensus and further complicating the environmental debate. One current example is the president of Argentina, Javier Milei, who openly questioned the severity of the effects of climate change, following other populist politicians, particularly within alt-right parties (Tarullo & Fenoll, 2024).

Furthermore, the polarization around this issue can only be understood by considering the expansion of social media and other digital platforms as mediators of public discourse. The increased attention to climate change is closely tied to the development and accessibility of web and social media platforms (Nieto-Sandoval & Ferré-Pavía, 2023). These networked media technologies provide a direct voice to various climate change stakeholders, including industry (Farrell, 2016), NGOs (García et al., 2018), governments (Klein, 2021), politicians (Abejón et al., 2020), educators, research centers, and think tanks (Almirón et al., 2020). In other words, technological advancements have expanded the quantity and diversity of available information on the subject. This high-tech change has presented new opportunities for attaining climate justice, offering civil society «intellectual arguments that discourage people's motivation to take action in the fight against global warming» (Abellán-López, 2021: 292).

However, the data demonstrates that increased technological access has not led to greater sensitivity to this specific issue, as only a small portion of the global population is concerned about climate change (Armesto, 2021). Furthermore, the internet enables fragmented information search and reading. Some experimental studies have observed that content algorithms are designed to amplify the human attraction to moral and emotional information (Brady et al., 2020). In this digital ecosystem, anger, animosity, affective polarization, and extreme political information can spread further (Huszár et al., 2021). Therefore, «misinformation that exploits the amplification of moral and emotional content can spread further than misinformation that does not» (McLoughin & Brady, 2024: 2).

This research investigates the nexus between algorithms, polarization, and misinformation on climate change. Employing a mixed-method approach, we analyze Google search data using digital methodologies and content analysis. It is within these new information spaces that numerous studies have detected misinformation and disinformation regarding climate change, creating or reinforcing uncertainty about it. There are endogenous and exogenous factors that hinder the fight against these information disorders (Salaverría et al., 2021): the widespread use of messaging applications and social networks, which accelerate the dissemination of unverified information (Vosoughi et al., 2018); the phenomenon of «the persistence of misinformation using confirmation bias as an explanatory mechanism» (Zhou & Shen, 2022: 501); political

polarization and populism (Yan et al., 2022); and the poor media literacy of a large portion of the public to discern credible sources on scientific issues (Osborne & Pimentel, 2022).

While there have been various studies on the role of social networks as «enforcers of truth» (Barrett, 2020), this research complements them by focusing on search engines. We believe that studying Google is relevant because its functioning is intertwined with the factors that facilitate the dissemination of disinformation online. In general terms, the internet has profoundly augmented the potency of information and influenced a diverse array of actors within the public sphere. Google has not only forged supremacy through monetizing user activity but has also been used for information dissemination to manipulate public opinions and beliefs (Rosenbach & Mansted, 2019). In essence, Google, a North American conglomerate, endeavors to monopolize the tech market while propagating Western ideologies regarding politics and economics (Yeo, 2016). In this research, we transfer this debate to the climate change issue.

Literature review

In recent years, algorithm usage has expanded alongside the development of technological devices in digitized and computerized societies (Fisher & Mehozay, 2019). This «algorithmic turn» (Napoli, 2014) has resulted in many algorithm-driven decision-making processes influencing various aspects of life. This context has spurred growing academic interest in the technical field and the cultural and social analysis of its implications.

Due to concerns about a lack of transparency and the complexity of algorithms, researchers have focused on their potential biases and warned about the possibility of reproducing power structures and discriminatory behaviours, such as racism or sexism (Garcia, 2016). Understanding algorithms from a mathematical, material, philosophical, and ethical perspective while considering the conditions under which they are created and developed is crucial considering these implications (Kitchin, 2017). This perspective becomes particularly central to approaches that view algorithms as rational and objective elements at the core of their symbolic power (Beer, 2017).

This debate has also found reflection in media content production and consumption, as these practices increasingly rely on algorithm-mediated processes. Personalized content on the internet is no longer solely dependent on user customization but also relies on implicit personalization based on data mining (Bozdag, 2013). Trending topics, recommended content, like-minded networks, and news feeds are developments that have led to a partial loss of control over distribution processes for traditional media (Bell, 2016).

The «algorithmic selection» of content (Just & Latzer, 2017) endows digital platforms with functions traditionally associated with journalism, such as agenda-setting and gatekeeping. Platforms and algorithms are closely intertwined, as code programming is a prerequisite for their existence (Helmond, 2015). Algorithms enable the construction of digital platforms and contribute to specific functions or even the entire structure of service functionality (Fisher & Mehozay, 2019). Conversely, platforms facilitate generating and extracting user-generated data, which serves as input for the algorithms (Boyd & Crawford, 2012).

Extensive literature has examined the use of algorithms for communicative purposes by various political, social, and journalistic actors (Siegel, 2013). Additionally, a substantial body of research has focused on providing a holistic perspective on major technological corporations (e.g., Facebook, Twitter, and Google) to shed light on the internet media ecosystem (Kreiss & McGregor, 2018).

These corporations have attained significant prominence within the digital public sphere, consolidating economic and political influence in what can be described as a monopolistic market (Rosenbach & Mansted, 2019; Siles González, 2023). Understanding the communicative power of these companies requires an examination of their digital platforms, which have partially replaced traditional media as intermediaries of information (Bozdag, 2013).

In their influential work, Plantin et al. (2018) define «platformization» as organizing the internet structure through various platforms that offer a wide range of services involving user participation. As a result, platforms are not singular, monolithic applications (Blanke & Pybus, 2020). Rather than focusing on specific functionalities, they strive to maximize data flows and interactions across their diverse web applications (Constantinides et al., 2018). In digitized and computerized contexts, these characteristics shape the configuration of a public sphere that influences the structure and practices of contemporary societies (van Dijck & Poell, 2015).

Google's search engine exemplifies this new sphere due to its widespread use, expansion, and integration into internet browsing (Plantin et al., 2018). Furthermore, Google has wielded its power through concentration and expansion strategies in various areas. It links its services together, forming an assemblage where distributing video content via YouTube, sending emails through Gmail, and searching for information through its search engine stand out (Kreiss & McGregor, 2018). This centrality on the internet has given rise to the term «googlization» (Rogers, 2009) to describe the diverse practices it encompasses, including those related to the reception of media content. Consequently, the company's most prominent algorithms are associated with searching for online information (Latzer et al., 2015).

Among the various types of algorithms at work, two have garnered significant academic interest: Google Autocomplete for search terms and PageRank for search results. In the case of Autocomplete, the algorithm utilizes text prediction to provide ten possible suggestions when a user enters a term in the search bar. This functionality can be problematic when the suggestions include racist or sexist concepts, perpetuating societal biases (Al-Abbas et al., 2020). The underlying debate revolves around Google's position on avoiding the visibility of conflicting terms in its application (Chonka et al., 2023) and the implications of this decision on freedom of expression (Karapapa & Borghi, 2015).

On the other hand, PageRank organizes the results pages based on the user's characteristics, such as location and language (Thielmann et al., 2013). The order of the pages is determined by several variables, including the number of incoming links a page has, effectively making the hyperlink a reputation indicator within the system (Helmond, 2013). The extent to which human and algorithmic criteria align has been a subject of prior discussion (Hariri, 2011). However, Google searches involve normalizing algorithmic power, and the results do not always align with civil society's interests and promotion (Finkelstein, 2008).

As previously mentioned, both functionalities provided by Google serve as gatekeeping and agenda-setting practices. In other words, they function as knowledge infrastructure (Plantin et al., 2018) with direct implications for the communicative functions of contemporary societies: shaping the worldview (Latzer et

al., 2015; Thielmann et al., 2013) and identifying the actors who contribute to its construction (Kreiss & McGregor, 2019).

Methodology

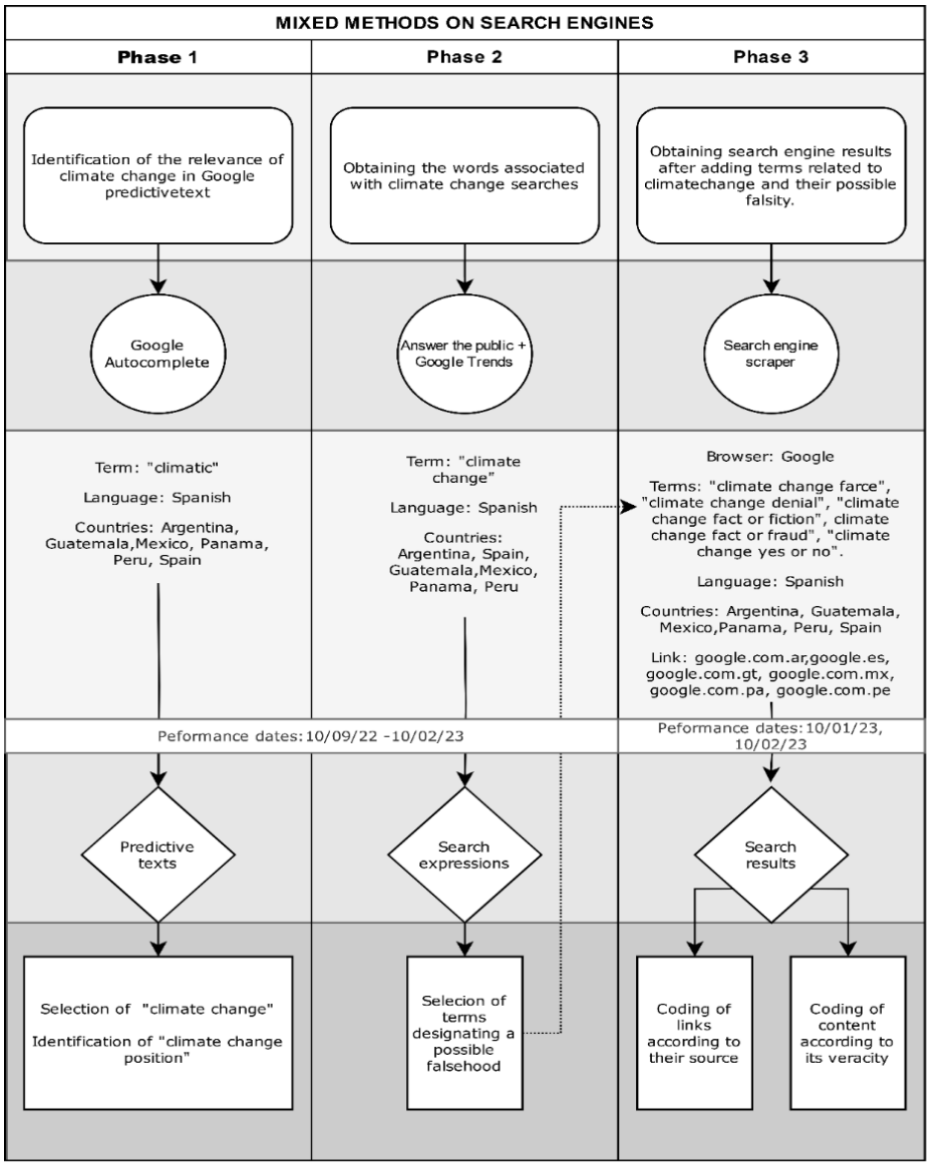
This research aims to investigate climate change dispute in search engines to understand better how Google structures the communication surrounding it. Ultimately, the research explores the algorithmic relevance of different social actors and content when users approach climate change as an epistemological matter. In pursuit of these objectives, three specific questions are posed:

RQ1. How do trends in Google searches about climate change manifest?
RQ2. Which actors are prioritized in search engine rankings related to climate change?
RQ3. In what contexts do search terms related to climate change manifest?

These questions were applied to searches conducted in Spanish from Argentina, Guatemala, Mexico, Panama, Peru, and Spain. The selection of these countries was based on two reasons. Firstly, they all share Spanish as an official language. Secondly, according to the Environmental Performance Index their populations exhibit diverse concerns regarding climate change (Wolf et al., 2022). This ranking summarises sustainability worldwide, providing information on 180 countries about change performance, environmental health, and ecosystem vitality. Spain (17) and Panama (47) topped the ranking, Mexico (73) and Argentina (92) were mid-range, and Peru (101) and Guatemala (167) were at the bottom.

This selection aimed to explore differences in search behavior and results between locations. The research methodology employed mixed methods (Molina-Azorin & Fetters, 2019), integrating different methodological approaches to address social issues. The fieldwork involved traditional communication research methods in conjunction with computational assistance for social research, as well as a quantitative and qualitative analysis of the resulting corpus. The extraction and analysis of the corpus were conducted on four different occasions to account for any potential changes in search terms and ranking positions. Thus, the fieldwork was extended from November 2022 to February 2023. Figure 1 explains each of the three phases involved in this process.

Figure 1. Complete fieldwork



Source: Author's elaboration.

Firstly, we extracted autocomplete predictions from Google's search engine when users began typing in the search box. Specifically, we used the term «change» and performed six searches, one for each country included in the study. We repeated this extraction once to observe any potential changes in Google's predictions over time. The Google Autocomplete tool was employed for this task. Subsequently, we manually identified the autocomplete suggestions related to «climate change».

Secondly, we aimed to delve deeper into users' search terms when searching for «climate change». To accomplish this, we utilized the Answer the Public tool, which provides results for words or phrases that commonly appear alongside «climate change» in Google searches. Similarly, we conducted this data extraction on six occasions, corresponding to each country in the study, and repeated the process twice over time. In this case, we analyzed the corpus using two variables. Firstly, we manually selected searches that inquired about the potential falsehood of climate change (e.g., «climate change fact or fiction»). Additionally, we collected the search volume for these keywords using related searches on Google Trends.

In the third phase, we selected terms that linked climate change with possible falsehoods to extract the pages associated with those search terms. This extraction was conducted on Google within each enabled domain and region for the respective country, all in Spanish. We selected the first ten results provided by Google (not sponsored), which corresponded to the first page of search results. This corpus extraction was performed twice using the Search Engine Scraper tool. Subsequently, we manually analyzed the results in two ways: firstly, by studying the source to which the extracted link belonged, and secondly, by examining the content type. The data extraction process was executed utilizing Firefox with private browsing mode enabled, alongside a VPN connection facilitated by the University of Valencia.

Participants engaged in the research were involved in the data extraction phase during fieldwork. Search parameters, including location and language, were configured within Google's options to scrape the search results page. Each tool employed for corpus extraction generated a CSV document containing the data. After completing data extraction, the dataset underwent quantitative and qualitative coding. Quantitative data came from the digital methods tools used, while qualitative analysis focused on two key variables: the source/creator and the type of content (Table 1).

This helps reveal the dynamics shaping the information landscape. Analyzing the source identifies actors, from scientific institutions to pseudo media, critical for assessing credibility and bias. Understanding the content type—whether scientific dissemination or polarizing commentary—evaluates its quality and potential influence. Categories were defined deductively based on initial observations, grounded in empirical data and inspired by previous studies (Lewandowsky et al., 2017; Molina et al., 2021). Two researchers coded links, with a third mediating discrepancies, ensuring a balanced and rigorous approach.

Table 1. Categorical variables: source/creator and content type.

Variable	**Categories**
Source/Creator of Content	1. Blogs, forums, and social media 2. Celebrities or influencers 3. Dictionaries, encyclopaedias, and scientific dissemination websites 4. Companies and online retailers 5. Institutions, international organisations, and government agencies 6. Media outlets and fact-checking platforms 7. Non-governmental organisations, social movements, and civil associations 8. Pseudomedia and disinformation websites 9. Scientific journals, research agencies, and public/private universities 10. Not applicable
Type of Content	1. Opinion pieces and commentaries 2. Hoaxes and fake news 3. Polarising and sensationalist content 4. Fact-checks 5. Scientific dissemination 6. Persuasive information and advertisements 7. Real news and reports 8. Academic and scientific papers 9. Not applicable

Source: Author's elaboration.

Results

Climate change as a search term

The data from Google Trends reveals more variations in climate change searches based on context rather than the study time. Mexico has the highest number of searches, with significant differences from Argentina, Guatemala, Peru, and Spain regarding climate change exploration on Google. On the other hand, Panama has the lowest number of searches, consistently reflecting the lowest search volume throughout the months studied in this research (Table 2).

The fluctuations between months are not substantial, indicating that the importance attributed to climate change remains consistent across all countries and is not solely driven by specific events. For instance, the United Nations Climate Change Conference held in November 2022 did not significantly impact the search results on this issue. Regarding the differences among countries, they are not necessarily linked to the significance citizens place on these issues. It can be inferred that various factors, such as the total population of the country or the occurrence of heat waves in the southern hemisphere during those months influenced the searches. These factors are more closely linked to the experiences of the populations rather than specific events dominating the agenda of each location.

Table 2. Monthly searches on climate change.

	Argentina	**Guatemala**	**Mexico**	**Panama**	**Peru**	**Spain**	**TOTAL**
November, 2022	851	275	1,088	247	1,258	993	4,712
December, 2022	622	295	761	120	1,021	732	3,551
January, 2023	252	300	1257	266	506	856	3,437
February, 2023	705	364	1845	390	865	1,161	5,330
TOTAL	**2,430**	**1,234**	**4,951**	**1,023**	**3,650**	**3,742**	**17,030**

Source: Author's elaboration.

When analyzing the position of the term «climate» in Google Autocomplete for the search query change, differences were observed between countries and across the two time points during the study. In the initial data collection, Panama had «climate change» as the first autocomplete option when searching for «change». For Argentina, it appeared as the second option, and for Guatemala, Mexico, and Peru, it ranked third. In the case of Spain, «climate change» was the ninth option in the first data collection and the tenth in the subsequent one.

When examining the terms associated with the search query «change», we found no significant differences between the two data collection periods. However, two trends emerged in the associated terms: currency exchange and time change (Table 3). In Latin American countries, the associations were often related to currency exchange rates and were consistent across both data collection periods. The only difference was observed in Mexico, where terms associated with time change appeared, even though the country had stopped implementing daylight saving time since October 2022, and the currency exchange option did not appear in either data collection period. Argentina, Perú, Panamá and Guatemala do not change the time.

Spain does it and this situation influenced the search results in the country, with currency exchange ranking second.

The Spanish word «cambio» («change») encompasses a wide range of expressions related to daily life. The results of Google Autocomplete highlight the platform's central role as a mediator of daily social processes. Climate change is gaining worldwide relevance as an issue beyond practical needs and events of importance in the global agenda. It brings together global perspectives on the responsibility to mitigate climate change and specific questions about its impact on people's material reality. As a result, internet users conduct searches that connect climate change with politicians, international organizations, consequences, and particularities in specific regions, as reflected in the related searches in Google Trends.

Table 3. Monthly searches on climate change.

Argentina	Guatemala	Mexico	Panama	Peru	Spain
chaco changes	exchange from dollar to quetzal	time change	exchange from dollar to colombian peso	dollar exchange rate	time change
physical change	exchange from pesos to quetzals	time change 2022	**climate change**	dollar exchange today in peru	time change
chilean peso exchange	dollar exchange rate	**climate change**	exchange from colombian pesos to dollars	change from dollar to soles	time change 2022
currency exchange	change from euro to quetzal	change of wellness card	currency exchange	**climate change**	time change spain
climate change	**climate change**	physical changes	change of residence	secure exchange	euro pound exchange
dollar exchange rate	change	time change october 2022	change	dollar exchange today	euro real exchange rate
regime change	time change in mexico	change	euro dollar exchange rate	change	time change
change of address	exchange from dollars to quetzals	change of sat address	exchange from mexican pesos to dollars	italo changes	exchange from euro to colombian peso
dollar to argentine peso exchange	physical changes in women after abortion	winter time change	physical changes	change of address reniec	**climate change**
moonchange	changes in material	physical changes in adolescence	democratic change	change from soles to dollars	currency exchange

Source: Author's elaboration.

Regarding searches related to «climate change» without using those exact words, the information provided by Google indicates that during the study period, queries such as «solutions for climate change», «Kyoto protocol», «acid rain», «Ayuso[1] climate change», and «consequences of climate change» were frequently

[1] Current President of the Autonomous Community of Madrid.

searched in Spain. These were the top five recurring concerns out of seventeen queries. In Argentina, only two queries appeared: «Ministry of Environment and Climate Change Santa Fe» and «climate change». In Peru, the top five frequent queries out of eleven included «climate change what», «climate change what is it», «what is climate change», «climate change in Peru», and «climate change causes». In Panama, all associated queries focused on «what is climate change». Unfortunately, there was not enough data available to provide results for associated queries in Guatemala, one of the countries with fewer searches on this topic. This lack of data may be due to a lack of interest on the part of Guatemalan citizens in seeking information on climate change.

Concerning the results offered by the search engine when it is linked to disinformation on climate change, the most significant number of results is concentrated on doubt, i.e., whether climate change is true. Thus, terms such as «climate change yes or no», «climate change fact or fiction», and «climate change fact or fraud» gather the highest number of results offered by the search engine. The lowest number of results linked to disinformation is found in searches based in Guatemala, while the highest is in Spain.

This data and the previous findings demonstrate the need for users to make their Google searches more specific. Faced with a continuous and endless flow of data on the internet, the use of keywords becomes the organizing principle of the information consumed through this medium. In this regard, many searches directly engage with the debate about the veracity of climate change. These searches do not necessarily indicate whether users believe in this issue. Still, they show interest in this polarized debate and request assistance from Google to gather information on it.

Table 4. Searches on disinformation in Google (February 2023).

	Argentina	Guatemala	Mexico	Panama	Peru	Spain	TOTAL
Climate change farce	6,050	511	9,340	260	977	26,400	**43,538**
Climate change denial	11,700	1,320	28,100	432	7,560	69,900	**119,012**
Climate change fact or fiction	67,700	1,080	39,500	9,960	5730	11,3000	**23,6970**
Climate change yes or no	1,230,000	86,300	2,230,000	76,400	393,000	12,200,000	**1,621,5700**
Climate change fact or fraud	50,500	3,490	108,000	2,890	29,300	243,000	**437,180**

Source: Author's elaboration.

Sources and content on climate change

In searches unrelated to disinformation, many focus on media information and verification sources, the most frequently explored sources across all the countries studied (Table 5). *La Estrella de Panamá*, known for its dedicated section «Planet», addressing environmental news and climate change, has the highest number of

entries in Panama. *Prensa Libre* and *Plaza Pública* are the sources with the most entries in Guatemala. *Radio programas del Perú* is Peru's most frequently referenced source of information. *Chequeado* is the most frequent source of information on climate change provided by the search engine for Argentina. It is important to note that *Chequeado* is a fact-checking platform (the only one in Argentina) and is part of the International Fact-Checking Network. In Spain, the distribution of sources is less concentrated, and the digital media outlet *El Confidencial* is one of the most common content creators. This indicates that traditional media or well-established sources in each country's market tend to have better positioning in search engines.

After media outlets, sources related to academia and research are the next category. These sources are most consulted in Panama and highly regarded in Peru. Sources from non-governmental organizations, social movements, and civil associations are used mainly in Guatemala, Mexico, and Spain. This suggests that independent organizations have relative importance in Google searches, and the scientific community holds authority in some countries. Organized civil society also manages to obtain important positions in specific countries.

Blogs, forums, and social networks receive the most attention in Mexico and the least in Guatemala. Companies and online businesses are the most consulted media outlets in Spain. Governments stand out as sources of information in Peru and Spain, while they are of little importance in Argentina and Guatemala. However, both countries have ministries or government departments dedicated to the environment. Dictionaries, encyclopedias, and popular science websites are only found in Argentina, Peru, and Spain. Pseudo-media and hoax websites are registered in Spain, with *Hispanidad* standing out, and in Argentina, with websites like *Bolsonweb*, *Debatetime*, and *Revolucion989*.

Celebrities and influencers have minimal presence in these searches. Therefore, we observe that informative prosumption takes on two aspects in Google. Firstly, blogs and collaborative encyclopedias like Wikipedia occasionally manage to be authoritative sources for the search engine. This potential for creating alternative communication spaces is also utilized by other projects with different objectives, often lacking civic intent, that aim to generate and disseminate falsehoods, particularly concerning climate change.

Table 5. Frequency of sources in Google searches.

	Argentina	Guatemala	Mexico	Panama	Peru	Spain	TOTAL
Blogs, forums and social networks	3	2	12	6	5	8	**36**
Celebrities or influencers	-	-	-	-	-	1	**1**
Companies, online businesses	10	1	3	-	6	16	**36**
Dictionaries, encyclopedias, science popularization web sites	6	-	-	-	3	7	**16**
Institutions, international organizations, government agencies	3	3	4		11	12	**33**

Media, verification media	55	77	36	89	56	31	**344**
Non-governmental organizations, social movements, civil associations, etc.	4	14	14	4	5	11	**52**
Pseudo-media and hoax sites	5	-	-	-	-	6	**11**
Scientific journals, research agencies, public and private universities, etc.	11	3	31	1	13	7	**66**
Others	3	-	-	-	-	1	**4**
Not applicable	-	-	-	-	1	-	**1**

Source: Author's elaboration

Two types of content stand out prominently: opinion articles and commentaries, as well as real news and reports that have already been identified as highly popular content on social media. On a secondary level, we encounter scientific dissemination and persuasive information/advertising, which, along with polarizing and sensationalist content, generate a significant number of search results on climate change in Google. Academic and scientific works also contribute to a substantial number of entries. Thus, we can observe that verified and informative information is intertwined with content that fuels the polarization of the climate change debate and invites skepticism regarding its veracity (Table 6). In general, only one entry categorized as a hoax was identified, appearing in the search engine for Argentina. It is found on the pseudo-media website *BWN Patagonia*, which includes blocked YouTube videos and concludes its final paragraph with the statement:

> In short, and again, dear readers. As we announced in our investigation into the Global Swine Flu Scam: We live in a world where there is nothing to fear except for the press, invented global pandemics and disasters etc, etc, etc. [sic.]. (BWN Patagonia, 2009).

In other words, the most extreme disinformation does not attain prominent positions in Google's search results. However, the absence of hoaxes does not indicate a consensus. It should not overshadow the presence of persuasive and polarized information that frames climate change as a subject to be debated from legitimate and opposing perspectives.

Analyzing each country individually, Guatemala exhibits the highest number of opinion articles and commentaries. Real news and reports are the most prevalent in Panama and Peru, while academic and scientific works dominate in Mexico. Spain has the most persuasive information and advertising pieces, followed by denials and scientific dissemination. In Argentina, users primarily encounter opinion articles, commentaries, and denials. Therefore, except in specific cases, opinion-based content is typically used to address climate change.

The type of information naturally corresponds to the sources that publish such content on the internet. In Argentina, denials are primarily published, notably from the verification platform *Chequeado*. Opinion articles and comments, including those from Estrucplan («The World's Hottest Fraud»), an environmental management advisory company, are also prevalent. In Spain, denials by *El Confidencial* («Seven climate change denial arguments (and their scientific answers)»), *National Geographic* («8 arguments against climate change deniers»), and the non-profit organization Ecovidrio («10 popular climate change videos on YouTube that are false or misleading») are repeatedly found.

In Guatemala, opinion articles and commentaries published in media outlets such as *República*, *Prensa Libre*, and *Gazeta* are frequently repeated. Mexico's most widely disseminated content consists of academic works hosted in the Redalyc.org repository, a network of open-access scientific journals. Panamanians often encounter news articles and opinion pieces published in *La Estrella de Panamá* («Climate change in times of manipulation and lies») and *La Prensa* («Obama criticizes climate change deniers»), highlighting the seriousness of climate change.

If the search is conducted in Peru, the results primarily include news articles from *El Comercio* («Spain's city that uses 3,000-year-old techniques to lower temperatures and combat climate change»), *Ojo Público* («The science of climate change: evidence and consensus»), *RPP* («YouTube warns it will not monetize content that denies climate change»), and *Perú 21* («Twitter and the harsh blow to climate change deniers»). These articles report on the existence of climate change and the preventive measures taken by technology companies to combat disinformation. As we can see, much information can be associated with climate change, even in searches that raise doubts about its existence. This indicates that the debate is not limited to deniers alone. In other words, the media have also incorporated this type of controversy into their content and, in doing so, have influenced the results displayed by Google when users employ keywords that suggest possible falsehoods.

Table 6. Frequency of content in Google searches.

	Argentina	Guatemala	Mexico	Panama	Peru	Spain	TOTAL
Academic and scientific papers	5	7	29	1	3	4	**49**
Fact-checking	22	-	5	-	6	19	**52**
Hoaxes and fake news	5	-	-	-	-	-	**5**
Opinion articles and comments	22	40	22	36	19	11	**150**
Persuasive information and advertising	4	1	16	1	12	22	**56**
Polarizing and sensationalist content	14	-	4	2	2	11	**33**
Real news and reports	17	16	14	45	34	10	**136**

Scientific dissemination	11	18	10	11	19	19	**88**
Others	-	1	-	-	3	4	**8**
Not applicable	-	17	-	4	2	-	**23**

Source: Author's elaboration

Conclusion

This research has aimed to investigate Google's role in climate change searches. This topic is relevant due to the ongoing climate emergency, and citizenship perceptions and experiences play a crucial role in its interpretation (Teso Alonso, 2022). In short, «all information is strategic» (Rosenbach & Mansted, 2019: 5). Consequently, it is unsurprising that various political actors, ranging from social movements to conservative politicians, have sought to influence this issue. For this reason, it is crucial to understand the role of digital platforms in comprehending the visibility and nature of communication on climate change in the contemporary world. Despite the potential opportunities of the internet to create awareness and empower civil society projects on climate justice, climate change denial has become a common occurrence in contemporary communication (Lewandowsky, 2021), and it has intersected with the problem of disinformation, which has become more prominent in recent years (Cook, 2016; Zhou & Shen, 2022).

As anticipated in the results, the data obtained in this research demonstrates that the Google search engine serves as a social mediator in citizens' daily lives. Internet users employ it for various purposes, such as currency exchange or time checking. These functions intertwine with searching for information on social issues, as evidenced by searches for «change». This behavior reinforces the perception of Google as a knowledge infrastructure (Plantin et al., 2018) since its use is valuable for obtaining broader and practical knowledge about the social world. Simultaneously, users' questions about climate change underscore its centrality in exploring related issues. In other words, Google can contribute to understanding different dimensions of climate change as it is consistently searched for on the platform, irrespective of specific events related to it.

Answering the first research question, when users express specific interest in climate change, they want to know how it will affect them and how political parties and international organizations address it. While commonly understood, certain inputs are necessary for general information on this subject. Google can capture the debate surrounding the existence of climate change by extracting searches that indicate users' interest in questioning its existence. Its algorithms are crucial for internet users who rely on the search engine to find accurate information amidst the overload of available information. However, as explained later, the causes and solutions of climate change are not visible in Google discussions. Searching for specific terms presents a paradoxical scenario wherein users can select the climate change topics they wish to pursue. Yet, they exert limited control over the specific information they receive. This implies a nuanced loss of agency, as previous research indicates (Bell, 2016).

In response to the second research question, we confirm that the media obtain better visibility in Google search results, serving as authoritative sources. Alternatively, the PageRank algorithm (Helmond, 2013) tends to favor established moral authorities and accentuates the visibility of highly esteemed entities. This suggests a nuanced interplay between the media and search engines. Media entities furnish Google with content, molding the digital landscape and preserving some semblance of their pre-internet authority. Concurrently, the media relies on Google to disseminate its content to a vast audience. These reciprocal relationships underscore the pivotal role of the media in shaping public discourse on the internet, transcending the realm of social media platforms.

In the theoretical framework, we anticipated that Google had become an intermediary between users and information, placing traditional media in a subordinate position (Bozdag, 2013). However, the internet has not changed the prevailing power relations that predate its existence, wherein civil society maintains a subordinate position concerning the centrality of the public sphere. This research demonstrates that the discourses of organizations and social movements share relevance with other actors, such as profit-driven companies, which seek to appropriate the issue of climate change for symbolic profitability. The results also reveal the presence of other voices, such as pseudo-media based on opinionated and polarizing content. While their positioning is secondary compared to other actors, the internet provides a particular materiality to discourses and perspectives on climate change that have gained prominence in the public sphere.

Google also enables the tangible manifestation of polarization in contemporary social debates, particularly concerning climate change. In response to the third research question, searches related to the existence of climate change yield opinion-based results. This analysis's highly extreme political content aligns with prior research highlighting the prevalence of polarization within communication flows on digital platforms (Huszár et al., 2021). Opinion, distinct from disinformation, is grounded in facts but facilitates the perception of climate change as a debatable topic. Thus, disinformation as a part of climate change dispute raises an epistemological debate. It does not directly address the requirements for social justice in adapting to environmental changes but instead denies their necessity by casting doubt on the very existence of this problem.

Additionally, it grants visibility to climate change deniers as a discernible group within the search engine: the content refuting them surpasses that of polarizing and misleading content denying climate change. This highlights the indispensability of cultural considerations in comprehending the ongoing battle against climate change. As efforts to mitigate its effects progress, resistance to these changes, including strategies to undermine the significance of this issue, is expected to intensify (Zhang & Skoric, 2018).

The nature of opinions benefits their position due to various factors such as their association with authoritative sources (e.g., media outlets), their targeting of specific audiences, and their connection to trending issues. As a result, Google serves as an active gatekeeper capable of selecting certain content over others through algorithms that incorporate their preferences. Consequently, discussing Google's responsibility to communicate crucial issues for contemporary societies, such as climate change, is not inappropriate. Notably, the criteria applied in journalism differ significantly from those employed by technology companies headquartered in the United States. Content provided by this entity often lacks in-depth coverage of climate change and does not typically engage with challenging economic or political paradigms in pursuit of climate justice. Consequently, the outcomes yielded by Google searches can be viewed through the lens of Google's strategic objectives (Yeo, 2016).

This study entails several limitations. Firstly, the analyzed corpus is monolingual and spans a limited timeframe. Broader geographical coverage and a longer study duration would be necessary to ascertain whether the findings are specific to a particular moment or can be generalized to other contexts and periods. The quantitative results present absolute figures without considering the number of Internet users in each country. Future studies should consider the context of use in each country to make more accurate comparisons in the Spanish-speaking world. Finally, expanding the scope of the investigation to encompass other social platforms such as Facebook and Twitter could provide a more comprehensive understanding of polarization across all platforms contributing to the ongoing discourse on climate change.

Moreover, the study needs empirical evidence regarding the functionality of Google algorithms. In other words, while the findings illustrate the outcomes of Google's operations, the opacity surrounding the programming of their platform restricts investigations primarily to examining its consequences. We contend that interdisciplinary efforts spanning computational sciences to cognitive psychology are imperative for a deeper comprehension of algorithmic functioning and its implications on the perception of reality.

Content selection and publication have traditionally involved journalism processes and news value criteria in the communication field. However, with the emergence of digital platforms, these processes have become detached from human activity, diluting the underlying criteria. Therefore, it is crucial to employ a discerning approach while scrutinizing Google's research findings, as this critical analysis facilitates a deeper understanding of the covert algorithmic framework governing public debate within the Google ecosystem.

Acknowledgements/Funding information

This investigation is part of the R&D projects PID2020-113574RB-I00 "Disinformation flows, polarization and crisis of media intermediation (Disflows)", financed by MCIN/ AEI/10.13039/501100011033/ and AICO/2021/125 Project "Information disarray: quality information: precarious quality, over(mis)information and polarization" (2022-2024), financed by Generalitat Valenciana.

Bibliographical references

Armesto, A. (2021). Preocupación por el cambio climático, condiciones económicas individuales y priorización del medioambiente en América Latina, *Opinião Pública*, (27). https://doi.org/10.1590/1807-019120212711

Abejón, P., Carrasco, R., Cabedo, J. & Mera, M. (2020). Los políticos como fuentes de la información sobre cambio climático. Comparativa entre los digitales El País y ABC. *Estudios sobre el Mensaje Periodístico*, *26*(4), 1283–1293. http://dx.doi.org/10.5209/esmp.68175

Abellán-López, M. A. (2021). El cambio climático: negacionismo, escepticismo y desinformación. *Tabula Rasa*, *37*, 283–301. https://doi.org/10.25058/20112742.n37.13

Al-Abbas, L. S., Haider, A. S., & Hussein, R. F. (2020). Google autocomplete search algorithms and the Arabs' perspectives on gender: A case study of Google Egypt. *GEMA Online Journal of Language Studies*, *20*(4), 95–112. http://doi.org/10.17576/gema-2020-2004-06

Almirón, N., Boykoff, M., Naberhous, M. & Heras, F. (2020). Dominant counter-frames in influential climate contrarian European think tanks. *Climatic Change*, 162, 2003–2020.

https://doi.org/10.1007/s10584-020-02820-4

Barrett, B. (2020, May 22). Enforcers of Truth: Social Media Platforms & Misinformation. *Center for Information, technology, and Public Life*. https://bit.ly/3Pg1EMt

Beer, D. (2017). The social power of algorithms. *Information Communication and Society*, *20*(1), 1–13. https://doi.org/10.1080/1369118X.2016.1216147

Bell, E. (2016). *The end of the news as we know it: How Facebook swallowed journalism*. Columbia Journalism Review. http://en.ejo.ch/short-stories/facebook

Blanke, T., & Pybus, J. (2020). The Material Conditions of Platforms: Monopolization Through Decentralization. *Social Media and Society*, *6*(4). https://doi.org/10.1177/2056305120971632

Boyd, D., & Crawford, K. (2012). Critical Questions for Big Data. *Information, Communication & Society*, *15*(5), 37–41. https://doi.org/10.1080/1369118X.2012.678878

Boykoff, M. T. (2013). Public Enemy Nº 1? Understanding Media Representations of Outlier Views on Climate Change. *American Behavioral Scientist*, *57*(6), 796–817. https://doi.org/10.1177%2F0002764213476846

Bozdag, E. (2013). Bias in algorithmic filtering and personalization. *Ethics and Information Technology*, *15*(3), 209–227. https://doi.org/10.1007/s10676-013-9321-6

Brady, W.J., Crockett, M.J., & Van Bavel, J.J. (2020) The MAD model of moral

contagion: the role of motivation, attention, and design in the spread of moralized content online. *Perspectives on psychological science, 15*(4), 978-1010. https://doi.org/10.1177/1745691620917336

Chonka, P., Diepeveen, S., & Haile, Y. (2023). Algorithmic power and African indigenous languages: search engine autocomplete and the global multilingual internet. *Media, Culture & Society*, *45*(2) 246–265. https://doi.org/10.1177/01634437221104705

Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Platforms and infrastructures in the digital age. *Information Systems Research*, *29*(2), 381–400. https://doi.org/10.1287/isre.2018.0794

Cook, J. (2016). «Countering climate science denial and communicating scientific consensus». In Von Storch, H. (Ed.), *Oxford Research Encyclopedia: Climate Science*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190228620.013.314

Farrell, J. (2016). Network structure and influence of the climate change counter-movement. *Nature Climate Change*, *6*, 370–374. https://doi.org/10.1038/nclimate2875

Finkelstein, S. (2008). «Google, links, and popularity versus authority». In Turow, J. & Tsui, L. (Eds.) *The Hyperlinked Society. Questioning Connections in the Digital Age* (pp. 104-120). University of Michigan Press. https://doi.org/10.3998/nmw.5680986.0001.001

Fisher, E., & Mehozay, Y. (2019). How algorithms see their audience: media epistemes and the changing conception of the individual. *Media, Culture and Society*, *41*(8), 1176–1191. https://doi.org/10.1177/0163443719831598

Francescutti, L.P., Tucho, F. & Íñigo, A. I. (2013). El medio ambiente en la televisión española: análisis de un año de informativos. *Estudios sobre el Mensaje Periodístico*, 19(2), 683–701. https://doi.org/10.5209/rev_ESMP.2013.v19.n2.43492

Garcia, M. (2016) Racist in the machine: The disturbing implications of algorithmic bias. *World Policy Journal*, *33*(4), 111-117. https://doi.org/10.1215/07402775-3813015

García, C., Fernández, C., & Del Olmo, J. (2018). La comunicación del Tercer Sector y el compromiso de los jóvenes en la era digital. *ZER*, *23*(44). https://doi.org/10.1387/zer.19164

Hariri, N. (2011). Relevance ranking on Google: are top ranked results really considered more relevant by the users? *Online Information Review*, *35*(4), 598-610. https://doi.org/10.1108/14684521111161954

Helmond, A. (2013). The algorithmization of the hyperlink. *Computational Culture*, *3* (16th November 2013). http://computationalculture.net/the-algorithmization-of-the-hyperlink/

Helmond, A. (2015). The Platformization of the Web: Making Web Data Platform Ready. *Social Media and Society*, *1*(2). https://doi.org/10.1177/2056305115603080

Huszár, F., Ktena, S. I., O'Brien, C., Belli, L., Schlaikjer, A. and Hardt, M. (2021). Algorithmic Amplification of Politics on Twitter. *Proceedings of the National Academy of Sciences, 119* (1). https://doi.org/10.1073/pnas.2025334119

Just, N., & Latzer, M. (2017). Governance by algorithms: reality construction by algorithmic selection on the internet. *Media, Culture and Society*, *39*(2), 238–258. https://doi.org/10.1177/0163443716643157

Karapapa, S., & Borghi, M. (2015). Search engine liability for autocomplete suggestions: personality, privacy and the power of the algorithm. *International Journal of Law and Information Technology*, *23*(3), 261-289. https://doi.org/10.1093/ijlit/eav009

Klein, E. (2021) *Por qué estamos polarizados*. Capitán Swing.

Kitchin, R. (2017). Thinking critically about and researching algorithms. *Information Communication and Society*, *20*(1), 14–29. https://doi.org/10.1080/1369118X.2016.1154087

Kreiss, D., & Mcgregor, S. C. (2018). Technology Firms Shape Political Communication: The Work of Microsoft, Facebook, Twitter, and Google With Campaigns During the 2016 U.S. Presidential Cycle. *Political Communication*, *35*(2), 155–177. https://doi.org/10.1080/10584609.2017.1364814

Kreiss, D., & Mcgregor, S. C. (2019). The "Arbiters of What Our Voters See": Facebook and Google's Struggle with Policy, Process, and Enforcement around Political Advertising. *Political Communication*, *0*(0), 1–24. https://doi.org/10.1080/10584609.2019.1619639

Latzer, M., Hollnbuchner, K., Just, N., & Saurwein, F. (2015). «The economics of algorithmic selection on the Internet». In Bauer, J. & Latzer, M. (Eds.) *Handbook on the Economics of the Internet* (pp. 395-425). Edward Elgar. https://doi.org/10.4337/9780857939852.00028

Lewandowsky, S. (2021). Climate change disinformation and how to combat it. *Annual review of public health*, *1*(42), 1–21. https://doi.org/10.1146/annurev-publhealth-090419-102409

McLoughin, K. L. & Brady, W. J. (2024). Human-algorithm interactions help explain the spread of misinformation. *Current opinion in Psychology, 56*, 1-7. https://doi.org/10.1016/j.copsyc.2023.101770

Molina-Azorin, J. F., & Fetters, M. D. (2019). Building a Better World Through Mixed Methods Research. *Journal of Mixed Methods Research*, *13*(3), 275–281. https://doi.org/10.1177/1558689819855864

Molina, M.D., Sundar, S.S., Le, T, et al. (2021). "Fake News" Is Not Simply False Information: A Concept Explication and Taxonomy of Online Content. *American Behavioral Scientist*, 65(2), 180-212. https://doi.org/10.1177/0002764219878224

Napoli, P. M. (2014). On Automation in Media Industries: Integrating Algorithmic Media Production into Media Industries Scholarship. *Media Industries Journal*, *1*(1), 33–38. https://doi.org/10.3998/mij.15031809.0001.107

Nieto-Sandoval, A. G., & Ferré-Pavia, C. (2023). TikTok y cambio climático: comunicar sin fuentes ni soluciones. *Revista de Comunicación*, *22*(1), 309–331. https://doi.org/10.26441/RC22.1-2023-2994

Osborne, J., & Pimentel, D. (2022). Science, misinformation, and the role of education. *Science*, *378*, 246–248. https://doi.org/10.1126/science.abq8093

Plantin, J. C., Lagoze, C., Edwards, P. N., & Sandvig, C. (2018). Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media and Society*, *20*(1), 293–310. https://doi.org/10.1177/1461444816661553

Rogers, R. (2009). «The Googlization question, and the inculpable engine». In Becker K. and Stalder F. (Eds.) *Deep Search: The Politics of Search Engines beyond Google* (pp. 173-184). Transaction. http://www.govcom.org/publications/full_list/rogers_inculpable_engine_27Dec2008.pdf

Rosenbach, E., & Mansted, K. (2019). *The geopolitics of information*. Belfer Center for Science and International Affairs. https://www.belfercenter.org/sites/default/files/2019-08/GeopoliticsInformation.pdf

Salaverría, R., Ordovás, J.M., Esteban, M., García-Retamero, R., et al. (20 de febrero de 2021). *Entender y combatir la desinformación sobre ciencia y salud*. Ministerio de Ciencia e Innovación. https://doi.org/10.20350/digitalCSIC/13853

Siegel, D. A. (2013). Social networks and the mass media. *American Political Science Review*, 107(4), 786-805. https://doi.org/10.1017/S0003055413000452

Siles González, I. (2023) *Vivir con algoritmos: Plataformas digitales y cultura en Costa Rica.* CICOM.

Tarullo, R., & Fenoll, V. (2024). "Long Live Freedom!": Digital Communication of Argentina's Emerging Libertarian Populism. *Tripodos,* (54), 01. https://doi.org/10.51698/tripodos.2023.54.01

Teso Alonso, G., Fernández-Reyes, R., Gaitán Moya, J. A., Lozano Ascencio, C. & Piñuel Raigada, J. L. (2018). *Comunicación para la sostenibilidad: el cambio climático en los medios.* Fundación Alternativas. https://idus.us.es/handle/11441/81114

Teso Alonso, G., y Lozano Ascencio, C. (2022). La comunicación online del Cambio Climático en España. *Revista Latina De Comunicación Social*, *80*, 65–87. https://doi.org/10.4185/RLCS-2022-1531

Thielmann, T., van der Velden, L., Fischer, F., & Vogler, R. (2013). *Dwelling in the Web: Towards a Googlization of Space. In HIIG Discussion Paper Series*. Alexander von Humboldt Institut für Internet und Gesellschaft. http://dx.doi.org/10.2139/ssrn.2151949

van Dijck, J., & Poell, T. (2015). Social Media and the Transformation of Public Space. *Social Media and Society*, *1*(2). https://doi.org/10.1177/2056305115622482

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, *359*,1146-1151. https://doi.org/10.1126/science.aap9559

Wolf, M. J., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. (2022). *2022 Environmental Performance Index*. Yale Center for Environmental Law & Policy. https://epi.yale.edu/

Yan, P., Schroeder, R., & Stier, S. (2022). Is there a link between climate change scepticism and populism? An analysis of web tracking and survey data from Europe and the U.S. *Information, Communication & Society*, *25*(10), 1400–1439. https://doi.org/10.1080/1369118X.2020.1864005

Yeo, S. (2016). Geopolitics of search: Google versus China? *Media, Culture & Society*, *38*(4), 591-605. https://doi.org/10.1177/0163443716643014

Zhang, N. & Skoric, M. M. (2018). Media Use and Environmental Engagement: Examining Differential Gains from News Media and Social Media. *International Journal of Communication*, *12*, 380–403. https://ijoc.org/index.php/ijoc/article/view/7650

Zhou, Y. & Shen, L. (2022). Confirmation Bias and the Persistence of Misinformation on Climate Change. *Communication Research*, *49*(4), 500–523. https://doi.org/10.1177/00936502211028049