

Understanding the Dimensions of Climate Change Misinformation

Evan Rodenburg, BSc

Sustainability Science and Society

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Faculty of Social Sciences, Brock University St. Catharines, Ontario, Canada

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Abstract

Climate change misinformation (CCM) is emerging as one of the most pressing barriers to climate action. Referring to false or inaccurate information about climate change, CCM threatens to cast confusion on both the severity and existence of climate change. As CCM has permeated into mainstream news and social media platforms, it can now reach larger audiences and decrease support for climate change mitigation practices and policies. To combat CCM effectively, more work is needed to understand it as one unified concept. This major research paper focuses on filling this gap by identifying the dimensions of CCM through an inductive content analysis of peer-reviewed literature. Utilizing an inductive approach, five overall dimensions of CCM were synthesized: attributes, psychology, politics, disinformation, and responses. These dimensions establish the necessary foundation to understand CCM as one concept, increase global resiliency to CCM, and develop strategies that focus on eliminating CCM in the future.

Keywords: Communication, Media, Climate Science, Scientific Consensus

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1.0 Introduction

As the world continues to battle with the environmental effects of the climate crisis, climate change and the importance of addressing pressing environmental issues has permeated into mainstream media (Cook, 2019). Within North America, many people look to a variety of news and social media platforms as a source of accurate information about real-time issues (Stoddart et al., 2016; Treen et al., 2020). These platforms can play an integral part in shaping one's understanding of climate change (Moser, 2016; World Health Organization, 2023). With the status of the climate continuing to worsen, effective climate change communication is needed across these platforms to generate support for positive mitigation actions (Cook, 2019; Cadorette et al., 2018). However, the infiltration of false or inaccurate information about climate change across these platforms, generally referred to as climate change misinformation (CCM), threatens to counteract effective climate change communication efforts (Stoddart et al., 2016; Treen et al., 2020). CCM accomplishes this by underselling the urgency of climate change, casting confusion amongst the public, and hindering the much-needed global understanding of climate change from developing (Nerlich et al., 2010; World Health Organization, 2023; Treen et al., 2020). This makes CCM problematic as it not only deters effective climate change communication but reduces the support for positive climate action.

The literature indicates that CCM is a relatively new concept, and minimal research explicitly uses it as a term when describing false information about climate change. (Treen et al., 2020). However, the literature that does utilize the term 'CCM' has some commonalities. First, the discussion surrounding misinformation, in general, is transferable to CCM (Karlova & Fisher, 2012). Second, CCM communicates false information about climate change (Karlova & Fisher, 2012). Third, CCM also encompasses truthful information that is misleading (Lazer et al., 2018; Treen et al., 2020). Lastly, CCM can be intentionally or unintentionally deceitful (Treen et al., 2020).

While more recent work has been done by Treen et al. (2020) in synthesizing the literature on CCM, it is apparent that no unified understanding exists. This is evident by the lack of a robust definition of CCM (Karlova & Fisher, 2012; Treen et al., 2020). Moreover, as CCM is a rather complex concept, an established foundation of the topic is needed to combat the spreading of it in the future (Cook et al., 2017; Cook, 2020). Overall, minimal research has established CCM as one unified concept.

The purpose of this study is to establish some key elements that inform the foundation of CCM as a concept. To do so, this research focuses on identifying the dimensions of CCM. At their essence, dimensions are the specific pieces that construct one overall concept (Bandalos, 2018). Identifying dimensions has become a beneficial practice within the field of social science to enhance understanding and develop ways to measure a concept (Bandalos, 2018). Dimensions have not yet been identified for the concept of CCM, which given its complexity, can establish a more concrete and unified understanding. This paper begins with a literature review that provides more context on CCM in relation to the media and the issues it creates. Following this, the guiding research question and methodology used for this research will be presented. This methodology consists of a five-step qualitative analysis to identify and synthesize key

themes from the CCM literature into eventual dimensions. Finally, all components of these synthesized dimensions will be discussed in detail.

2.0 Literature Review

2.1 Climate Change

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as the human-driven long-term changes in the earth's temperature and weather patterns (Pielk, 2005; IPCC, 2012). It is no secret that climate change is the most significant threat facing the global population and that little success has been seen from mitigation efforts. The sixth assessment report generated by the IPCC reinforces this claim (IPCC, 2022). The report indicates that the world will surpass the 1.5 °C warming threshold by 2040 (IPCC, 2022). Moreover, the planet is close to reaching irreversible tipping points if greenhouse gas emissions are not significantly reduced (IPCC, 2022). This conveys that immediate global action is needed to combat the effects of climate change. One significant aspect of this pertains to increased awareness of climate change (Moser, 2016). If more individuals understand the risks they face, then positive behavioural change and support for initiatives that combat the climate crisis can be supported (Moser, 2016; World Health Organization, 2023).

2.2 Climate Change Communication & Media

Climate change communication at its core, focuses on educating, encouraging and or motivating audiences to take action and confront the climate crisis (Moser, 2016; Ballantyne, 2016). To do so effectively, climate change communication strategies typically involve using factual scientific information and or the scientific consensus on climate change as reinforcement (Bayes et al., 2023). The scientific consensus asserts that humans are causing global warming, with near unanimous agreement among climate scientists and publications (Bayes et al., 2023; Cook et al., 2017; Treen et al., 2020). Having said this, climate change communication remains complex to implement effectively amongst the general public because the issue of climate change deals with 'virtual risks' (Moser, 2016; Nerlich et al., 2010). These virtual risks refer to climate change-related issues that are not yet visible but are highly anticipated to occur (Nerlich et al., 2010; Moser, 2016). Members of the public are likely to not act on issues they cannot physically see or experience, making it difficult to generate widespread support for climate mitigation actions (Nerlich et al., 2010; Moser, 2016). Layering the challenges associated with climate change communication onto the complexities of communication in general makes for a challenging space to operate in (Nerlich et al., 2010).

In tandem with the challenges associated with climate change communication, the issue of climate change continues to worsen, which has surfaced as a prevalent topic throughout the media (Cook, 2019). The media can be a highly beneficial tool when looking at climate change communication, as it can allow effective messaging to be distributed across much larger audiences (Wu et al., 2023). In particular, the use of media platforms that are well-established and heavily utilized by the widespread general public,

generally referred to as mainstream media, can significantly increase the viewership of messaging that supports the scientific consensus and climate change mitigation practices (Wu et al., 2023). However, utilizing the media can be challenging as the language used throughout climate change messaging can influence the audience's behaviour toward climate change, either in positive or negative ways (Nerlich et al., 2010). Therefore, to generate more motivation and support for combatting climate change, it is necessary to bring awareness to how information is presented throughout the media, paired with the influence media platforms can have on their target audiences.

There are many forms of media, some of which are more heavily relied on by the general public than others for frequent communications. News media is a source that many rely on daily to receive accurate, relevant, and trustworthy information on current issues from the local to global level (Cadorette et al., 2018; Stoddart et al., 2016; Tschötschel et al., 2019). There are three separate classifications of news media outlets: print, broadcast, and internet news (Cotter, 2015). Print news references physical documents such as magazines or newspapers, broadcast news refers to television or radio channels, and internet news refers to websites or online publications (Cotter, 2015; Taylor & DeCillia, 2021). The organizations that operate these outlets can be referred to as news media platforms (Cotter, 2015). There are a multitude of news media platforms which utilize one or more news media outlets that fall under multiple classifications. For example, The New York Times is a highly viewed news media platform based out of the United States that publishes newspapers (print news) and online articles through a primary webpage (internet news) to international audiences (The New York Times, 2023). Moreover, news media platforms are often specific to a country or region; for example, within Canada, the most utilized news media platforms by the general public are as follows: CBC, The Globe & Mail, CTV News, and Global News (Taylor & DeCillia, 2021). It is important to note that the term 'news media' throughout this research references the many news media platforms that exist worldwide and the associated news outlets they use to distribute content.

News media remains one of the more dominant areas that can influence an individual's perception of climate change and presents some challenges to climate change communication (Cadorette et al., 2018). Primarily, news media platforms can employ a political bias, some more than others, to enhance a story's newsworthiness (Cadorette et al., 2018; Lazaridou & Krestel, 2016). This often leads to journalists and reporters tailoring information to fit with the political opinions that align with the overall views of the platform (Tschötschel et al., 2019). Moreover, the language used when reporting on climate change can articulate inaccurate premises, which can be present when featuring discussions or controversial opinions about climate change-related issues (Tschötschel et al., 2019). Audiences can then draw different conclusions from news stories that are often inaccurate to the reported information (Tschötschel et al., 2019; Cadorette et al., 2018). This evidence suggests that news media platforms can spread false interpretations or inaccurate information about climate change (Lazaridou & Krestel, 2016).

Social media is another form of media that has exploded in global use over recent years, with approximately 60% (4.75 billion people) of the global population utilizing social media platforms (Jha & Verma, 2023). Loosely defined as online platforms that allow individuals to share content and interact with others (Carr & Hayes et al., 2015; Merriam-Webster, 2023. b), social media offers valuable channels to spread knowledge

about climate change (León et al., 2023). It is important to note that the word content in the context of this study refers to any information, opinions, or digital posts that are shared on or off media platforms. Some of the more heavily utilized social media platforms globally are Facebook, YouTube, Instagram, Twitter, and TikTok (Statista, 2023). The use of the term ‘social media’ throughout this research is in reference to social media platforms and the social networks created through them. It is important to highlight that individuals can obtain news through social media platforms (León et al., 2023; Wu et al., 2023); however, for this research, social media and news media are two separate distinctions.

The vast interconnectedness of the social networks present on social media platforms and the speed at which content can be shared gives social media immense potential to generate more widespread climate action (León et al., 2023; Wu et al., 2023). However, social media is relatively unregulated, meaning that falsehoods about global issues can garner equal, if not more, attention than factual information (León et al., 2023; UNESCO, 2023). Like news media, social media can influence one's perception of climate change (Jha & Verma, 2023). False or inaccurate information about climate change thus has an equal opportunity to reach global audiences via social media and can lead individuals to draw false conclusions about climate change (Jha & Verma, 2023). Moreover, opinion-based claims refuting climate change can proliferate through these social networks, which can take support away from global climate action (León et al., 2023). It is also vital in the context of social media to protect an individual's right to expression, making false claims and false information difficult to eradicate across platforms (UNESCO, 2023). Ultimately, social media proves to be a profoundly concerning area where false information about climate change can rapidly spread and influence a large portion of the global population.

2.3 Climate Change Misinformation

Discussion throughout the literature pertaining to the general term ‘misinformation’ is transferable to CCM, which refers to misinformation that is specifically related to the topic of climate change (Treen et al., 2020). Generally, misinformation refers to false or inaccurate information (Cook et al., 2017); however, there is no widely accepted consensus. A vast majority of dictionary definitions and reference material remain contradictory to each other, meaning there exists no widely accepted definition of misinformation (Cook, 2019; Treen et al., 2020). Karlova & Fisher (2012) indicates that authors often refer to the Oxford English Dictionary's definition of misinformation, which labels this term as “wrong or misleading information,” providing no further analysis or discussion about the topic.

In contrast, information refers to accurate and truthful facts (Karlova & Fisher, 2012). Misinformation, even though false, can be viewed as accurate information by an individual depending on the source and the way it is presented (Karlova & Fisher, 2012). Treen et al. (2020) indicates that misinformation exists as a subset of information and outlines two common themes; “inaccurate” and “misleading.” It is noteworthy that accurate information has the potential to be misleading as it can be taken out of context and be intentionally or unintentionally deceptive (Lazer et al., 2018; Treen et al., 2020). As misinformation has the potential to disguise itself as the truth, it can be rather simple for an individual to perceive misinformation as factual information (Lazer et al., 2018).

Lastly, disinformation is an important term to highlight as a subset of misinformation. The main differentiating factor separating it from misinformation is that disinformation is purposely meant to deceive with more malicious intent (Treen et al., 2020).

CCM creates issues when communicated to the widespread population. This is because it has the extreme potential to perpetuate climate denial, demotivate people to take climate action, cloud the true urgency of the climate crisis, and reduce an individual's acceptance of climate change (Nerlich et al., 2010; Cook, 2019). Exposure to CCM can develop misconceptions, reduce support for climate change mitigation practices, and influence the public's perception in supporting the false reality that humans have no involvement in climate change (Cook, 2020). The effects of CCM can intensify if presented through a trusted source, such as different media platforms (Cook, 2019). An individual can mistake CCM from these sources as factual content, which is concerning given that a global understanding of climate change is needed to address its widespread challenges (Cook, 2020). Ultimately, CCM is still an evolving concept and continued effort is needed to establish a unified understanding.

2.4 Defining Climate Change Misinformation

Given that there is no widely accepted definition of CCM, as indicated in section 2.3, it is necessary to establish one for this research. It is also imperative that this definition encompasses the majority of what the literature discusses about the topic. Keeping this front of mind, the following definition adopted from Treen et al. (2020) and Lazer et al. (2018) has been developed.

Climate change misinformation:

False or misleading content about climate change that is disseminated with or without the intent to deceive.

3.0 Research Question

Given these ideas, this major research paper aims to synthesize the multifaceted nature of climate change misinformation. Specifically it asks: What are the dimensions of climate change misinformation?

4.0 Methodology

An inductive approach was selected for this research because of the primary analytical strategy and outcome it produces. This being to extract the core meaning of specific text by producing the most relevant themes and categories related to the objectives of the research (Thomas, 2006). Moreover, selecting an approach that did not use pre-determined categories was required, given the exploratory nature of this research. To apply this approach a five-step qualitative analysis was used to satisfy the guiding research question stated in section 3.0. The methodology informing the analysis was adopted from Saldaña (2014) and Thomas (2006). The first two steps of this qualitative

analysis established a manageable corpus of literature that was then taken through an inductive content analysis (ICA), performed in the subsequent three steps. To execute this ICA the software dedoose, a platform designed to assist with qualitative analysis, was utilized to carry out the development of thematic and in-vivo codes. Dedoose was also used to organize key themes and refine the finalized dimensions of climate change misinformation (CCM).

4.1 Step One: Keyword Search

The qualitative analysis began with a keyword search to establish an initial corpus of literature. The Web of Science Core Collection was used as the sole database for this keyword search because of the platform's multidisciplinary nature and high global use in answering scientific questions (Li et al., 2018). As CCM does not fall under one specific discipline, the Web of Science established a highly diverse corpus to address the research question. The keyword search executed the following query:

“climate change” OR “global warming” (Topic) And misinformation OR disinformation (Topic)

The keywords “climate change” and “global warming” were included in the query as both phrases are often used interchangeably in the scientific community to describe anthropogenic activity causing the rise in average global temperatures (Benjamin & Budescu, 2017; Kennedy & Lindsey, 2015). Both misinformation and disinformation were included in the query because misinformation encompasses the functionality of disinformation, and literature surrounding both concepts is highly applicable to understanding CCM as a whole (Treen et al., 2020). The overall query searched for these terms within the title, abstract, and keywords of the literature included in the Web of Science Core Collection database using the function “Topic.” The keyword search ultimately produced 289 pieces of literature.

4.2 Step Two: Abstract Review

The literature isolated in Step One then went through an initial review, which consisted of a detailed reading of each abstract. This was conducted in the order of the search engine results from the Web of Science Core collection database. In order for a piece of literature to move forward to the ICA, it needed to meet a set of predetermined criteria. These criteria consisted of four main components outlined in Table 4.1. First, CCM, misinformation about climate change, or climate change disinformation needed to be a central theme of the paper. Specifically, one of these three topics had to inform the main objective of the literature, which could have included playing a key role in the methodology, informing the main issues addressed in the literature, and or influencing the results. Second, misinformation or disinformation had to be discussed solely in the context of climate change. This meant that literature discussing both climate change alongside other issues, such as the prevalence of misinformation or disinformation during the COVID-19 pandemic, were omitted. Third, the literature could not be hyper focused on one specific community. As this research pertains to the more general aspects of CCM, information specific to one community including demographics, dynamics, individual backgrounds etc. would significantly narrow the reach of any synthesized

dimensions. Literature that was scaled to the national level was deemed acceptable for this study as it still maintains the generalization of CCM. Fourth, background information about CCM needed to be present throughout. This was primarily to target literature that would inform more robust dimensions. In the case where a concrete determination could not be made about one or more criteria, the piece of literature was included in the following step.

Table 4.1: Inclusion and exclusion criteria used to evaluate individual pieces of literature

Inclusion Criteria	Exclusion Criteria
Climate change misinformation, misinformation about climate change, or climate change disinformation is a central theme of the literature.	Climate change misinformation, misinformation about climate change, or climate change disinformation is not a central theme of the literature.
Misinformation or disinformation is discussed solely in the context of climate change.	Misinformation or disinformation is not discussed solely in the context of climate change.
Study is not hyper focused on one specific community.	Study is hyper focused on one specific community.
Background information about climate change misinformation is presented.	Background information about climate change misinformation is not presented.

Note: In the context of this study 'hyper focused' references a high level of attention put into researching one location within a specific geographic boundary.

4.3 Step Three: Full Reading & Initial Coding of Text

This step marked the initiation of the ICA, which combined the three initial procedures of the inductive coding process outlined in Thomas (2006). These procedures included the preparation of raw data files, a close reading of the text, and the creation of categories (Thomas, 2006). For this research, the preparation of raw data files began by importing the CCM literature into dedoose. Following this, a close reading of the text was completed for each document in tandem with a preliminary round of coding, known in Thomas (2006) as the creation of categories. During this initial reading, the criteria outlined in Step Two were used to screen each paper. If a piece of literature did not concretely fit all criteria following the full text reading it was eliminated from the ICA. This initial reading also provided clarity and concrete evidence to support either omitting or including the literature that loosely met one or two criteria following the abstract review. A hybrid of thematic and in-vivo coding was selected for this ICA as these forms of coding provide the desired output of information necessary for establishing dimensions (Thomas, 2006; Saldaña 2014). Thematic coding, referred to as the qualitative data analysis strategy "to code" in Saldaña (2014), involves identifying extended phrases or sentences that highlight the true meaning of data. In-vivo coding is a method of qualitative analysis that uses the language of the physical literature to identify data that stands out as significant or summarizes what is being communicated (Saldaña, 2014;

Thomas, 2006). The completion of this step resulted in each paper having been completely read through, paired with a complete set of both thematic and in-vivo codes within dedoose.

4.4 Step Four: Reviewing & Categorizing Codes

This step involved reviewing the preliminary codes produced in Step Three and synthesizing them into overarching categories. This was done by exercising two key elements of the inductive coding process highlighted in Thomas (2006), pertaining to labeling the preliminary codes into initial categories, followed by reducing overlap amongst those categories. Methodology on the categorization of specific codes from Saldaña (2014) was also used to assist in the reviewing process. To begin, the preliminary codes were evaluated for similarities and codes with significant overlap were classified into similar clusters (Saldaña, 2014). Once the whole list of codes was sorted into established clusters, appropriate labels were assigned to them deemed the initial categories (Saldaña, 2014). Following this, categories that substantially overlapped, either by sharing the same titles or key themes, were grouped together. As this study is exploratory it was unknown how many categories this step would yield. However, Thomas (2006) suggests that 15-20 categories be the benchmark to indicate the completion of this step. This was the main guideline that was followed throughout the reviewing process. Ultimately, Step Four was deemed complete when all codes were placed into a corresponding category that aligned with the guidelines set out by Thomas (2006).

4.5 Step Five: Refining Categories & Identifying Themes

This final step exercised the fifth procedure of inductive analysis outlined in Thomas (2006), which further refined the established categories from Step Four. This consisted of combining categories into approximately three-eight superordinate categories (Thomas, 2006; Saldaña 2014). To do this, the quantitative data analysis strategies 'To Analyze' and 'To Pattern' from Saldaña (2006) were used as guidance. The main takeaway from these strategies was to reread the coded segments of the literature and look for developing patterns (Saldaña, 2026). This enhanced familiarity of the data which led to the identification of more specific details, and assisted in amalgamating patterns emerging from the themes. Once the key superordinate categories were created, they were each assigned an overall theme and labelled as the dimensions of CCM.

5.0 Findings

Upon completion of the keyword search, 289 pieces of literature were produced from the Web of Science core collection database. Following the abstract review, of these 289 studies, 45 were deemed acceptable to move forward into the ICA. It is also important to mention that four of these 45 studies could not be accessed due to paywall restrictions and or unavailability through the Brock University Library proxy. After the full-text reading and initial coding were complete, 24 pieces of literature were found to

fully satisfy all criteria set in place for this research (Appendix 1). These 24 studies were taken through the entirety of the ICA, where five overall dimensions of climate change misinformation were synthesized from 397 thematic/in-vivo codes (Appendix 2). Each of these dimensions contained two-four subcategories that were created to better summarize and communicate all components of each dimension. The following section of this paper presents and discusses these five synthesized dimensions of CCM along with their associated subcategories. A summary of the five dimensions and their associated subcategories can be found in Figure 5.1. Each of the following subsections begins with a description of the dimension, followed by a discussion of the individual components that construct each associated subcategory.

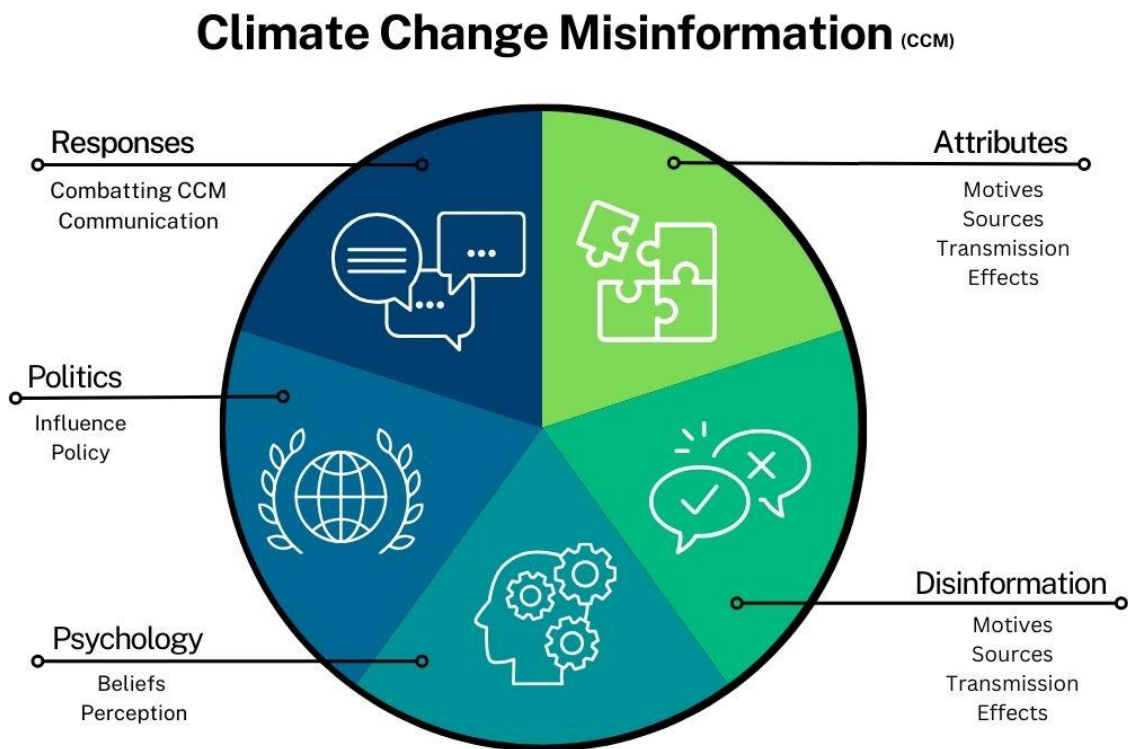


Figure 5.1: Five dimensions of climate change misinformation and their associated subcategories

5.1 Attributes

When analyzing the literature, there was considerable discussion on four key attributes of CCM, including what it aims to accomplish, where it originates, how it moves, and the effects it has. All these properties focused on distinguishing CCM from factual information and served to provide a deeper understanding of CCM as a concept. This dimension encompasses all these distinguishing properties under the first theme titled 'Attributes.'

5.1.1 *Motives*

This attribute encompassed what CCM aims to accomplish, referred to as the motives behind creating and spreading misinformation. When analyzing the literature on the motivation behind CCM, the main theme that emerged was undermining the scientific consensus on climate change. CCM has put concerted effort into casting doubt on climate scientists and climate science, mainly by claiming the scientific consensus does not exist or understating climate change's true seriousness and severity (Krishna, 2021). CCM can use these types of inaccurate claims to undermine the scientific consensus, which causes confusion and misconceptions to proliferate amongst the public (Chu et al., 2023; Maertens et al., 2020). CCM seeds doubt about scientific consensus by reducing the efficacy of accurate science communication and enhancing polarization surrounding climate change-related issues (Chu et al., 2023; Maertens et al., 2020). CCM also seeks to discredit the scientific consensus by calling into question the credibility of climate science (Treen et al., 2020; Lewandowsky, 2021; Cook et al., 2017; Krishna, 2021). This includes questioning the legitimacy of climate projections, the credentials of climate scientists, and the accuracy of the scientific consensus in general (Treen et al., 2020; Lewandowsky, 2021; Krishna, 2021). Ultimately, the primary motive of CCM is to undermine and discredit the scientific consensus on climate change.

5.1.2 *Sources*

Sources was the name given to the attribute of CCM that references where misinformation originates. Specific sources that create CCM can most commonly be referred to as actors. This was reflected in the ICA underneath the unifying code 'Actors of CCM.' Treen et al. (2020) referenced these actors in two superordinate categories. First was 'philanthropic and corporate actors', encompassing conservative foundations, industry, and corporations with an emphasis on fossil fuels (Treen et al., 2020). The second category was 'producers of climate change misinformation,' which included political & religious organizations, astroturf/grassroots organizations/campaigns, and contrarian scientists (Treen et al., 2020). Evidently, there is a distinct dichotomy between the various types of actors that create CCM. In addition, philanthropic and corporate actors are responsible for funding and providing resources to the producers of CCM so that it can be created (Treen et al., 2020). The components distinguishing these different types of actors were evident in other studies under the 'Actors of CCM' code; however, the term actors or their separate classifications were often not used. Hassan et al. (2023) used the term 'anti-climate agents,' which were found to resemble these actors of CCM because they were described as creating and spreading CCM. Contrarily, Farrell et al. (2019) combined the two forms of actors synthesized by Treen et al. (2020) and labelled them simply as 'producers.' Farrell et al. (2019) continued to describe these producers by giving examples of organizations that would fall under the 'producer' classification. This included think tanks, philanthropic foundations, corporations, trade associations, public relations firms, etc., indicating that they are aimed at driving cultural and political conversation surrounding climate change (Farrell et al., 2019). Based on this information about the actors of CCM, they can effectively be labelled as the primary sources of CCM.

Think tanks and misinformation campaigns are two specific sources that surfaced in the ICA outside of the 'Actors of CCM' code. Think tanks, in short, refer to policy or research institutions that work to play a role in making and influencing policy from the

local to global scale (McGill University, n.d.; University of Oxford, n.d.). Think tanks also exist in a wide range of fields, including economics, technology, industry, and business (McGill University, n.d.; University of Oxford, n.d.). It was interesting that conservative think tanks surfaced throughout the ICA as a dominant source when looking at CCM. Conservative think tanks are responsible for producing articles and books that dismiss the scientific consensus on climate change and create counterproductive arguments about climate change mitigation policies (Samoilenko & Cook, 2023; Coan et al., 2021). Misinformation campaigns were found to be the second highly referenced source of CCM. These campaigns possess some similar characteristics to think tanks; however, their primary motive is to produce movements of inaccurate or false information that aim to discredit or attack climate scientists, environmentalists, and other policymakers (Samoilenko, 2023; Lewandowsky, 2021; Cook et al., 2018). Misinformation campaigns have been a longstanding source of CCM and a significant contributor to the public's misperceptions about climate change (Cook et al., 2018; Farrell et al., 2019). These campaigns often use what is called ad hominem attacks on climate scientists, whereby the character of these scientists is called into question rather than debating the information they are presenting (Farrell et al., 2019; Samoilenko & Cook, 2023). What makes think tanks and misinformation campaigns interesting is how heavily they both link to politics. Often think tanks and misinformation campaigns are able to proliferate via funding from philanthropic and corporate actors that have deeply conservative political motivations (Treen et al., 2023; Boussalis & Coan, 2017; Farrell et al., 2019). Overall, think tanks and misinformation campaigns are two sources of CCM that are heavily referenced throughout the CCM literature separately from other CCM actors and have the capacity to threaten climate change action in the political space.

5.1.3 Transmission

The following section breaks down the attribute titled transmission, which focuses on how CCM moves. Transmission was the most highly discussed attribute throughout the CCM literature, evident by the number of codes produced by the ICA. The analysis uncovered a considerable number of themes describing the main avenues, concepts, and theories that give ample context to understanding the movement of CCM. The most prolific avenue in which CCM is transmitted is through the media, which is where most of the following discussion is situated. Following this discussion on media, other concepts of transmission pertaining to politics and pseudoscience are discussed.

CCM presented throughout the media can come in many forms, one of which is fake news. Much like CCM, there is no universal understanding of the concept 'fake news'; however, it is known to be deliberately false and created to imitate conventional media reporting (Taddicken & Wolff, 2020). The term 'fake news' was often coded in conjunction with CCM throughout the ICA. When looking at the relationship between these two terms, it was evident that fake news closely resembled the definition of CCM established for this research. This being that fake news can represent false or misleading content about climate change and can be spread with or without the intent to deceive. Treen et al.(2020) gave information about identifying or correcting fake news within the media, suggesting that it creates an issue similar to the distribution of CCM. In addition, Taddicken & Wolff (2020) used 'fake news' rather interchangeably with 'misinformation' in the context of climate change. Fake news appeared to be a term that

very closely represented CCM within the media, which, given the similarities between the two, made it evident that CCM can take the form of fake news when travelling throughout the media.

Fake experts also play an integral role in the movement of CCM throughout the media. CCM often employs a fake expert, referring to an individual whose opinions defy the scientific consensus with no factual basis, to give more validity to the claims being made (Green et al., 2022; Cook et al., 2017). This casts doubt on the scientific consensus and enhances polarization on the issue of climate change amongst the public (Cook et al., 2017). Surprisingly, it was found that legitimate experts in the field of climate change can also cast doubt. Through many media outlets outside of conventional scientific channels, one may find experts engaged in enhanced discussion to provide more context on climate change-related issues (Bedford, 2010). From this, if the audience perceives this discussion as argumentative, they will default to thinking these experts are in disagreement, which can cast doubt and reduce support for addressing the issues at hand (Bedford, 2010). This doubt cast by fake and potentially legitimate experts in the field of climate change can be deemed an additional avenue that spreads CCM throughout the media.

A considerable volume of CCM can also travel more discreetly throughout the media. The ICA identified several tactics that disguise CCM as factual content, allowing it to move fluidly and undetected through media outlets. Reasoning error was found to be the tactic contributing to this, referring to a writer employing an assertion that is unsupported to defend their central idea (Cook et al., 2018). Reasoning errors about climate change pose a real threat to audiences as they are forms of CCM that are highly challenging to identify and generally go unidentified throughout the media (Cook et al., 2018). Fear was the second tactic found to transmit CCM discreetly. It was revealed that the use of fear in the reporting of climate change news has proven to be counterproductive in promoting climate action (Lewandowsky, 2021). There have been effective uses of fear, but only if the threat being addressed could easily be avoided (Lewandowsky, 2021). As climate change is such a complex issue with no easy solution, reporting and other content containing fear could adversely affect audiences (Lewandowsky, 2021). The final tactic that makes the movement of CCM more discreet is the attempt to use authority. This surfaced in the ICA through a study by Chu et al. (2023), which discussed the use of authority flagged under the code ‘authority reference.’ An authority reference can be defined as “referencing an individual or organization that possesses knowledge in a related field” (Chu et al., 2023, p.4). This can be used in a way to support factual content about climate change by representing trustworthiness and credibility. However, CCM seeks to mimic this by employing the same approach (Chu et al., 2023). Often, CCM will reference non-specific sources of authority or fake experts to give it the appearance of credible content. (Chu et al., 2023; Green et al., 2022; Cook et al., 2017). Doing so gives CCM the ability to travel undetected across various media outlets.

There are two predominant types of media where the majority of CCM is consumed. Both news media and social media were found to be the most significant outlets where CCM can be transmitted. These forms of media play an integral role in conveying accurate information about climate change to the global population (Hassan et al., 2023), making them highly susceptible targets for the infiltration of CCM. It was

found that historically, traditional news media focused on providing what is called ‘false balance coverage’ where factual information would be presented in a way that allows the audience to draw their own conclusions, leaving room for false interpretations (Lewandowsky, 2021; Treen et al., 2020). Modern-day news media has strayed away from this idea of ensuring balance; however, attention is still given to contrarian sources in reporting (Lewandowsky, 2021; Treen et al., 2020). Contrarian scientists, or contrarianism, references individuals seeking to contradict the scientific consensus on climate change through verbal and online attacks (Coan et al., 2021). The attention given to contrarian sources is a key way CCM gets injected into news media.

Social media, more so than news media, is where the transmission of CCM is significantly amplified (Lewandowsky, 2021; Treen et al., 2020; Hassan et al., 2023; Vu et al., 2023). False claims on social media can move up to six times faster than factual content (Hassan et al., 2023). Moreover, Vraga et al., 2020 showed that social media has been implicated in enhancing the pervasiveness and popularity of misinformation, which frequently performs better than factual content. Vu et al. (2023) supports this claim by highlighting that the growing use of social media significantly increases the pervasiveness of CCM. A major component of the amplification of CCM on social media pertains to the sharing and repetitive behaviours of users, which relates to the term homophily (Treen et al., 2020). Homophily refers to the tendency for humans to form linkages with others who share similar traits, which occurs in nearly all online and offline social networks (Treen et al., 2020). This can form homogenous clusters of like-minded individuals, known as echo chambers, where CCM can spread (Treen et al., 2020). Homophily surfaced as an integral component of the ICA and further highlighted why CCM can flourish on social media.

Outside the media, some other key areas exist where CCM can be transmitted. Political outlets, specifically politicians, were evident in the ICA as key areas where CCM can move. Politicians create outlets of CCM that can have the power to influence policymaking and public audiences by using political affiliations as leverage (Vu et al., 2023; Treen et al., 2020). If a politician has strong beliefs rooted in climate denial or is attempting to push for unfavourable climate policies, they may in- or unintentionally use their position to spread CCM to the general public (Vu et al., 2023; Boussalis & Coan, 2017; Lewandowsky, 2021). It is necessary to highlight that most discussion about the political outlets of CCM was drawn from literature based in North America, mainly in the United States. This suggests that these avenues of CCM may be more applicable to the United States in comparison to other countries that differ politically. Another area where CCM can move is through the presence of pseudoscience. This was also a closely related term to CCM that surfaced during the synthesis of this subcategory. Pseudoscience refers to beliefs, claims or practices that are mistakenly referred to as factual scientific information (Pongiglione & Martini, 2022). Pseudoscience seeks to discredit the scientific consensus, spread false or inaccurate content, and can be difficult to detect (Lewandowsky, 2021; Pongiglione & Martini, 2022). Given its similar characteristics to CCM, it is evident that pseudoscience could be deemed as another discreet method of transmitting CCM.

5.1.4 Effect

The final attribute of CCM highlights the effects it has on the widespread population. Confusion caused by exposure to CCM was the primary effect that surfaced throughout the ICA. The code ‘confusing the public’ was the most common theme that emerged under this subcategory, referring to the general public not being able to differentiate fact from fiction when exposed to CCM (Treen et al., 2020; Chu et al., 2023; Krishna, 2021). It was evident that confusion was the root cause of many other effects caused by exposure to CCM. Confusion often lowers the acceptance of climate change, casts doubt on the scientific consensus, impedes climate action, and increases political polarization (Treen et al., 2020; Chu et al., 2023; Krishna, 2021). CCM employs this by targeting the beliefs and personal views of the audience to alter their perception of climate change (Cook et al., 2018). As CCM has the vast potential to spread throughout the media, its effects can be felt across a widespread audience and have more longevity (Green et al., 2022; Cook et al., 2017; Bedford, 2010). When an individual experiences the effects of CCM, even if there is an attempt to correct it, their initial beliefs formulated from the exposure can still have continued influence (Lewandowsky, 2021; Maertens et al., 2020). In sum, the themes presented throughout the ICA showed that confusion is at the root of these resilient effects of CCM.

5.2 Psychology

This dimension unpacks the psychological elements and applications of CCM. Results from the ICA were synthesized into two primary subcategories: belief and perception. These communicate how the mindset and thinking of an individual play into the acceptance of CCM.

5.2.1 Belief

A significant theme at the forefront of the ICA was belief. Human application of these beliefs emerged as a major element of the psychology behind CCM. In the context of this research, ‘beliefs’ refer to content humans believe to be true regardless of evidence. As human beliefs about climate change are an important component of effective climate change communication (Chu et al., 2023), it makes sense for CCM to use them as a target to instill confusion about the scientific consensus. A common theme found within the ICA was coded as ‘human beliefs on climate change,’ which amalgamated a multitude of topics. Worldview surfaced as a more heavily referenced topic underneath this overall code. An individual’s worldview can be defined as “a collection of attitudes, values, stories, and expectations about the world around them, which inform their every thought and action” (Gray, 2011, p.58). This is grounded and expressed in ethics, religion, philosophy, and scientific beliefs (Gray, 2011). In essence, an individual’s worldview plays an integral part in their acceptance of climate change. If CCM either indirectly or directly resonates with someone’s worldview, it can form very strong misbeliefs about climate change (Treen et al., 2020; Lewandowsky, 2021). Misbelief can be referenced as “a false belief that contradicts the best available evidence” (Chu et al., 2023, p.849). Attitudes, or climate attitudes, also surfaced to be influenced by an individual’s worldview and focus on the way an individual thinks or feels about

climate change (Cook et al., 2017). Climate attitudes are very difficult to change, which can be problematic if an individual's worldview aligns with misbeliefs (Lewandowsky, 2021). In tandem with this theme of worldview, familiarity also surfaced as an influential element in shaping human beliefs on climate change. Someone's familiarity with a piece of information, i.e. how often they come across it, often correlates to the development of a strong belief (Green et al., 2022). Repeated exposure to CCM can deem false content familiar to an individual and can form misbeliefs about climate change. This is particularly applicable to the transmission of CCM on social media, whereby repeated exposure to CCM via strong homophily can increase its familiarity and lead to the formation of these strong misbeliefs (Green et al., 2022; Treen et al., 2020).

Confirmation bias was an additional term surfacing under the theme 'human beliefs on climate change.' Confirmation bias can be defined as the tendency of an individual to interpret or search for new evidence in order to validate their existing beliefs (Zhou & Shen, 2022; Peters, 2022). The ICA found that confirmation bias enhances polarizing beliefs and is a key contributor to the spread of misinformation (Zhou & Shen, 2022). This can prove to be applicable to CCM in relation to exposure. If an individual has pre-established beliefs on climate change that go against the scientific consensus, exposure to CCM can be used as false validation. This can foster stronger misbeliefs about climate change, which can serve as a barrier to pro-climate action.

Climate denial frequently surfaced throughout the ICA, and findings suggest that it strongly applies to human beliefs (Chu et al., 2023; Zhou & Shen, 2022). Climate denial refers to the component of CCM messaging that rejects the scientific consensus on climate change (Cook et al., 2017; Schubatzky & Haagen-Schützenhöfer, 2022). In addition, an individual whose beliefs are rooted in rejecting this scientific consensus can be deemed a 'climate denier' (Krishna, 2021; Pongiglione & Martini, 2022). Such individuals can fall into this classification regardless of whether they have encountered CCM or not. However, it is highly likely that a climate denier has formulated their beliefs based on exposure to some form of CCM (Hassan et al., 2023). Moreover, other climate deniers have the potential to spread CCM by projecting their beliefs or viewpoints onto others. Climate denial can be powerful enough to drive individuals with strong climate acceptance into establishing beliefs associated with CCM (Krishna, 2021). This shows that climate denial weaves its way into CCM in order to sway one's beliefs toward rejecting the existence of climate change. It is also important to mention that the ICA flagged the terms climate skepticism and climate contrarianism as they are used rather interchangeably with climate denial throughout the CCM literature. Closer examination revealed that climate skepticism and climate contrarianism effectively refer to the same principles that define climate denial.

5.2.2 Perception

The theme of perception was found to be an important component of CCM. What makes this interesting is that some distinct differences and connections exist between one's perception and beliefs on climate change. Perception focuses more on the sensory applications of an individual, whereby the ability to hear, see, or become aware of something through the senses informs someone's ability to understand information (Oxford Learner's Dictionary, 2023; Merriam-Webster, 2023.a). In the context of climate

change, as there are a vast majority of individuals who may not directly feel the effects of it, information that an individual hears and sees from what they deem a trusted source significantly shapes their perception of climate change as an issue (Chu et al., 2023; Lewandowsky, 2021). Moreover, perceptions often form the foundation of one's beliefs; therefore, one's perception of the scientific consensus forms a key gateway to shaping one's beliefs into either supporting or opposing the existence and threats of climate change (Lewandowsky, 2021). In addition, perception infiltrates into the discussion of CCM through perceived credibility. The public often relies on expert opinion to help them understand science-based information (Chu et al., 2023). Fake experts often use CCM to seem legitimate by enhancing their perceived credibility, which can instil false perceptions of climate change (Chu et al., 2023). Overall, perception was found to play a key role in shaping one's beliefs on climate change and can be directly impacted via exposure to CCM.

5.3 Politics

This dimension is centred around deconstructing the connections between CCM and politics. It was interesting that of the 24 studies taken through the ICA, 83% of them (20 studies) contained political themes throughout. This political dimension focuses on the influence politics has on the spread and effects of CCM paired with its application to policy.

5.3.1 Influence

Populism, belief, and effect were the three common themes identified throughout the ICA that highlight the various ways in which CCM is influenced by politics. The term populism was presented more as a tactic that enhances the believability of CCM to the general public. Populism refers to a political strategy that focuses on appealing to the average person who feels their concerns are ignored by elite individuals or groups, elite referring to people or organizations in positions of power (Yilmaz & Morieson, 2022; Lewandowsky, 2021). Often the politically elite will use populism to convey their beliefs rooted in CCM for some type of political gain (Lewandowsky, 2021). Lewandowsky (2021) indicated that the actions of the elite are dominant in shaping the public's perception of climate change. If audiences get caught up in these populist movements, their perception of climate change may be shaped in a way that defies the scientific consensus on climate change.

The theme of belief was seen to be highly relevant throughout the political discussion surrounding CCM. An individual's political beliefs often correspond to their susceptibility to being influenced by CCM; however, this depends on where they lie on the political spectrum (Green et al., 2022). Conservative or right-wing individuals tend to be more susceptible to CCM and have a greater potential to develop beliefs that deny the scientific consensus on climate change (Cook et al., 2017; Hassan et al., 2023). In comparison, liberal or central/left-winged individuals tend to be less susceptible, if not unaffected by CCM and tend to give more support to the scientific consensus on climate change (Cook et al., 2017; Hassan et al., 2023; Zhou & Shen, 2022). Belief as a theme of CCM also surfaced in the form of political authority. Similar to populism, if the ideology of the political elite is rooted in CCM, their authority in the political space can have

enough influence to alter the public's beliefs on climate change (Lewandowsky, 2021; Boussalis & Coan, 2017). This calls back to the concept of authority reference discussed in section 5.1.3, whereby the politically elite can pose as a credible point of reference or fake expert to reinforce CCM (Chu et al., 2023). This can convince the public to believe the CCM transmitted by the politically elite and cause distrust around credible scientific information (Lewandowsky, 2021; Boussalis & Coan, 2017; van der Linden et al., 2017).

The third theme identified in the ICA under this subcategory was effect, which surfaced due to CCM exposure in the political space. Polarization as a result of confusion was found to be one of the more common effects of CCM. It was found that climate change, in general, is a politically polarizing issue, meaning there exists strong divergence in political opinions that extend closer toward ideological extremes (Vu et al., 2023; Farrell et al., 2019). This political polarization can be significantly enhanced by CCM as it can give apparent validity to denialist claims, which ultimately increases the intensity of these extreme views rooted in climate denial (van der Linden et al., 2017; Chu et al., 2023; Cook et al., 2018; Pongiglione, Martini, 2022). This direct effect of polarization can reverberate through different levels of government and among members of the public (Pongiglione, Martini, 2022). It can be seen that polarization in relation to political influence is a significant by-product of CCM.

5.3.2 Policy

There was considerable discussion throughout the ICA surrounding the application of CCM to public policy. CCM often seeks to directly impact the success of climate policy, which is a crucial area where climate action can be set in place (Lewandowsky, 2021). CCM mobilized in the political space can create a general lack of support for climate policies and is often used for political gain (Green et al., 2022). There have been calls to put more emphasis on enhancing the communication of climate policy by making them more resilient to the effects of CCM (Green et al., 2022; Lewandowsky, 2021). The fact that CCM can infiltrate so far into political institutions that there is conversation around making policy more robust is a testament to its tenacity. CCM proves to be challenging in relation to policy because the impacts it generates can differ significantly depending on a nation's political structure (Green et al., 2022). This means that any approach to making climate policy more resilient to CCM needs to be catered specifically to an individual nation and is likely not universally applicable. This gives ample grounds to deem CCM a significant threat to the success of climate policy.

5.4 Disinformation

Disinformation was found to be a separate classification of misinformation. As a subset of CCM, disinformation about climate change, or climate change disinformation, shares the same overall attributes as CCM. However, some key differences make climate change disinformation a unique form of CCM. This dimension unpacks the distinguishing elements of climate change disinformation and how it is situated under the broader context of CCM.

5.4.1 *Motives*

Understanding climate change disinformation begins with what it aims to accomplish, which emerged in the ICA through definitions. Much like CCM, the general principles of disinformation were found to be directly applicable to climate change disinformation (Treen et al., 2020). It was found that most studies deemed disinformation as misleading information that is consciously created and spread with the intent to deceive (Treen et al., 2020; Hassan et al., 2023; Green et al., 2022; Vu et al., 2023; Taddicken & Wolff, 2020). Moreover, a key similarity between CCM and climate change disinformation is that undermining and discrediting the scientific consensus on climate change is the primary objective (Treen et al., 2020; Hassan et al., 2023; Krishna, 2021). What further defines climate change disinformation pertains to the element of intent. Climate change disinformation is solely intentional in the way it is created and spread (Treen et al., 2020; Hassan et al., 2023). This intent makes climate change disinformation a more targeted and malicious form of CCM that counteracts the scientific consensus (Treen et al., 2020; Hassan et al., 2023; Lewandowsky, 2021). Treen et al. (2020) situated disinformation as a subset of misinformation, which suggests that climate change disinformation has the potential to be deemed a specific classification of CCM. Ultimately, the presence of intent is a distinguishable feature of climate change disinformation under the broader context of CCM.

5.4.2 *Sources & Transmission*

Much like CCM, climate change disinformation originates through specific sources called actors. Established actors of CCM also have the potential to create and spread disinformation; however, intention has to be an integral part of it (Treen et al., 2020; Hassan et al., 2023; Green et al., 2022; Vu et al., 2023; Taddicken & Wolff, 2020; Cremades & Stella, 2022). There was one primary piece of literature that stood out in the ICA that provided more context about these actors of climate change disinformation. Hassan et al. (2023) contained the most valuable themes, referring to these actors as ‘agents of disinformation.’ It was indicated that there are different types of agents that can produce and disseminate climate change disinformation. These agents can be distinguished as fabricators, producers, or distributors (Hassan et al., 2023). Fabricators are agents that create false claims with the intent to deceive for some form of political gain (Hassan et al., 2023). Producers consolidate and organize the messages from the fabricators, which then move to the spreaders who support and disseminate said messages (Hassan et al., 2023). It was evident that these agents of climate change disinformation presented in Hassan et al. (2023) exhibited the same characteristics as actors of CCM; therefore, for continuity purposes in this research, agents of disinformation will be referenced in the form of actors of climate change disinformation.

In order to reach a wider audience, these actors of climate change disinformation often use the media to transmit their messaging. The ICA found that social media, broadcast media, and online news are the most frequently used platforms to transmit disinformation (Hassan et al., 2023). Moreover, it was found that disinformation campaigns are one of the most prominent ways climate change disinformation moves across these platforms. Disinformation campaigns refer to a large grouping of false or inaccurate information that is formulated into an organized attack (Treen et al., 2020; Lewandowsky, 2021; van der Linden et al., 2017; Krishna, 2021; Legates et al., 2013).

These campaigns are intended to be malicious and purposefully disseminated on a large scale to affect as many individuals as possible (Treen et al., 2020; Lewandowsky, 2021; van der Linden et al., 2017; Krishna, 2021; Vu et al., 2023; Legates et al., 2013). In addition, climate change disinformation spreads faster through the media in comparison to other conventional channels of communication and employs different tactics to enhance viewership (Cremades & Stella, 2022; Hassan et al., 2023). One of said tactics pertains to clickbait, which purposefully makes false messages more attractive so that viewers click on links to specific disinformation webpages (Hassan et al., 2023).

The final elements that round out the transmission of climate change disinformation are detectability and political involvement. Climate change disinformation is an additional discreet form of CCM as it can be challenging to detect and can move undetected across or outside of various media platforms (Pongiglione & Martini, 2022). In addition, the use of fake experts when transmitting climate change disinformation is more common. This is because attacks are more targeted at defaming legitimate experts or diverting the audience's attention away from information (Samoilenko & Cook, 2023; Pongiglione & Martini, 2022). Using a fake expert also exercises authority or forms the basis of an authority reference, which gives more apparent validity to disinformation claims (Chu et al., 2023; Samoilenko & Cook, 2023; Pongiglione & Martini, 2022). This means that fake experts can make climate change disinformation more likely to go undetected by audiences. Political involvement also plays into the bigger picture of climate change disinformation. Messages rooted in extreme political populism have been immensely transmitting climate change disinformation across social and news media platforms for several years (Cremades & Stella, 2022). Governments, advocates, and organizations with specific political agendas are often manipulators that control how information about climate change is disseminated across media platforms (Hassan et al., 2023). In doing so, climate change disinformation catered specifically to support political outcomes may be weaponized for political gain (Cremades & Stella, 2022; Hassan et al., 2023).

5.4.3 Effect

Climate change disinformation is a form of CCM that leads to effects of greater intensity and proves to be a specific barrier to climate action (Hassan et al., 2023; King et al., 2022). Climate change disinformation elicits more intense emotional responses rooted in confusion that cast doubt on the scientific consensus on climate change (Cremades & Stella, 2022; Hassan et al., 2023; Krishna, 2021). This presence of emotion results in stronger doubt and enhanced polarization on the issue of climate change (Cremades & Stella, 2022; Hassan et al., 2023; Treen et al., 2020). It was found that an emotional response cast by climate change disinformation mainly surfaces in the form of anger, fear, sadness, and or a lack of trust (Cremades & Stella, 2022). Generating these emotional responses is a tactic used by climate change disinformation to negate factual content about climate change and confuse an individual into believing more extreme denialist claims (Cremades & Stella, 2022). It is important to note that no one is immune to these effects of climate change disinformation (Krishna, 2021; Hassan et al., 2023), which emerged in the ICA as a thematic code titled 'Disinformation effects both deniers and believers'. It was highlighted that climate change disinformation has been accepted by climate change deniers and, surprisingly, by climate change believers as well

(Krishna, 2021). This is a rather discomfoting statistic because it shows how powerful of an effect climate change disinformation can have on all individuals, regardless of pre-existing beliefs. Climate change disinformation is a form of CCM that takes a large toll on an individual's emotions and can have a greater influence on more widespread audiences.

5.5 Responses

Responses to CCM were found to be highly discussed throughout the literature. The ICA revealed that both combatting CCM and communication were the two central themes that encompass the majority of the responses to CCM. This dimension unpacks the ways to counteract the effects, spread, and extensive reach of CCM.

5.5.1 *Combatting Climate Change Misinformation*

One of the most interesting elements of this research was the plethora of discussions about how to combat CCM effectively. The theme of combatting misinformation situates itself under the 'Responses' dimension by highlighting how to counteract the effects and spread of CCM. The following section unpacks the strategies and methods uncovered by the ICA to do so.

No strategy or method of combatting CCM was more widely accepted than the use of inoculation. Of the 24 studies in the ICA, 11 discussed inoculation theory or the use of Inoculation in combatting CCM. 'Inoculation theory' in essence refers to intervention prior to an individual receiving misinformation, acting like a vaccine (Treen et al., 2020; Lewandowsky, 2021; Schubatzky & Haagen-Schützenhöfer, 2022; Cook et al., 2017; Maertens et al., 2020; van der Linden et al., 2017; Cook et al., 2018; Vraga et al., 2020; Green et al., 2022; Farrell et al., 2019). The idea is that exposing people to misinformation prior to them encountering it on their own gives them more immunity to its effects (Treen et al., 2020; Lewandowsky, 2021; Schubatzky & Haagen-Schützenhöfer, 2022; Cook et al., 2017; Maertens et al., 2020; van der Linden et al., 2017; Cook et al., 2018; Zhou & Shen, 2022; Vraga et al., 2020; Green et al., 2022; Farrell et al., 2019). In the case of CCM, inoculation can be used as a means to neutralize its effects and increase the public's ability to detect it (Treen et al., 2020; Lewandowsky, 2021). It was found that inoculation messages should either explain how the arguments and claims presented by CCM are flawed or bring attention to the scientific consensus in order to be the most effective (Treen et al., 2020; Cook et al., 2017).

An interesting element of inoculation is that it can come in different forms, four of which were uncovered in the ICA. Active/passive inoculation pertains to how counterarguments are presented or created (Green et al., 2022). When looking at passive inoculation, the audience is exposed to pre-existing arguments that disprove CCM, whereas with active inoculation, the audience is responsible for creating their own argument to disprove CCM (Green et al., 2022). Next, there is attitudinal inoculation, where a threat is introduced to the audience, explaining that they are going to be exposed to information that challenges their beliefs (van der Linden et al., 2017; Green et al., 2022). After this initial threat has been communicated, CCM is presented to them paired with an explanation as to why it is false (van der Linden et al., 2017; Green et al., 2022).

It was observed that attitudinal inoculation would be the most effective at building resiliency to CCM amongst individuals with pre-existing beliefs supporting the scientific consensus. Attempts to exercise this type of inoculation on individuals with denialist mindsets would likely not be effective. Lastly, information-based and reason-based inoculation surfaced as the other effective means of combatting CCM. Information-based inoculation calls attention back to the scientific consensus by presenting scientific evidence to educate the audience prior to CCM exposure (Cook et al., 2017). The essence of information-based inoculation is to instill the true facts on climate change so that individuals can detect the falsehoods associated with CCM (Cook et al., 2017). Reason-based inoculation follows a similar idea, but instead of presenting scientific facts, an explanation of the tactics used by CCM to influence audiences is presented (Cook et al., 2017; Cook et al., 2018). Overall, active/passive, attitudinal, information-based, and reason-based were the 4 forms of inoculation found within the ICA that directly pertain to combatting CCM.

The ICA found several instances where inoculation has been used successfully to combat CCM, but there are concerns about the longevity of its interventions. Out of the 11 studies that discussed inoculation, seven highlighted it as a successful tactic for combatting CCM. The general consensus was that intervention before CCM exposure is a highly effective way to combat it. One element found to be of interest was that inoculation can be effective amongst individuals regardless of political affiliations (van der Linden et al., 2017; Maertens et al., 2020). This was particularly significant given the deeply political aspects of CCM. Effective methods of combatting CCM amongst individuals of all political affiliations would be much more widely applicable to public audiences. On the other end of this discussion were some concerns about the applicability and longevity of inoculation. Treen et al. (2020) indicated that one drawback of inoculation is that it depends on understanding what type of CCM will be distributed and eventually reach audiences, which is a challenging feat to accomplish. In addition, Maertens et al. (2020) indicated that the effects of inoculation could wear off over time, leaving an individual susceptible to the effects of CCM later down the line. One suggested solution to this is an inoculation booster, whereby inoculation messages could be reintroduced to an individual to reinstate their resiliency to CCM exposure (Maertens et al., 2020). Although inoculation has not been established as the universal approach, these findings show that it has garnered the most attention and has been widely accepted as one of the more successful strategies for combatting CCM.

The term prebunking was uncovered in the ICA as another term for inoculation. Both prebunking and inoculation communicate the same ideas; however, prebunking was found to be the opposing term to debunking. Debunking refers to exposing the falseness or illegitimacy of a belief or myth (Schubatzky & Haagen-Schützenhöfer, 2022; Vu et al., 2023). Climate myths and CCM are relatively one and the same; however, myths have deeper roots and often are the product of longstanding misinformation (Schubatzky & Haagen-Schützenhöfer, 2022; Vu et al., 2023). Some common climate myths are statements like ‘the earth’s climate has always changed,’ ‘climate change is an issue for the future,’ and ‘climate change does not exist’ (Vu et al., 2023). Much like the relationship between prebunking and inoculation, debunking and correction effectively refer to the same principle. Debunking can be referenced as a specific form of this broader strategy known as correction. Whereas inoculation, or prebunking, focuses on

addressing CCM prior to exposure, correction pertains to addressing CCM after exposure (Freiling & Matthes, 2023; Vraga et al., 2020). Correction often uses scientific facts to counteract the effects of CCM (Freiling & Matthes, 2023; Vraga et al., 2020) and was found to reduce some effects caused by CCM, mainly by instilling the truth about climate change. One positive result coming from correction pertains to what is called the expression effect, whereby if an individual makes a correction to CCM independently, they are more likely to engage in other pro-environmental activities (Freiling & Matthes, 2023). Despite some positive outcomes, it was found that correction lacks the ability to address the misbeliefs CCM causes (Freiling & Matthes, 2023; Vraga et al., 2020; Lewandowsky, 2021; Treen et al., 2020). CCM is also very challenging to correct (Green et al., 2022; Maertens et al., 2020; Cook et al., 2017; Cook et al., 2018), meaning that this strategy of correction begins at an inherent disadvantage in comparison to inoculation. However, as correction does put forward benefits, it should not be disregarded in the broader discussion of combatting CCM.

The theme of fact-checking surfaced in the ICA as a way to combat CCM throughout the media. It exists as a form of correction and is an active tactic used to identify the truthfulness of information presented across a variety of media platforms (Chu et al., 2023). It was found that there are fact-checking organizations designated to eradicating political misinformation, mainly in the United States (Vu et al., 2023); however, the ICA found no such organization that tackles solely CCM. Moreover, CCM can be difficult to detect and can fly under the radar of general fact-checking practices; therefore, at its current developmental stage, fact-checking may not be as effective as other strategies for combatting CCM. As fact-checking further develops, it could become a more widely accepted strategy for combating CCM.

The final contributing factors that round out this subcategory of combatting CCM are cognitive dissonance, self-efficacy, human ethics and responsible parties. First, cognitive dissonance was a term found within the ICA through Taddicken & Wolff (2020), which describes the discomfort felt by an individual when confronted with facts that contradict their worldview. This idea of cognitive dissonance is important to acknowledge when combatting CCM because one might feel their beliefs are being attacked by way of inoculation, correction, fact-checking, etc. If an individual presents with strong cognitive dissonance, they are less likely to be receptive to any form of communication that highlights factual information about climate change. This should be a widely considered factor when employing strategies for combatting CCM. Second, self-efficacy is a concept that describes one's individual belief in their skills to effectively identify and or debunk CCM (Schubatzky & Haagen-Schützenhöfer, 2022). This is an important factor to consider because exposure to CCM can cause significant decreases in one's self-efficacy (Schubatzky & Haagen-Schützenhöfer, 2022). It was observed that interventions causing increases in one's self-efficacy would be beneficial in prolonging resiliency to CCM exposure. Third, human ethics surfaced as an important point of consideration when developing methods of combatting misinformation. There has been debate centred around whether addressing a false claim infringes on one's freedom of speech (Treen et al., 2020; Lewandowsky, 2021). This suggests that human ethics needs to be taken into consideration when looking to combat CCM. Finally, the ICA uncovered some discussion under the theme 'Responsible parties,' which was centred around who the onus should fall onto for combatting CCM. Interestingly, Treen et al. (2020)

highlighted that ongoing debate has been occurring throughout academia, media, and even governments about the responsibility media platforms have for the circulation of CCM across their domains. Despite this, it was evident that no specific party has yet been designated solely responsible for combatting CCM. In sum, cognitive dissonance, self-efficacy, human ethics, and responsible parties are relevant factors to consider when developing effective strategies and methods for combatting CCM.

5.5.2 Communication

This subcategory focuses on how strategies rooted in climate change communication can be effective responses to reduce the extensive reach of CCM. This highlights how individuals or media platforms can adapt how they communicate on climate change to reduce the potency or counteract the effects of any potential CCM.

Consensus messaging surfaced as the first relevant theme under communication, which was discussed in the context of reporting and news media. This form of messaging refers to content that is used to communicate the scientific consensus on climate change (van der Linden et al., 2017; Maertens et al., 2020; Cook et al., 2017). It was found that consensus messages are effective at counteracting the CCM found within false balanced news reporting or conventional news media (van der Linden et al., 2017; Maertens et al., 2020; Cook et al., 2017). This suggests that utilizing a consensus message when discussing climate change-related news could be a beneficial way to generate more widespread support for the existence of climate change (Lewandowsky, 2021) and increase one's resiliency to CCM.

The ICA uncovered that consistency and emotion enhance the effectiveness of climate change communication in general. First, consistency is essential when distributing messages about climate change. The more an individual is exposed to accurate information about climate change, the better their chances are at formulating beliefs aligning with the scientific consensus (Lewandowsky, 2021). Second, emotion was a common theme that contained some interesting information about increasing the effectiveness of climate change communication. The emotion of trust plays a role in an individual's acceptance or rejection of information (Krishna, 2021). If an individual trusts a source of information, they are more likely to accept its content as factual (Krishna, 2021). Moreover, emotion can increase one's motivation toward supporting climate action. Surprisingly, art and visuals were found to be avenues of climate change communication that can significantly influence one's emotions. Art and visuals use metaphors and narratives that can appeal to individuals on a much deeper level in ways that conventional communications cannot (Lewandowsky, 2021). Using either could yield more robust support for climate action by enhancing one's connection to climate change messages and making them less susceptible to believing CCM. One drawback is that art or visuals in climate change communication can indirectly act as CCM by demotivating audiences if misused (Lewandowsky, 2021). It is suggested that for images to be the most effective, they should highlight events that are scientifically legitimate causes of climate change or depict positive climate change mitigation strategies (Lewandowsky, 2021).

The final element of this subcategory pertains to the theme of education. Educating individuals on climate change can be challenging, especially with the prevalence of CCM (Schubatzky & Haagen-Schützenhöfer, 2022). The relationship

between education and effective climate change communication often permeates into the classroom. Schubatzky & Haagen-Schützenhöfer (2022) highlighted that teachers often feel unprepared to educate students on the science behind climate change. Moreover, it has been suggested that the general curriculum should increase its coverage of climate change (Treen et al., 2020). This suggests that more effort could be put into adequately educating teachers on effectively communicating the science behind climate change. In addition, there is an opportunity to provide teachers with the tools necessary to identify and refute CCM if present in their classroom. When looking at the general population, the ICA found several references to the uniform understanding of climate change necessary for supporting global climate action (Lewandowsky, 2021; Schubatzky & Haagen-Schützenhöfer, 2022; Hassan et al., 2023; Krishna, 2021). It was found that a large component of generating this understanding is to increase science literacy and enhance one's base knowledge of climate change (Chu et al., 2023; Pongiglione & Martini, 2022). The primary way to do so is through proper education via effective climate change communication. Educating the general public on climate change also has the secondary benefit of increasing their ability to recognize CCM (Pongiglione & Martini, 2022). Overall, the theme of education revealed some exciting applications to climate change communication in the classroom and throughout the general public.

5.6 Limitations

While this study provides valuable contributions towards understanding and defining the dimensions of climate change misinformation, several limitations should be taken into consideration. First, only one database was used to locate literature for the qualitative analysis; this could have limited the scope of the available literature. The use of multiple databases could have further diversified the corpus of CCM literature that was taken through the ICA and could be a productive next step for future research. Second, the analysis of thematic and in-vivo codes is subjective, meaning there could be alternative ways of interpreting the findings from the ICA. Finally, the criteria used for evaluating these studies were somewhat restrictive. If these criteria had been expanded, this could have yielded other information warranting the creation of other subcategories or dimensions of CCM.

6.0 Conclusion

This study set out to establish the dimensions of climate change misinformation to ultimately bring more context to the concept as a whole. Five overall dimensions of climate change misinformation were synthesized by executing a five-step methodology inclusive of an inductive content analysis. In unpacking these dimensions, there were some notable key findings. First, the attributes of CCM showed that it mainly aims to discredit the scientific consensus on climate change, originates from what are called actors of CCM, travels most frequently through news and social media platforms, and causes effects rooted in confusion. Second, the dimension of psychology showcased that both beliefs and perception play influential roles in an individual's capacity to accept

CCM. Third, CCM can be used in the political space to influence one's beliefs on climate change and impact the success of climate policy. Fourth, disinformation emerged as a separate classification of CCM that can be distinguished by the presence of intent when creating and spreading CCM. In addition, climate change disinformation shares the same attributes as CCM but remains a more malicious form of discrediting the scientific consensus. Finally, responses to reduce the effects, spread, and reach of CCM can include using the widely accepted method of inoculation, paired with forms of correction, better-developed fact-checking strategies, and climate change communication that acknowledges the prevalence of CCM throughout its messaging.

As a whole, this research unearthed the true colours of CCM. It revealed the areas where CCM gains the most attention, spreads the most effectively, and does the most damage to hinder the success of global climate action. Armed with these dimensions, effective and more targeted strategies for eliminating CCM can be developed and implemented across global communication channels. The most promising way of doing so is by increasing the awareness of CCM to the creators and users of these communication channels. Specifically, news and social media platforms can use these dimensions to understand how CCM spreads across their domains, which can lead to the development of unique strategies to improve ways of detecting CCM and avoiding it throughout their messaging. Beyond the context of the media, this research can be used by global policymakers to strengthen climate policy. This can be achieved by utilizing these five dimensions to understand how CCM can infiltrate into the political space to derail positive climate actions. In doing so, strategies can be implemented to increase the resiliency of climate policy to the effects of CCM. These are only a few examples of the application these dimensions can have in addressing CCM globally. In a much broader sense, this research serves as the starting point to construct eventual robust solutions that eradicate CCM and direct global attention toward the importance of combatting the climate crisis.

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<https://doi.org/10.1177/00936502211028049>

Appendix

Appendix 1: List of studies included in the inductive content analysis (ICA)

Title	Author(s)	Year
Online misinformation about climate change	<ul style="list-style-type: none"> ○ Kathie M. d'I. Treen ○ Hywel T.P. Williams ○ Saffron J. O'Neill 	2020
Climate change Disinformation and How to Combat It	<ul style="list-style-type: none"> ○ Stephan Lewandowsky 	2021
Debunking Climate Myths Is Easy – Is IT Really? An Explorative Case Study with Pre-Service Physics Teachers	<ul style="list-style-type: none"> ○ Thomas Schubatzky ○ Claudia Haagen-Schützenhöfer 	2022
Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence	<ul style="list-style-type: none"> ○ John Cook ○ Stephan Lewandowsky ○ Ullrich K. H. Ecker 	2017
Combating climate change misinformation: Evidence for longevity of inoculation and consensus messages effects	<ul style="list-style-type: none"> ○ Rakoem Maertens ○ Frederik Ansell ○ Sander van der Linden 	2020
Inoculating the Public against Misinformation about Climate Change	<ul style="list-style-type: none"> ○ Sander van der Linden ○ Anthony Leiserowitz ○ Seth Rosenthal ○ Edward Maibach 	2017
Analysis of climate change disinformation across types, agents and media platforms	<ul style="list-style-type: none"> ○ Isyaku Hassan ○ Rabi Muazu Musa ○ Mohd Nazri Latiff Azmi ○ Mohamad Razali Abdullah ○ Siti Zanariah Yusoff 	2023
Deconstructing climate misinformation to identify reasoning errors	<ul style="list-style-type: none"> ○ John Cook ○ Peter Ellerton ○ David Kinkead 	2018
Characterizing the semantic features of climate change misinformation on Chinese Social Media	<ul style="list-style-type: none"> ○ Jianxun Chu ○ Yuqi Zhu ○ Jiaojiao Ji 	2023
Confirmation Bias and the Persistence of Misinformation on Climate Change	<ul style="list-style-type: none"> ○ Yanmengqian Zhou ○ Lijiang Shen 	2022
Understanding the differences between climate change deniers and believers' knowledge, media use, and trust in related information sources	<ul style="list-style-type: none"> ○ Arunima Krishna 	2021
Agnotology as a Teaching Tool: Learning Climate Science by Studying Misinformation	<ul style="list-style-type: none"> ○ Daniel Bedford 	2010
Correcting climate change misinformation on social media: Reciprocal relationships between correcting others, anger, and environmental activism	<ul style="list-style-type: none"> ○ Isabelle Freiling ○ Jörg Mathes 	2023

Elite Polarization and Correcting Misinformation in the “Post-Truth Era”	<ul style="list-style-type: none"> ○ Constantine Boussalis ○ Travis G. Coan 	2017
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Active versus passive: evaluating the effectiveness of inoculation techniques in relation to misinformation about climate change	<ul style="list-style-type: none"> ○ Madison Green ○ Connor Jo McShane ○ Anne Swinbourne 	2022
Evidence-based strategies to combat scientific misinformation	<ul style="list-style-type: none"> ○ Justin Farrell ○ Kathryn McConnell ○ Robert Brulle 	2019
Developing an Ad Hominem typology for classifying climate misinformation	<ul style="list-style-type: none"> ○ Sergei A. Samoilenko ○ John Cook 	2023
‘Fake News’ in Science Communication: Emotions and Strategies of Coping with Dissonance Online	<ul style="list-style-type: none"> ○ Monika Taddicken ○ Laura Wolff 	2020
Climate Change and Culpable ignorance: The Case of Pseudoscience	<ul style="list-style-type: none"> ○ Francesca Pongiglione ○ Carlo Martini 	2022
Computer-assisted classification of contrarian claims about climate change	<ul style="list-style-type: none"> ○ Travis G. Coan ○ Constantine Boussalis ○ John Cook ○ Mirjam O. Nanko 	2022
Fact-Checking Climate Change: An Analysis of Claims and Verification Practices by Fact-Checkers in Four Countries	<ul style="list-style-type: none"> ○ Hong Tien Vu ○ Annalise Baines ○ Nhung Nguyen 	2022
Climate Consensus and ‘Misinformation’: A Rejoinder to <i>Agnotology, Scientific Consensus, and the Teaching and Learning of Climate Change</i>	<ul style="list-style-type: none"> ○ David R. Legates ○ Willie Soon ○ William M. Briggs ○ Christopher Monckton of Brenchley 	2013

Appendix 2: List of thematic and in-vivo codes produced from the inductive content analysis (ICA)

DEPTH	TITLE	DESCRIPTION
0	Dimensions (RQ)	What are the dimensions of Climate Change Misinformation
1	Attributes	
2	Effect	
3	Confusion	Confusion surrounding the topic of CCM
4	CCM confusing public	Public confusion of climate change, i.e. not understanding the factual information
4	Confusing Definitions/Terms	Pertains to the use of multiple terms to explain one specific thing. i.e. not unified term to describe the issue of climate change leading that significantly contributes to confusion.
4	Media Confusing the Public	
4	Misinformation confusing fact	The two sided debate in which misinformation can undermine the credibility of scientific information. Conflicting pieces of evidence (misinformation and fact) can cancel each other out.
3	Lowering Climate Acceptance	
3	Media Influences Public Perception of CC	
4	Opinion pieces are prone to misrepresenting the scientific consensus	
3	Misinformation has negative impacts	
3	Misinformation impeding climate action	
3	Misinformation lingers despite correction	
2	Motives	
3	Scientific consensus on climate change	
4	Discredit climate science	
4	Discrediting science as a mechanism of moral disengagement	
4	lack of awareness if the scientific consensus	
4	Misconceptions	
5	Character assassinations of climate scientists	Most common fuel for contrarians
5	Contrarian claims throughout levels of society	
5	Misinformation seeming credible	
5	Misinformation causing doubt as a technique	
4	Myths, Science, and Denial	
4	Public perception on the scientific consensus	

4	Questioning Credibility of Climate Science	Doubt, disbelief, not accepting etc. scientific fact about climate change
4	Undermining the scientific consensus	
4	Undermining the Severity of CC	Downplaying the risks/severity of the climate crisis.
2	Sources	
3	Actors of CCM	People, Groups etc. who are involved in utilizing CCM.
4	anti-'Climate agents	
3	Other	
4	Funding can feed misinformation	
4	Misinformation Campaigns	
5	Ad hominem	Type of attack or form of misinformation dissemination
6	Abusive ad hominem	
6	Ad hominem and misinformation campaigns	the connection between the two
6	Attacks	
7	Attacks prevalent over time	
7	Types of Ad hominem attacks	
8	Bias	
8	Circumstantial	
8	Competence	
8	guilt by association	
8	Moral	
6	Bias ad hominem	
6	Circumstantial ad hominem	
6	Influencing public perceptions	
5	Misperceptions about climate change	
3	Think Tanks	
4	Conservative think tanks	
5	Producing and Disseminating CCM	
4	Think Tanks Spread Misinformation	
4	Think Tanks spreading disinformation	Think tanks: Think tanks, policy institutes, research institutes are organizations or groups involved in research and advocacy in a range of fields including social policy. Think tanks can also be involved directly into disinformation.
2	Transmission	
3	Alternative ways of presentation	
4	CCM Can be found in a wide variety of places	
4	CCM can be presented as visuals	
4	Misinformation can vary in intensity	

4	Permeating into the classroom	CCM has extended effects into the classroom as a result form media exposure likely.
3	Media	
4	Discrete movement of CCM	
5	Authority in the media	
6	Lack of authority reference increases susceptibility	Social media posts with non-'specific authority references were more likely to be misinformed.
6	Misinformation not using authority reference	
6	Trustworthiness	
5	Climate Alarmism spreading CCM	
5	Credibility '-' used for an advantage	
6	Contrarianism	
5	Fake experts causing doubt in Climate Change	
6	Experts casting doubt	
5	Fear Campaigns	Fear campaigns generally have a negative effect. Some would argue other wise
5	Features of social networks	
5	Mainstream media acknowledging misinformation as an issue	
5	Media coverage of Climate change	
5	Reasoning Errors	occurs when a writer employs an unsupported assertion in defense of their central idea.
4	Fake News	
5	"Fake News" another term for misinformation	misinformation can be referred to as what is called fake news
5	Fake News as CCM	Fake news is a term that is used when discussing CCM when looking at mainstream media outlets. Definition: "Fabricated information that mimics news media content in form but not in organizational process" (Treen et al., 2020)
5	Fake news resistance	
5	Media can create exposure to polarization	
5	Problem Awareness	
4	Medias Involvement with CCM Distribution	
5	Conservative media tends to more commonly spread CCM	
5	False Balance Coverage	evenly balances contrarian voices and expert views (this element is not as prevalent in the present day as it used to be) but still is relevant.

6	Decreasing public certainty	
5	Faster Spread	
6	Misinformation Spreading faster online	
6	Social Media enhancing the spread of misinformation	
5	News Media spreading CCM	
5	Social Media Involvement with CCM	Distribution, Promotion, amplification etc. caused specifically by social media.
6	Experts are the most significant source of misinformation	Within the media experts turned out in this one particular study to be the most significant source of misinformation.
6	Little research on Diffusion	
6	Main topics on social media	
6	Social media amplifying the spread	
6	Social Media Shifting Human Perspective	
6	True information and government sources	
3	Politics	
4	Polarization of traditional media spreads misinformation	
5	Partisan News sorting	
4	Politicians are Major spreaders of CCM	
3	Pseudoscience	Definition: statements, beliefs, or practices that claim to be both scientific and factual but are incompatible with the scientific method.
4	Pseudoscience difficult to detect	
4	Pseudoscience separate from disinformation	
1	Disinformation	
2	Effect	
3	Calls to action	Ironic that we need to mitigate climate change and disinformation, could be a components of mitigating climate change as a whole.
3	Current issue of Global significance	
3	Disinformation effects both deniers and believers	
4	Lack of faith	
4	Unbiased individuals are not immune to disinformation	
3	Disinformation	Subcategory to group disinformation codes together
3	Disinformation effecting moral judgement	
3	Emotion	
3	Influencing public perception	
3	Politics and social media as the most influential factors	Crucial factors influencing climate change debate and disinformation effects

3	Public Doubt on Climate Change	
3	Semantic association	
3	Trust, anger	
2	Motives	
3	Definition of Disinformation	Specific definition of Disinformation for one particular study
4	Disinformation as a longstanding issue	
4	Enhancing disinformation	
2	Sources	
3	Agents of disinformation	
4	Agents Using Social networks more frequently	
4	Types of Climate change Disinformation agents	
5	Agents on social media	
5	Agents undercut scientific information	
5	High likelihood of Spreading disinformation	
5	Lower likelihood of spreading disinformation	
5	Politicians use social media frequently	
3	Disinformation as malicious/intentional	
3	Types of Disinformation	Various types of disinformation exist, this text outlines these specific types (or at least some of them)
4	Key themes of Disinformation	
2	Transmission	
3	Disinformation can be undetectable	
4	Fake Experts and Disinformation	
3	Heavy Political involvement with disinformation	
4	Political disinformation Via Media	
5	types that are more likely to spread	
3	Media	
4	Disinformation Campaigns	Term to describe that actively use a systematic ways of spreading disinformation.
5	Attacking the Scientists	
5	Social movements	
5	Various media platforms	
4	Media and disinformation are intimately linked	
4	Media Spreading Disinformation Rapidly	
5	Click Bait	

5	Types of media spreading disinformation	
4	Social media, broadcast media, and online news are most frequently used	used to disseminate disinformation
1	Political	
2	Influence	
3	Effects of Political Influence	Using misinformation for climate policy/fueling a specific agenda
4	conservative involvement in Climate denial	
4	misrepresentation by democratic politicians	
4	Polarization	
5	Informing political decisions/actions	
5	Polarization centered around CC	
6	Misinformation enhancing polarization	
6	Positions on climate change	
5	Political Polarization influencing public	
5	Weaponization of CCM in Political Sphere	
4	Political and Economic Influence	
4	Political Discourse amplifying denial	
3	Influence on Belief	
4	Political affiliations affecting CC belief	
4	Political Authority leads to belief	If misinformation is presented by a person in a high position of power it is more likely to be believed by the widespread population.
4	Political Influence on World View	
4	Political Influence on Human Perception	Politics influencing an individual to believe a piece of cc misinformation for gain.
3	Populism	Populism: a political approach that strives to appeal to ordinary people who feel that their concerns are disregarded by established elite groups.
4	Populisms influence on climate denial	
2	Policy	
3	Climate change and public policy	
3	Communicating Climate Policy	
4	Framing of Climate policy	
3	Misinformation leading to lack of public policy support	
3	Political application of CCM	Reference to CCM throughout the political space
1	Psychology	
2	Beliefs	

3	Climate Denial	Discrediting scientific information about climate change. Not believing scientific fact. Includes other terms that may be associated to the disbelief of climate science and credible information.
4	Adjacent Themes	
5	Climate Contrarianism	a biproduct of misinformation
6	Categories of Climate contrarianism	
6	Contrarian	
6	Contrarian blogs	
6	Misinformation is a demanding task	
6	Reasoning Fallacies	
6	Rhetorical device	
6	Salient relationships	
6	Skeptical	
5	Conspiracy in place of Science	
5	Skepticism, Contrarianism, denial	
4	Denial as a by-product of Disinformation	
5	Deniers Spreading misinformation	Climate deniers also can be the root cause of spreading disinformation, they can be the catalyst to create more deniers.
4	Denial created by ideology, worldview etc.	
5	Denialism is the major voice in framing beliefs and perceptions	
5	Results	
6	Decrease in public acceptance	public acceptance of climate change
6	Doubt on Climate change	
4	Denial present in positions of authority	
4	Denialist Arguments	Arguments about or centres around climate denial
5	Addressing arguments	
5	Denialist claims are typically definitive	
6	Checking for truth or plausibility	
6	Checking for validity	
5	Non definitive denialist claims	
4	Deniers and believers	
5	Climate believers	
5	Climate deniers	
4	Media	

5	Consumption of Conservative media leads to denial	
5	Media consumption has a large influence on Climate denial	
5	Media promoting Climate Denial	
4	Political Climate Denial	Denial that occurs throughout the political space.
5	Knowledge structure	
3	Human Beliefs	
4	Actors influencing beliefs on cc	
4	Beliefs on CC	
5	Familiarity of information	
5	Human connection to Misinformation	When humans find CCM more impactful because it resonates with their own identity or appeals deeply to their personal nature.
5	Human opinions/beliefs on CC	
5	mental state negatively influencing inquiry	
5	misbelief connected with misinformation	A term that is closely related to misinformation
5	Worldview	Individuals perception about global issues, how someone sees the world
6	Attitudes	
7	Attitudes are difficult to change	
7	Attitude certainty	
7	Climate attitudes	
7	Climate change perceptions linked to worldview	
7	Global attitudes on climate change vary	
7	Misinformation and Climate Attitudes	
6	Individualism and Free-'market support	Individualism: individualism is all about taking care of yourself; it is the belief and practice that every person is unique and self-'reliant. Free Market: The free market is an economic system based on supply and demand with little or no government control.
4	Homophily: Engagement on Social Media Platforms	Linkage of humans to people that share similar traits. This term is at the root of a fair amount of social media platforms.
5	Promoting the Spread of CCM	
3	Theory	
4	Confirmation bias	
5	Cognitive element of Confirmation Bias	
5	Contribution to political polarization	
5	Definition of Confirmation Bias	

5	Forms of Confirmation Bias	
5	How does Confirmation Bias contribute to misinformation?	
5	Human element of confirmation bias	
5	Inaccurate knowledge	
5	Misinformation in the form of confirmation bias	
5	Motivation and denial	
6	Accuracy motivation	
6	Defense motivation	
5	Presence of confirmation bias	
5	Strength of confirmation bias	
6	The role of attitude	
2	Perception	
3	Culpability	responsibility for a fault or wrong, blame
4	Ignorance	
4	Negligence	
3	Human influence on CCM	Belief and distribution of climate change misinformation
3	Human Perception of Climate Change as an issue	How CCM influences an individual's view climate change and/or decreases climate acceptance.
3	Misinformation influencing public perception	
3	Perception influencing belief	
3	Public perception of climate change	
3	Public reliance on expert opinion	particularly on social media
1	Responses	
2	Combating Misinformation	
3	Cognitive Dissonance	
4	Coping strategies	
5	Changing Views	
5	Coping with dissonance	
5	Re-'reading known information	
5	Seek information about specific details	
5	Strategies vary individually	
5	Unfinished coping	
4	Dissonant public spheres	
4	Emotional State of a human can affect beliefs	
5	Activation	
5	Alarm	Is a contributing factor

5	Anger is a common emotion	
6	Conspiracy connected to anger	
4	Quick defence	
4	State of dissonance	
3	Correction	
4	Cognitive reference	
4	correcting misinformation connected to political activism	
4	Correcting with Fact	
4	Correcting With logic	
4	Correction and activism	
4	Correction and Anger	
4	Correction and politics	
4	Correction is after exposure	focusing on counteracting misinformation after it had been spread
4	Corrections of misinformation are not always effective	
4	Corrections reduce but don't entirely mitigate	
4	Counteracting with science	countering CCM with scientific fact after humans have been exposed to misinformation.
5	Continued Influential Effect	Counteracting misinformation with retractions does not eliminate an individual's reliance on the initial misinformation they were exposed to.
4	Expression effect	
4	Factual corrections	
5	Factual corrections as a success	
4	Humor as a form of correction	
4	Inoculation and Correction	
4	Logic focused corrections	
5	Credibility	
5	Logic focused correction as a success	
4	Misinformation cancels out accurate information	
4	Misinformation is difficult to correct	
4	Observational correction	
3	Debunking	expose the falseness or hollowness of (a myth, idea, or belief).
4	Climate Myths	May be another form of climate misinformation. In that myths undermine the severity of climate change (down play the severity). Myths are misleading
5	Myths about existence	

4	Correcting differs from debunking	
4	Debunking can be relatively ineffective	
4	Debunking Climate Misinformation	another way of referring to counteracting misinformation with truthful information.
4	Deconstructing CCM using argumentation	
5	FLICC Taxonomy	FLICC '1' Fake experts, logical fallacies, impossible expectations, cherry picking, and conspiracy theories.
5	Reasoning errors	An error in reasoning similar to making an unstated or invalid assumption occurs when a writer employs an unsupported assertion in defense of her central idea. An assertion is a declaration stated positively, but with no support or attempt at proof.
4	Different skill levels in debunking	
4	Effective Debunking	Having the proper scientific knowledge to counteract a climate myth
4	Inoculation and Debunking	
3	Fact Checking	Having a party or individual independently verify information through trusted sources of information.
4	Bias can exist in fact checking journalism	
4	Detecting Misinformation is Challenging	
4	Fact checking content needs to be more accessible	
4	Fact Checking does not completely reduce lack of trust in CCM	
4	fact checking is effective but can lack longevity	
4	Fact checking is still developing its process	
4	Fact checking not as effective	
4	Fact checking provides insight into how CCM is created	
4	Fact checking varies country to country	
4	Fact checks often align with belief	
4	People cannot always fact check	
4	Transparency is key	
3	Inoculation Theory: Exposure leading to awareness	Educating the population about what to look for within CCM. Combating misinformation before it spreads
4	Active Inoculation	
5	Active Inoculation as a Success	

5	Passive Inoculation	
5	Skepticism towards news media	
4	Attitude based inoculation	
5	Prophylactic and Therapeutic inoculation	to better distinguish between inoculation interventions that try to "treat" an existing attitude and ones that purely protect, scholars have proposed to use the terms prophylactic and therapeutic inoculation.
5	Threat of Attitude inoculation	
4	Inoculation as a success	
5	Blanket or umbrella protection	
5	Inoculation creating Immunity against Misinformation	
5	Inoculation effective across all political affiliations	IN the US the inoculation was effective across individuals affiliated with all parties
5	Interventions as success	
4	Longevity of Inoculation concerns	
5	Inoculation Booster	
5	Inoculation can dissipate over time	
4	Prebunking	another term for inoculation. Refers to neutralizing potential misinformation before it is encoded.
5	Inoculation is pre-emptive	Addressing misinformation before it happens
4	Reason based inoculation	
3	Reference is important for the audience	
4	Authority Reference	
4	Legitimate credible sources	
4	Peoples acceptance and credibility	
3	Responsible Parties	Who is the ownness on for addressing misinformation, governments, the consumer? this is a widespread ongoing debate.
4	Human Ethics	do humans have a right to be misinformed. Does fact checking impede on freedom of speech and right to information.
4	Regulations to address CCM	Policies and regulations by governments to eradicate the spread of CCM

3	Self-Efficacy	Self'-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977, 1986, 1997). Self'-efficacy reflects confidence in the ability to exert control over one's own motivation, behavior, and social environment. These cognitive self'-evaluations influence all manner of human experience, including the goals for which people strive, the amount of energy expended toward goal achievement, and likelihood of attaining particular levels of behavioral performance.
4	Climate Change knowledge	
4	Intrinsic motivation	Intrinsic motivation is defined as the motivation to engage in a behavior because of the inherent satisfaction of the activity rather than the desire for a reward or specific outcome
2	Communication	
3	Consensus Messaging	Consensus messaging is a climate change communication strategy emphasizing the fact of scientific consensus on anthropogenic global warming (AGW)
4	Can decay over time	
4	Climate acceptance	accepting climate change as a real and relevant issue
4	Cognitive Repertoire	
4	Communicating Science on CC	
4	Consensus beliefs improving judgement	
4	Consensus Building	
4	Consensus effect	
4	Consensus messaging as success	
4	Consensus messaging can act as inoculation	this can occur if exposure to consensus messaging is done before exposure to misinformation.
4	Efficacy of Consensus messaging	
4	Inoculation connected with consensus messaging	
4	Messaging not immune to political affiliation	
4	Misinformation can neutralize or reduce consensus messaging	
4	Shifting public perception of CC	
4	Strong enough on its own	Consensus messaging is often paired with inoculation. There is evidence that consensus messaging can be still effective as its own entity

3	Educating using Scientific Fact	Referring to the use of scientific fact when discussing misinformation and educating people on true climate change information
4	Educating by recognizing climate denial	Inoculation to teach individuals how to recognize climate denial
4	Educating Youth	
4	Improper teaching can lead to Susceptibility	Susceptibility of believing misinformation
4	Lack of scientific literacy increased misinformation's effect	
4	Teachers feel unprepared	Educators are not comfortable in teaching CC because they feel as though they cannot decipher the truth about climate change from misinformation.
4	Teaching Climate Change is challenging	Misinformation inhibits the ability for effective education about climate change.
4	Uniform Understanding of climate change	
5	Base level CC Knowledge is needed to combat CCM	
5	Public Knowledge of Climate Change	
5	Science literacy is needed	
3	Effective climate science communication	Ways to meaningfully and effectively communicate climate change related information.
4	Consistency in Messaging	CC messaging needs to be specific in order to promote this unified understanding to address the climate crisis.
4	Emotion as a factor	
5	Human emotion leading to CC action	
5	Misinformation affecting Trust	
5	Significant impact on humans	How humans feel, and what misinformation can do to fuel emotions/ human actions
5	Trust as an important element of Climate change acceptance	
5	Visuals as a challenge	
5	Visuals as a positive	
4	Proper communication leading to acceptance	Communicating the scientific consensus on climate change leads to acceptance.
4	Science communication	