Polluting the discourse: How misinformation impacts climate change advocacy

COURSE: MCM 740 Capstone

SUBMITTED BY:

Christina Friend, MCM Candidate, McMaster University

friendc@mcmaster.ca | 416-320-3560

SUBMITTED TO:

Dr. Terence (Terry) Flynn, PhD

Instructor, Master of Communications Management (MCM)

Department of Communication Studies and Media Arts

Faculty of Humanities, McMaster University

SUBMISSION DATE: March 29, 2023

Table of Contents

Abstract

While scientists, governments, and climate change advocates grapple with finding solutions for the devastating consequences of global warming, communicating this urgency to the public has proved to be an even larger challenge (Marshall, 2014). Communication barriers such as fuel-industry interference, the public's lack of scientific literacy, and the public's inability to comprehend the risk that climate change poses (Marshall, 2014), are hindering advocates' efforts to make the necessary change to mitigate this existential threat. Furthermore, the increased use of social media to disseminate information has led to echo chambers and an environment in which misinformation spreads faster than credible information (Treen et al., 2020). Through in-depth interviews with senior climate change advocates and communications specialists, complemented by a content analysis of social media climate change discussions, this study examines these communications barriers and identifies potential solutions to creating impactful campaigns. Using a content analysis as a secondary research method, it. demonstrates that misinformation is more likely to be shared on Facebook than on Twitter and that while misleading climate change information receives the most shares from online users, fabricated misinformation actually has the highest reach. The results reveal that an audience-tailored approach that considers individual motivations and social identities, and focuses on building trust, can help advocates advance their organizations' missions through effective communications strategies. Further research is recommended to conduct empirical testing of these strategies to provide quantitative evidence of their efficacy.

Keywords: Climate change, misinformation, echo chamber, science communications, advocacy, environmentalism, climate skepticism, climate denial

Background

Climate change has become an urgent issue worldwide for its role in intensifying extreme weather patterns, putting human health and lives at risk, and threatening the natural and built environment (Wieteska-Rosiak, 2020). A recent report by The Intergovernmental Panel on Climate Change has reiterated that the earth's warming trend over the past 200 years is due to human activity, primarily through the use of fossil fuels, and is responsible for the increased number and severity of weather events (IPCC, 2023). The damage already caused by climate change and its potential for further damage has impacted various commercial industries. For example, as climate change makes extreme weather more frequent and severe, it increases the probability of weather events that are more intense than the infrastructure is built to withstand, which increases the likelihood of supply-chain disruptions (Woetzel et al., 2020). Weather-related losses could cost the insurance industry over $1 trillion (US) in a single year by 2040 (Mills, 2007). In the real estate sector, extreme weather events and changes in natural resource availability pose a threat to assets because they may cause severe impairment to and even loss of individual buildings (Bienert, 2016).

A broad scientific consensus confirms that large-scale shifts are needed for mitigation and adaptation to climate change to avoid its most severe consequences (León et al, 2021). The property and casualty insurance industry in Canada has warned that more and bigger floods, wildfires, hailstorms, and windstorms – influenced by our changing climate – are costing billions of dollars and putting people and property at risk (Climate Proof Canada, n.d.). Yet, according to research by Climate Action Against Disinformation, 6% to 23% of the population of the countries it studied do not believe in climate change or are uncertain about whether climate change is happening. A further 22% to 38% believe that humans are only partly responsible for

the change in climate (Climate Action Against Disinformation, n.d.). Climate change misinformation is closely linked to climate change skepticism, denial, and contrarianism. A network of actors is involved in financing, producing, and amplifying misinformation. Once this information reaches the public, characteristics of online social networks, such as homophily, polarization, and echo chambers—characteristics also found in the climate change debate—provide fertile ground for misinformation to spread (Treen et al., 2020).

Climate change is not the first environmental threat requiring large-scale global cooperation and action. In 1987, the international community committed to protecting the Earth's ozone layer, which provides protection from the sun's ultraviolet rays, by signing the Montreal Protocol. The agreement required signatories to phase out a group of chemicals, including chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), that were responsible for the ozone layer's large erosion over Antarctica. Thanks to large-scale cooperation and a clear understanding of the risks and solutions, the ozone layer is now recovering, shielding the planet and its inhabitants from potentially deadly consequences (United Nations Environment Program, n.d.).

At the time, there was little evidence of doubt or skepticism about the need to remove CFCs and HCFCs from products, and little debate as to whether regulation or behavioural changes were essential. Yet, as the world faces a similar crisis requiring a large-scale effort to reduce the threat to human life, the narrative has been mired in arguments, deception, and intentional confusion, impeding any real action toward solutions. Unlike audiences in 1987, today's media consumers have a multitude of channels from which they can select their information and deselect that which doesn't conform to their worldviews—regardless of its accuracy. In fact, social media algorithms are able to spread false narratives six times faster than

real news (Vosoughi et al., 2018). If scientists raised concerns about the ozone layer today, would their message be drowned out by claims of conspiracy theories or messages to minimize the risk to the planet? The rise of social media sites, blogs, podcasts, and YouTube videos means anyone with an opinion can share their thoughts on social issues, which can then be highly targeted to demographics that fit their current cultural norms and worldview, reinforcing beliefs, and driving opinions to extreme poles of thought.

The existence of climate-warming trends due to human activity has been recognized in multiple peer-reviewed scientific journals and supported by most leading scientific organizations worldwide (NASA, n.d.), yet merely disseminating factual information to the public is insufficient in countering the simplistic, highly shareable content from misinformation campaigns. The rise of misinformation may be attributed in part to citizens' eroding trust in institutions such as governments and academia, creating an information vacuum easily filled with alternative information (Bennet & Livingston, 2018). According to the Edelman Trust Barometer (2022), trust in governments and news media has declined since the 2020 survey. Sixty-one percent of respondents in Edelman's most recent survey believe that they are being misled by journalists and 58% believe they are being misled by their countries' leaders. While scientists enjoy the highest level of trust at 75%, a decline of trust in traditional communications channels allows those who spread disinformation the ability to "disrupt authoritative information flows with strategic deceptions that appear credible to media consumers" (Bennet & Livingston, 2018, p. 124). The results of misinformation about climate change are a confused public, political inaction, and stalled support for or outright rejection of policies to mitigate climate change (Treen et al., 2020).

The continuous proliferation of content and the hyper-connected nature of social media have made misinformation spread faster and easier with the potential to do significant real-world damage. In 2014, the World Economic Forum identified the rapid spread of misinformation online as one of the top 10 global trends worldwide (World Economic Forum, 2014). However, social media platforms, along with traditional media, do present opportunities for public discourse that may advance climate advocacy goals.

The purpose of this capstone paper is to consider the reach and influence of social media communication along with the complicated and often contentious issue of climate change advocacy. The research includes examining existing literature, conducting in-depth interviews, and performing a content analysis of climate change information shared online to gather insights on countering misinformation and improving the efficacy of communications strategies aimed at increasing action to mitigate climate change.

Literature Review

This study examined research on the following topics: the nature of disinformation and misinformation and how they have impacted climate change communication; the drivers behind misinformation; how misinformation is amplified through social media; why misinformation works, and which demographics are most susceptible; and opportunities and strategies for climate change advocates to reach and influence their audiences. The literature review clarifies the difference between disinformation and misinformation, which are distinguished based on the level at which the information is intended to deceive audiences, however, the researcher has used the term “misinformation” throughout this document for simplicity. Both misinformation and the ripple effects of social media are vast and complex topics, much of which are out of scope for

this research. The literature review provides a brief overview of both, and then aims to connect their implications to the subject of disseminating accurate and credible climate change information. This literature review also notes the extreme differences between the recipients of climate change information. It will delineate the demography and various characteristics of a climate change audience with a focus on those most likely to be targeted and influenced by misinformation. While social media and tactics used by the oil and gas industry to alter the discourse of climate change have effectively created discord, the literature shows insights on how similar tactics and channels can be used to help share valid and urgent climate change information with targeted audiences.

Disinformation and Misinformation

"Misinformation" can be defined as "misleading information that is spread, regardless of whether there is intent to deceive" (Treen et al., 2020). It is distinct from "disinformation," which operates with the goal of disrupting credible information sources to strategically deceive an audience (Bennet & Livingston, 2018). In many cases, this deliberate manipulation of facts is associated with radical right-wing movements and organizations attempting to mobilize support by discrediting mainstream news organizations (Bennet & Livingston, 2018). For simplicity, the remainder of this study will use the term "misinformation" to refer to both definitions. Where required, the study will clarify if the term "misinformation" does involve intentional deception.

The recent spread of online misinformation has been a driving force in growing extreme right and populist sentiments worldwide. Politically and economically motivated actors have found online channels to be a powerful tool for spreading their messages while undermining their opponents. These are the same online channels that were touted as catalysts for enhancing

democracy only a few years ago (Iosifidis, 2020). The Institute for Public Relations' "Disinformation in Society" (2022) study looks at and tracks how disinformation is spread in the United States. Key findings in the 2022 report show that more than two-thirds of the Americans surveyed on both sides of the political aisle believe disinformation and misinformation are "major problems" in society, with nearly three-quarters of respondents believing misinformation will prolong the COVID-19 pandemic, is a threat to democracy, and undermines the election process, while seven out of ten said it has a negative impact on society and well-being. In addition, Facebook is considered to be one of the top sources responsible for spreading disinformation (The Institute for Public Relations, 2022). Despite the proliferation of misinformation, most people may not spread misinformation intentionally. Rather, other motives may drive them to share information without considering its accuracy (Pennycook et al., 2020). In the case of climate change misinformation specifically, these motivations tend to arise from climate skepticism, denial, and contrarianism (Treen et al., 2020). Deceptive or misleading climate change information appears in various iterations. For example, these messages may:

- create doubt about climate change's existence or impact, the fact that it is caused by human action, and the need for urgent action to mitigate and adapt;
- confuse conversations by distorting scientific data, such as omitting or cherry-picking information, as a means to reduce trust in authoritative and accurate climate change communications; or
- engage in "greenwashing" by falsely attributing efforts as supporting climate action, while actually contributing to the problem (Climate Action Against Disinformation, n.d.).

To help encourage doubt and inaction, misinformation may be financed, produced, and amplified by those who have a vested interest in the reliance on fossil fuels. Once in the

ecosystem of social media, this misinformation flourishes through algorithms that encourage polarization and echo chambers (Treen et al., 2020). It is further spread due to the users' underlying belief systems, social norms and confirmation biases used to interpret climate science (Treen et al., 2020). For example, those who already are skeptical of climate change will assume an extreme weather event is proof that weather is variable and unpredictable. Those who accept climate change as fact will interpret that same weather event as evidence that supports established climate science (Marshall, 2014). Ironically, extensive research has found that climate change misinformation peaks with adverse weather events and during important climate policy milestones. For example, some of the worst climate change misinformation received peak engagement in August 2021, coinciding with the release of the Intergovernmental Panel on Climate Change's latest report (Stop Funding Heat, 2021).

As climate change science has become more understood and accepted, the nature of misinformation has evolved from the denialist narratives prevalent in the 1990s and early 2000s to tactics that simply prevent progress. Industries that benefit from the status quo are adept at employing these tactics with a goal of confusing the audience into inertia or preying on cultural and identity politics and distrust in authorities. This results in established environmental science becoming enmeshed in uncertainty and divisiveness (King et al., 2022).

The Origin of Climate Change Misinformation

Why is climate change information easier to distort than other threats such as terrorism or health hazards? Its impact may be less tangible as it lacks many of the clear signs of danger needed to mobilize our natural reactions to imminent harm, making it more susceptible to misinterpretation. Communicating about climate change is challenging due to several reasons,

including its abstract nature, its complexity, and the tendency to believe the threat is slow-moving (León et al., 2021). When climate change is perceived as distant, uncertain, and difficult to understand, misinformation can easily lead the public to skepticism and outright denial (Marshall, 2014).

Climate change misinformation is financed, created, and spread by a multitude of actors, who then amplify it to public audiences through traditional media, politicians, and other skeptics with an online audience (Treen et al., 2020). Scientific research can easily be oversimplified or convoluted through online channels (Dale, et al., 2021) and is therefore well suited to social media, which prioritizes quick and easily digestible pieces of information, such as short lines of text, videos, and memes. At times, users may carefully consider the information presented to them through their news feeds. However, at other times they will make rapid decisions based on heuristics. For example, researchers have found that Facebook's interactive features tend to be used spontaneously without giving thought to the validity of the content (Buchanan, 2020). Popular social media platforms give the general public the ability to share information with their networks across the globe instantly, which can then shape climate change discourse and possibly even affect international political mechanisms (Mavrodiea et al. 2019). While there may be no intent to mislead in these instances, the desired effect of those who initially spread the misinformation is achieved.

Who is Most Affected by Climate Change Misinformation?

As misinformation tends to stem from lesser-known or authoritative sources, taking into consideration the interplay of user motivations can provide insights into why false messages are so readily accepted, and by whom (Pennycook et al., 2020). Climate science is rarely viewed

through an objective lens; rather, it is filtered through existing cultural identities, social norms, worldviews, and values that influence the way a person perceives the information. (Lewandowsky, 2020). Misinformation creators prey on the mindset that seeks to protect the individual from scientific evidence that can be ideologically or economically threatening. However, even without the interference of misinformation, there are multiple aspects of human cognition that make climate science difficult to fully accept (Lewandowsky, 2020). Speaking to an audience's core values can resonate far more than rational, scientific data.

When cultural meanings become attached to a concept such as environmental conservation, they become part of a matrix of values, politics, and lifestyles that are difficult to detach with scientific arguments (Marshall, 2014). Political views are a strong predictor of climate values: those who are inclined towards climate denial or skeptical beliefs tend to adhere to the conservative values of liberty and small government (Schmid-Petri & Bürger, 2021). For example, nearly 90% of Americans who consider themselves left-wing politically report feeling serious concern about climate change, compared to merely 18% of those with right-wing beliefs. These beliefs are reinforced by right-wing media outlets that often take a skeptical view of the scientific consensus and report fears that restrictions will harm the US economy. Politics has had a similarly polarizing effect on climate science in Sweden where right-wing websites oppose the consensus on a range of issues including climate change (Andı, n.d.).

A study by Schmid-Petri and Bürger (2021) further supports the evidence that pre-existing beliefs and worldviews shape climate-related attitudes. The research has found that participants who support unregulated markets, align themselves with populist attitudes, and identify as right-wing are particularly skeptical of climate change science (Schmid-Petri & Bürger, 2021).

Other research supports evidence that social media users are more likely to share information that is consistent with their pre-existing beliefs, particularly on subjects with a right-wing orientation. In one experiment, neither an indication of consensus, authority, nor media literacy impacted the participants' likelihood of sharing misinformation; however, conservative political beliefs did. In the same experiment, lower education levels were associated with a higher self-reported likelihood of sharing online content, leading researchers to hypothesize that less-educated people may be more susceptible to online influences, which is consistent with other evidence that less-educated people are more likely to be influenced by micro-targeted political advertising on Facebook. The experiment also suggested gender to be an important variable, with men reporting a higher likelihood of sharing misinformation messages than women (Buchanan, 2020).

Age is another factor in susceptibility to misinformation. Research has found that older adults, especially those aged over 65, were by far the most likely to spread misinformation from alternative news sources, possibly due to older adults' lower digital media literacy making them less able to distinguish between true and false information online (Buchanan, 2020).

Other personality traits may play a role in a person's decision to share information with their online connections. The Association for Consumer Research found that people with a high need for uniqueness may be less able to detect credibility signals from online sources and have an increased motivation to receive attention, leaving them more likely to spread false content (Pennycook et al., 2020). Despite demographic and personal characteristics, a content analysis found a simpler reason for why misinformation was shared: people who shared the content simply believed it was likely to be true, though the belief appeared to be connected to pre-existing beliefs and previous familiarity with the material (Buchanan, 2020).

Those who report being less concerned about climate change are paradoxically just as, or more likely to, share news about it online. For example, Americans who do not believe that climate change is concerning are as likely to share articles on the subject through their social media networks or email as those who do find it extremely concerning. In Sweden, those who are least concerned are twice as likely to share the information as those who see climate change as a serious problem (Andi, n.d.). While the least concerned may be a minority, they are able to over-represent themselves through their online sharing behaviour.

Knowing more about those engaged in misinformation may help communicators target their information campaigns in a way that addresses the audiences' cultural and behavioural norms; however, existing attitudes are relatively stable over time and difficult to change. Persuasive climate change communication can only be successful in these groups if advocacy for climate change and climate protection can be reconciled with these core personal values (Schmid-Petri & Bürger, 2021). Consistent messaging rather than limited hits of information will be required to alter these deeply held beliefs in a sustainable way (Schmid-Petri & Bürger, 2021).

Methods and Tactics of Climate Change Misinformation

Manipulative tactics may be used to spread climate change misinformation such as impersonation accounts, creating provocative and emotional content, sharing polarizing information, convincing users of conspiracy theories, and discrediting environmentalists (Schmid-Petri & Bürger, 2021). Fake experts may also appear to be conveying authority on the subject without any relevant scientific background (Cook et al., 2017). As the nature of climate change is complex and abstract, audiences may have difficulty in differentiating fake experts

from credible sources. Research has shown that using fake experts to disseminate climate change misinformation reduces the perceptions of scientific consensus in skeptical readers, as well as their trust in legitimate climate science (Cook et al., 2017).

Some rhetorical strategies employed by climate misinformation specialists include undermining and questioning the scientific consensus, drawing attention to uncertainty and demanding that a consensus be achieved before taking action, attacking individual scientists and institutions to undermine their expertise, and distorting the conversation by sharing pseudoscientific alternatives. The mere existence of misinformation can impact credible information by preventing constructive discourse and causing confusion and uncertainty in readers. Through a content analysis of 16,000 documents produced by think tanks from 1998 to 2013, researchers found an increase in statements casting doubt on mainstream science (Lewandowsky, 2020).

How Social Media Contribute

Researching online misinformation requires an understanding of how social media networks are structured and the characteristics that influence how content is shared, as well as the impact of human behaviour on the platforms. Social media, once thought of as a digital version of the public square, has become increasingly segregated into partisan communities sharing their messaging with highly targeted audiences. Populist sentiments are often fostered through online misinformation by actors who intend to capitalize on political and social unrest. These actors include groups with extremist ideologies, foreign entities, or those motivated by financial gain. This online environment has led to a rising tide of misinformation, creating one of the most daunting challenges of the online era (Iosifidis, 2020).

There is evidence that social media has the power to affect not just public perceptions but also political decision-making. By providing the public with a platform to discuss their thoughts on issues such as climate change, the public are able to use social media as a tool to shape public opinions, which influence political policy (Mavrodiea et al., 2019). The existence of a decentralized source of power such as social media can lead to uncertain outcomes. There is some encouraging evidence that sharing information through social networking can help raise awareness of legitimate environmental issues and encourage ecologically responsible actions; however, it also has the power to lead users into opinion silos and to reinforce anti-environmental behaviours (Mavrodiea et al., 2019). Worse news for climate scientists is the finding that online misinformation can spread faster and deeper than factual information, making it more difficult for credible information to reach the entire population (Maertens et al. 2020). Even when credible sources use scientific facts more effectively to counter misinformation, initial (and incorrect) beliefs are still difficult to change (Maertens et al., 2020).

Research shows that mainstream information sources and discussions of "settled science" about climate change are common characteristics of content on social media (Crestodina, n.d.), despite the significant difference between what the media publish and what is actually shared online (León et al., 2021). There is growing evidence that the social media giant Meta is a significate contributor to climate change misinformation (Stop Funding Heat, 2021.) A report on Facebook activity in the US found climate change and renewable energy misinformation videos received an estimated 25 million views within just 60 days. In September 2021, InfluenceMap, an aggregator of corporate and industry association lobbying for climate policy, documented how the oil and gas sector paid Facebook to disseminate inaccurate climate change information through its advertising platform (InfluenceMap, 2021). The Institute for Strategic Dialogue

released further evidence of Meta's role in misinformation through its study on how a "climate lockdown" rumour was spread through both traditional and social media (Maharasingam-Shah & Vaux, 2021). These studies indicate that Meta's role in spreading climate change misinformation may not only be worse than the company suggests, but that it has the potential to grow.

Similar to internet users preferring information that supports their worldview, the internet has also led to like-minded users creating echo chambers, where information that supports their pre-existing beliefs is widely shared and dissenting opinions are filtered out (Pennycook, et al., 2020). Social media users' behaviour tends to show alignment with peers or a commonly held idea, and sharing these ideas publicly helps the user to establish their identity (Crestodina, n.d.), creating a form of self-censorship. Biases that flourish in these echo chambers gain influence over the other members in the group that overrides logical reasoning. Even information that one group member may believe to be factual is unlikely to be discussed over fears of it being rejected by the others, leading credible information to be censored from online conversations (Mavrodiea et al., 2019).

Humans have a tendency to be linked to others who have a similar mindset through a trait known as homophily. Social media encourages this phenomenon by suggesting new contacts based on mutual characteristics. Homophily also suggests that a user will engage with online content based on the consumption choices of their network (Treen et al., 2020). When groups of similarly minded people are consuming similar content, echo chambers tend to form, encouraging the same information (or misinformation) to be repeated within the group (Treen et al., 2020). Online forums, such as Reddit, allow users to be highly selective in which discussions they engage in, encouraging the formation of like-minded participant groups while giving an easy exit to dissenting opinions. Echo chambers, homophilic tendencies, and their resulting

polarization of attitudes create a fertile environment in which misinformation can flourish. This may take the form of false, inaccurate, or misleading information, along with skepticism, contrarianism, or outright denial of climate change science (Treen et al., 2020). While climate change activists have been successful at sharing credible information and increasing climate change awareness, particularly on Twitter, promoting these messages effectively through online media is difficult when users are mostly interacting solely through their echo chambers (Williams et al., 2015).

The algorithms, which ensure content is highly palatable to individual users, also ensure content is promoted based on its potential for engagement rather than credibility (Treen et al., 2020). In fact, in one study 71% of participants said “no” when asked if they trust the information that companies are posting on social media (Crestodina, n.d). Yet, given that advertisers are provided with tools to hyper-target their audiences, those respondents would likely still be engaging with the companies’ content they are seeing in their news feeds. A study that investigated the diffusion of tweets between 2006 to 2017 found that false news was significantly more likely to be shared than truth, in all categories of information (Vosoughi et al., 2018). The effects were most pronounced with false political news and novel information (which was more likely found in false news than a verified source). The study also found that bots spread false and true news at the same rate, which implies false news is most likely to be spread by humans. US congressional committees on misinformation that have looked at the role of bots in spreading false news concluded that humans are actually more likely to spread misinformation than bots. This suggests that social media policies should provide behavioural guidelines such as content labelling and incentives to curtail the users’ role in spreading misinformation, rather than focusing exclusively on eliminating interference from bots (Vosoughi et al., 2018).

On the opposite spectrum to the denial and contrarianism commonly found on Twitter and Meta's channels, a content analysis of TikTok videos found that climate change is being communicated as a "legitimate and anxiety provoking issue" (Basch et al., 2021). However, like that of other social networks, TikTok's content was still less likely to show comprehensive coverage of climate change information (Basch et al., 2021). This may indicate that whether information is directed at skeptics or believers, content that produces a strong emotional response will still be prioritized by social media algorithms over factual and thorough scientific messages.

While this research paper is focused on the spread of misinformation through digital media, it is important to note that traditional media can also play a role in amplifying climate change falsehoods. Data show that people pay far more attention to television when it comes to climate change than to other forms of media (Andi, n.d.). While news media on television may appear to be a more trusted source of information, reporting can often distort the way scientific consensus is perceived. For example, this distortion results from the use of false-balance, which is providing an equal amount of coverage for opposing views even though the contrarian view is only held by a small percentage of people, or by presenting false expert accounts, such as a professor in an unrelated field providing information as a climate expert (Maertens et al., 2020)

Strategies and Opportunities for Climate Change Communicators

Constructing or targeting misinformation messages to maximize consistency, consensus, and authority may be a way to increase a climate change communicator's organic reach (Buchanan, 2020). Using the messaging characteristics that contribute to the dissemination of misinformation online may work in favour of advocates and scientists with legitimate messages to share. For example, the appearance of consensus and authority in a post may increase its

appearance of validity, making it more likely to be shared, which is why those intending to spread misinformation may use these attributes in an attempt to increase their reach (Buchanan, 2020). However, these same attributes could also be exploited by initiatives to counter misinformation.

Social media sites tend to favour information that is presented in easily digestible formats, coupled with eye-catching images or videos. Scientific papers, academic literature and the like may find more engagement if their content is reformatted into "bite size videos, podcasts, art, or data visualizations to engage the senses (auditory, visual, etc.) and provide additional points of entry beyond traditional text-based formats" (Dale et al., 2021, p. 88). Furthermore, the information should be adapted to each social media platform, using the language and unique characteristics of the platform (Dale et al., 2021).

Other research shows that encouraging people to think about the accuracy of the information they receive can improve the chances of them sharing higher-quality content (Pennycook et al., 2020). People's acceptance of science can improve when they are provided with an explanation of why climate change occurs, when they are made aware of the scientific consensus around climate change, and when the messages are aligned with their cultural identity. Climate change misinformation can also be curtailed when it is debunked before it is even encountered, through a technique known as inoculation (Lewandowsky, 2020).

Some initiatives use digital media literacy programs as a way to slow online misinformation. One such program is a Facebook game developed by the NATO Strategic Communications Centre of Excellence called "News Hero" (Facebook, n.d.). Numerous fact-checking organizations also attempt to share strategies for identifying false news. However, a survey has found that people don't necessarily eschew sharing information even if they know it

is untrue; therefore, digital literacy alone may not have an impact on reducing misinformation (Buchanan, 2020). Instead, communicators should look to internet users' beliefs about the misinformation content and what sets them apart from those who don't share false information to inform their strategy. Considering that the former is a small subset of the population, messaging to help reduce the sharing should be microtargeted to those most likely to do so (Buchanan, 2020).

One caveat to the above strategies is that it may be difficult to determine the motivation or intention of the user who is sharing misinformation (Treen et al., 2020). Some content may be initially shared with the intent to deceive an audience, but then be shared by other users for different purposes, and vice versa. Treen et al. (2020) conducted a content analysis of academic journals and conference materials to identify approaches to countering misinformation. Their findings included "inoculation, technological solutions, corrective and collaborative approaches, and regulation" (p. 13).

Inoculation and Consensus Approaches

The inoculation approach is cited by many sources as an effective method for tackling misinformation (Lewandowsky, 2020, Maertens et al., 2020, Banas & Rains, 2010, Schmid-Petri & Bürger, 2021, Treen et al., 2020). This small dose of misinformation, delivered with appropriate contextualization, works much like a vaccine for a virus, building up the user's understanding of the logical fallacies of a climate skeptic's arguments, thus becoming less likely to be persuaded by them. An inoculation message may include an explicit warning that content includes misinformation (e.g., an alert that there are false accounts of climate change science), along with an explanation of the techniques being used to mislead (e.g., employing information

from unqualified sources) (Schmid-Petri & Bürger, 2021). As debunking strategies often miss their target audience due to the censoring effects of social media algorithms and echo chambers, inoculation (sometimes referred to as “prebunking”) aims to build up resistance to false messaging before the belief becomes ingrained (Maertens et al., 2020). This works by pre-emptively correcting misinformation before a user encounters it (Treen et al., 2020). Inoculation is based on the theory that people are less susceptible to misinformation if they are informed of factual information beforehand, as well as techniques used by those who spread false information intentionally (Banas and Rains, 2010). Campaigns that use this strategy may provide some protection against the spread of misinformation; however, the challenge in this strategy is getting the message to the right audience before they are convinced by climate change-denying arguments (Treen et al., 2020).

Research has shown that communicating norms about climate change beliefs, such as the fact that 97% of scientists agree that the climate change emergency is caused by human behaviour, can help create more support for environmental action (Maertens et al., 2020). For example, the Gateway Belief Model, shows how “debiasing misperceptions about scientific norms can lead to higher perceived scientific consensus, which in turn serves as a gateway belief with cascading effects on personal attitudes and support for collective action” (Maertens et al., 2020, para. 3). Several studies support the Gateway Belief Model and have shown that it can lead to positive actions such as the support of binding policy regulations (Schmid-Petri & Bürger, 2021).

A study by Maertens et al., (2020) concludes that both consensus messaging and inoculation theory are likely effective methods to combat climate change misinformation and suggests that the longevity of inoculation spans for at least one week. The most prevalent forms

of misinformation could be identified, and then severely weakened doses could be tested and distilled into inoculation messages disseminated via social media platforms, news articles, and press conferences (Maertens et al., 2020).

Social Media Company Initiatives/Solutions

Technological solutions require cooperation from the online platforms where misinformation typically spreads such as Google and Facebook. These platforms could reduce the spread of misinformation by allowing users to flag it once detected. Meta's CEO Mark Zuckerberg has conceded that new rules should be implemented to curtail "the power internet companies have over speech" (Zuckerberg, 2019, cited in Iosifidid and Nicoli, 2019). In September 2020, the company committed to tackling climate misinformation and announced it would apply warning labels to both Facebook and Instagram posts containing climate change misinformation (Smith, 2021). However, despite this announcement, analysis by First Draft, a non-profit coalition that provides guidance in verifying online content, identified thousands of Instagram posts connected to hashtags associated with climate change misinformation such as #climatehoax, with ensuing denial of climate change. The effectiveness of warning labels is also questionable. Treen et al. (2020) cite a study conducted by Lawrence & Estow (2017) in which climate change misinformation is shown to participants who are then presented with a correction to the message. The reaction of the participants who chose to reply to the correction tended to be more argumentative, indicating that the correction caused their belief in the original false message to increase rather than abate. This led Treen et al. (2020) to consider if the source of the correction impacts its credibility. Another proposed strategy put forth by Pennycook et al. (2020) aims to remind users about the accuracy of information before they share it. This would include

having platforms periodically ask users to rate the accuracy of randomly selected headlines potentially under the guise of helping to inform the algorithms.

Online misinformation, particularly that which contorts critical issues such as climate change, will require multiple levels of intervention to resolve. Governments, industries negatively impacted by climate change, environmental advocates, and communicators need to use their expertise and resources to ensure credible information has an equal, if not better, chance at reaching audiences than does information spread by those who are generating noise intended to confuse and degrade the narrative around urgent environmental concerns.

Gaps in Literature

While there are several theories on why misinformation is created, shared, and becomes closely held beliefs—along with proposed strategies to counteract misinformation and effectively communicate the need for climate change mitigation—there is little research conducted to test these theories with real-world behaviour on social media. Providing climate change advocates with actionable strategies to test may provide opportunities to develop best practices for both combating misinformation and providing accurate information to the public in a way that is persuasive enough to impact personal behaviours and public policy. For example, pilot projects with non-governmental organizations (NGOs) could allow for observable effects of accessible scientific literature, spokespeople with similar cultural identities to their audience could provide insights into how climate change messages are received, and journalists could test the validity of inoculation methods.

Statement of the Problem / Research Questions

The world is now confronted with twin crises: climate change and misinformation. One will threaten our physical environments, homes, ability to grow food, and survival. The other threatens to sow political extremism, undermines scientific consensus, and hinders the ability of humanity to work together to solve large-scale problems, such as those presented by climate change. Both the deliberate and causal effects of social media are causing climate change misinformation to flourish. This study will investigate how and to what extent online misinformation affects climate change advocacy and why climate change is a difficult topic to communicate and will also identify strategies that organizations use to reach and influence critical audiences.

To understand the impact of online misinformation, other challenges that impede climate change communications, and the best strategies identified by those working in the field, this paper will focus on three research questions:

RQ1: How and to what extent does social media contribute to misinformation about climate change?

By answering this question, the researcher will gain a better understanding of the origins of misinformation, the type of tactics used to mislead the public, and the extent to which it influences audiences.

RQ2: What other factors complicate climate change advocacy?

Despite the prevalence of misinformation, persuading the public of the threats posed by climate change and the need for immediate action has proven difficult for advocates as the

situation “contains none of the clear signals that we require to mobilize our inbuild sense of threat and it is remarkably and dangerously open to misinterpretation” (Marshall, 2014, p. 3). Therefore, this question will determine some of the other factors that must be considered to create a successful climate communications campaign.

RQ3: How and to what extent can communications professionals help disseminate credible climate change information?

To provide actionable guidance to climate change advocates and communicators, information gained from this question will identify strategies to provide successful communications outcomes.

Justification for Research Questions

These questions were designed to gain a better understanding of the social and environmental factors that may impact a climate change advocacy strategy. The questions first look to examine the types of misinformation that exist, the motivations of those spreading it, and how and to what extent it influences online audiences. The questions then aim to improve understanding of other hindrances to climate change communications. This information may be able to help shape communications strategies to proactively counter the obstacles that prevent effective advocacy. The questions also aim to identify insights on what makes climate change communications effective: what attributes, channels, and methods have the potential to resonate with audiences and produce the desired outcomes.

Research Methods

This research employed qualitative and quantitative methodologies to discover best practices, learnings, and insights from climate change advocacy campaigns. The information was analyzed for trends, patterns, and commonalities to develop an understanding of the most effective strategies.

Qualitative research

The qualitative data was collected through a series of in-depth interviews with public relations professionals and climate advocates whose knowledge and participation in the climate change ecosystem will provide significant insight into the challenges of misinformation and successful communications strategies (Stacks, 2017). A benefit of this type of research method is that it provides the ability to understand not only the research problem but also the interview participant, as well as the ability of the researcher to control the type of questions asked, keeping the discussion focused on the most pertinent information (Stacks, 2017). Through these semi-structured interviews, the researcher gained an understanding of the impact of misinformation on different types of advocacy organizations, the various challenges faced in achieving their communications goals, and insights into their thoughts on what contributes to successful climate change campaigns.

Quantitative research

The ideal approach to understanding the phenomenon of online misinformation is to triangulate qualitative and quantitative methods (Stacks, 2017). To better equip communicators to combat misinformation, a content analysis of online climate change discussions augments the in-depth research data by providing an understanding of how, and to what extent, it is shared on social media platforms. This allowed the researcher to answer a question of fact, empirically

testing and comparing two groups of content to determine how much both types of information are shared (Stacks, 2017).

The content analysis sought to determine upon which online platform misinformation spreads the most, what type of misinformation is most likely to spread, and if there is a relationship between the platform and the type of misinformation shared. The method was modelled after a recent content analysis that analyzed the relationship between content creators and traditional media outlets (Hassan et al., 2023).

Data Collection Procedures

In-depth Interviews Data Collection Procedures

The researcher identified research participants through an online search of climate change organizations and then initiated contact after receiving McMaster Research Ethics Board approval. The researcher used publicly available email addresses to contact potential participants, with the exception of three participants who were referred by other participants who accepted the invitation. Participants were emailed five questions in advance of the interview and a Letter of Information providing details of the research project. The 12 interviews were conducted, recorded, and transcribed over the Zoom platform. The researcher used an interview discussion guide with some variations depending on each participant's background and asked probe questions where more details could provide relevant information. The general interview schedule was as follows:

1. What are some of the main goals of your climate change advocacy work?
2. What communications tactics do you use to inform the public about climate change and why?

3. Do you believe the spread of misinformation about climate change hinders your mission? If yes, what is the nature of the misinformation and what methods do you find effective to counteract this? Provide examples if possible.
4. What other challenges do you face in communicating your organization's mission?
5. What do you believe are some of the best practices for countering misinformation and educating the public about the urgency of climate change?

Content Analysis Data Collection Procedures

The content analysis was conducted using the BuzzSumo content analyzer platform to identify social media posts over the past year that included climate change content. The BuzzSumo search criteria included all online, English-only sources, written by journalists and non-journalists. Keywords and popular hashtags were used to find content that included both credible climate information and misinformation sources. Hashtags #ClimateHoax and #ClimateScam were included in the search as two of the most commonly used hashtags on Twitter for content that appeared to be from climate change deniers. The hashtag #ClimateEmergency was included as it is commonly used by climate change advocates on Twitter. The neutral phrase "Climate Change" and hashtag "#ClimateChange" were also included to ensure both credible and misinformation messaging were captured in the search.

Data Analysis Technique

Information gathered from the in-depth interviews was broken down into short answers and entered into a grid to sort the responses to each question. Details that were not necessarily obtained after asking a specific question, were entered into the grid if they provided insight pertaining to that question.

Content Analysis Coding, Reliability and Data Analysis Techniques

The 50 social media posts containing misinformation that had the highest total number of shares were collected for analysis. The first step in sorting the data involved viewing or reading each post to confirm that it contained some form of climate change misinformation. The second step involved determining which type of misinformation was used in the messages. The researcher looked for the categories identified by Wardle and Derakhshan (2018), with identifying descriptions developed by the researcher:

- Misleading content (use of a perceived expert, who may or may not be a climate change subject matter expert or one whose views are divergent from generally accepted scientific opinions)
- Manipulated content (information that is based on facts, but skewed with anti-science conclusions)
- Fabricated content (not based on any factual information, generally a conspiratorial view of climate change)
- False context of connection (based on factual information but lacking important context)
- Satire and parody
- Imposter content

(As the latter two categories were not present in the data sample, they were eliminated from the categories used in the analysis.)

The final sorting step was to identify the type of platform used to create the communication. Based on the sample, the information was found on three platform types: news media (categorized as a website with articles by multiple authors), a personal blog (categorized

as written content by one author) or a video (categorized by any video platform including TikTok, YouTube and Rumble).

For reliability, an independent coder re-tested the full data set to verify that the posts contained misinformation and, using the descriptions above, the type of misinformation deployed. The coder received a codebook with detailed descriptions of each type of misinformation to guide the retest. The outcome of the intercoder analysis showed a reliability of 42 %.

A statistical analysis was then employed, using a Chi-square test to determine if a difference between observed data and expected data is due to chance, or if it is due to a relationship between the types of misinformation and the platforms where it is most likely to be shared (Scribber, n.d.).

Results

In-depth Interview Results

The interview participants were involved in climate change communications in a variety of facets including fundraising, public awareness, government advocacy and policy promoting renewable energy, conservation, and science journalism. Each participant was a senior communications leader, senior manager, advisor, or specialist in their field.

Results from the in-depth interviews are organized below by research question:

RQ1: How and to what extent does social media contribute to misinformation about climate change?

Participants noted that those with an intent to spread misinformation about climate change turn to social media to disseminate messages of denial, deflection, and confusion. The

non-curated aspect of social media allows users to perpetrate falsehoods and then ascribe them to more high-profile individuals, as well as appeal to the emotional beliefs of other users. This may create emotional attachments to beliefs that can be difficult to counter without one-on-one engagement. The availability of social media also helps misinformation spreaders to magnify their content exponentially. Astroturfing, a tactic that creates the illusion of a grassroots movement usually orchestrated by an organization that conceals its identity, (Merriam-Webster, n.d.) campaigns are commonly used to develop online communities. The organizers are often well funded and employ highly sharable and relatable content, often fostering nationalist sentiments, which is able to quickly develop an online community to share the messaging. The echo chamber phenomenon helps to encourage these communities and prevents productive debates on climate science. Outside of communities where users are highly dedicated to discrediting climate change, others may inadvertently spread misinformation because they don't take time to verify content before sharing it with their connections. This ease of sharing built into social media platforms may encourage this behaviour. Others found that while climate change deniers are a nuisance, the nature of social media can, at times, be self-correcting. One commented that their supporters often tackle climate deniers' posts and that those who try to spread misinformation tend to have little influence and are therefore not detrimental to their mission.

RQ2: What other factors complicate climate change advocacy?

Some of the participants felt the problem they face is not audiences fully denying climate change but adopting other forms of denial, such as the idea that humans have already done too much damage to the climate to reverse it. The issue itself is so complicated it can lead to misunderstanding. Similarly, community resistance to renewable energy may stem more from a

lack of understanding of how the technology works rather than a deliberate attempt to block its implementation.

Many of the participants indicated that the oil and gas industry is primarily responsible for misinformation because it is making a deliberate effort to confuse the public and obfuscate the issue. Some of their tactics include using greenwashing and disingenuous environmental commitments, pushing back on or stalling government-proposed climate action, using "whataboutism" to deflect responsibility by pointing out a perceived lack of climate effort in other countries, and attempting to convince the public that it's now too late to stop climate change.

One participant pointed out that misinformation has more to do with one's social group and how they perceive themselves in relation to others. Disagreeing with peers can compromise one's social standing in that group. This means even a well-educated individual may identify as a climate denier if that conforms to their social group and will appeal to their education to undermine environmental arguments.

While some advocates find misinformation a "significant barrier" to carrying out their mission, others are not overly concerned about it and have found, in online forums, the community would correct those spreading misinformation. Others felt it is more effective to focus communications on audiences who accept that climate change is real but believe it is too expensive to address or too late to change, rather than trying to convince climate deniers of the real threat. Those whose primary audiences are government officials were less likely to be concerned about misinformation than those whose goal is to target the general public.

Many other issues the participants faced in communicating the threat of climate were related to cognitive barriers. Climate change is a difficult issue to fully understand, requiring

slow and rational thinking, which is time-consuming and difficult for people who are inundated with information in daily life. Advocates also need to ask people to make sacrifices to manage an often-intangible risk, which adds to the challenge of motivating people to take action. Climate change requires sustained, ongoing action. But the public generally thinks and acts in short-term contexts.

The participants identified another challenge communicating with a large portion of the population who understand climate change is happening but either don't see it as urgent enough or believe it is too late for their actions to make a difference. There were a few responses with solutions for communicating with this audience. A global issue may be difficult to comprehend, but climate advocates may find engaging their publics in conversations about locally tailored solutions and actions they can take to help themselves avoid disaster, such as adaptation measures, is more effective. This audience needs to know that what they do can have an impact locally but also needs a realistic understanding of the scale of the problem and what needs to be done to meet larger goals. Engaging in democracy and pushing for more impactful changes can complement individual actions. Communicators should avoid messaging that is overly dour or apocalyptic. Instead, the audience needs to know they have agency and needs to have a sense of responsibility. Other global issues may compete for attention; however, advocates can show how sustainability can overlap with other issues that affect humans and nature. To reach younger audiences, the message needs to contain a novel or unique angle to get their attention.

RQ3: How and to what extent can communications professionals help disseminate credible climate change information?

Most of the participants mentioned using some form of online or social media to achieve their communications goals. Twitter, Facebook, Instagram, LinkedIn and TikTok were the most mentioned platforms, in addition to podcasts, videos, and blogs. These channels are often used to share new research reports and organizational updates and to keep supporters engaged. Some of the participants also ensure their social media posts are shareable to facilitate their supporters' ability to take on an ambassador role, disseminating the messaging and helping to increase the organizations' reach. One participant has cultivated a strategic following on LinkedIn enabling the organization to share new reports, news releases, and media coverage with key stakeholders.

Traditional media relations—both proactive and reactive—is used by most participants on a regular basis to reach new audiences and establish credibility. One participant ensures new reports have a media hook or angle plus a summary that is accessible to general audiences to increase the report's ability to receive news coverage. Another pointed out that non-specialist reporters may need extensive background information along with screening to ensure the story is covered accurately.

Participants who work primarily with governments and policymakers were more concerned with distilling scientific information into readable reports, briefing notes, visualizations, and presentations. In one case, a masterclass for mayors is used to arm municipal leaders with the latest climate science.

A number of participants engage in extensive offline tactics, including speaking at conferences, providing educational materials for school curricula, attending community meetings, using word-of-mouth, and participating in other types of in-person events. One

organization employs a “participatory democracy” event, which brings together citizens to work together on climate solutions.

Reaching the right audience is also a challenge in the social media era, as people can easily choose which sources to get their information from. Several of the participants noted that their communication tends to only reach their supporters who already agree with the message, and their messages are less likely to resonate with more challenging audiences that don’t understand the seriousness of the issue. For small NGOs this problem is compounded by having smaller budgets to purchase media, while large industries have more resources to connect with hard-to-reach audiences. Scientific explanations and research reports are complex and can be difficult for general audiences to read and understand. This gives misinformation another advantage as it can easily fit into short messages that evoke emotions, such as a photo of famous climate-change activist Greta Thunberg on a yacht. Politicians may also use short sound bites to create the perception of action without real commitments.

Some participants believe it is worth investing the time to counter misinformation and counter climate change myths, with the caution that the communicator avoids entering into a discussion with those who are not open to being persuaded. Others prefer to arm their supporters with credible information to act as ambassadors to correct misinformation when encountered. When speaking with climate change deniers, advocates need to find a way to engage them in conversation without alienating them. For example, messaging around clean energy jobs may be alienating to individuals who work in the oil and gas industry. Those who identify with right-of-centre or populist political sentiments may be best reached through an influencer with whom they can identify, to counter misinformation. One-on-one engagement with respected influencers can be an effective method to counter deeply held beliefs about climate change.

A participant noted a study by Goldberg et al (2021) highlighting that Republicans in the United States are more receptive to climate risk messaging when it is framed with personal references, such as their lifestyles, opportunities, and leisure activities being affected. Countering misinformation requires an understanding of what information the audience has been exposed to and what is driving their opinion. Being specific and humanizing the scientist and researchers who contributed to climate science can help demonstrate that their work is not biased by political agenda or financial interest. Demonstrating that science is reproducible and well-grounded in facts, and showing the evidence can also help create trust between a reluctant audience and the communicator. Environmental organizations should also be transparent about what is unknown or unsure: rather than promoting a message of "generally understood science," communicators can point to areas where scientists have differences of opinion. A similar approach can be taken to renewable energy: openness about the flaws of renewables can help build more trust when communicating their benefits.

One of the most important factors in persuading a climate change denier may be understanding the root of their motivation: it could be social, emotional, economic, or driven by their peer group. Identifying these factors can help ensure the messaging is appropriate to address the barriers to understanding. Reducing the prevalence of misinformation also requires an effort to stop social media users from sharing it. A participant noted the UN's efforts to combat this problem through its "Pause" campaign, which encourages internet users to pause and verify the information before sharing. Another solution is to put pressure on social media companies to find ways to reduce the spread of misinformation on their platforms. Communicators can also work with journalists to reduce sharing of misinformation through traditional media outlets.

The participants also noted efforts to communicate the urgency of climate change to audiences who may agree that it is a problem without fully appreciating the risk or need for immediate action, as well as to those who are convinced that their efforts alone will not be significant. Communicating more immediate concerns around climate change, such as the cost of natural disasters, insurance implications, higher energy bills, and health risks of being exposed to extreme heat, can help provide a more tangible understanding of the threat to well-being.

While general audiences may be less likely to read scientific reports, those whose work involves changing policy at the government level need to ensure their scientific data is understandable by a lay audience. Using visual data, charts, and graphs can be an efficient way to inform government audiences without requiring too much of the reader but can still communicate urgency. Graphs should be kept simple and tell the story without jargon or specialist terminology. One participant explained an influential presentation strategy that first sets out the current situation and why action is needed, then turns to the increasing costs—both financial and social—that are associated with climate change, including insurance data on losses due to natural catastrophes and, finally, explains the psychosocial and mental stress associated with natural disasters such as residential flooding. These elements help paint the full picture of the crisis and the consequences of inaction, however the presentation ends on an optimistic note by explaining positive developments and the progress made, giving the audience a reason to believe it is worth making changes to mitigate the risk.

Content Analysis Results

A total of 50 social media posts containing climate change misinformation were analyzed. The first objective of the content analysis was to determine on which social media

platforms each type of misinformation was likely to be shared. The following graphs show the number of times each type of climate change misinformation was shared on Twitter (Figure 1), Facebook (Figure 2), the two platforms combined (Figure 3), and the "Evergreen score" of each post (Figure 4), a ranking system developed by BuzzSumo to measure the growth in engagements and links, 20 days after content is published (BuzzSumo, n.d.) The evergreen score helps to determine the impact of each post as online users' posts may have fewer shares but reach a larger audience.

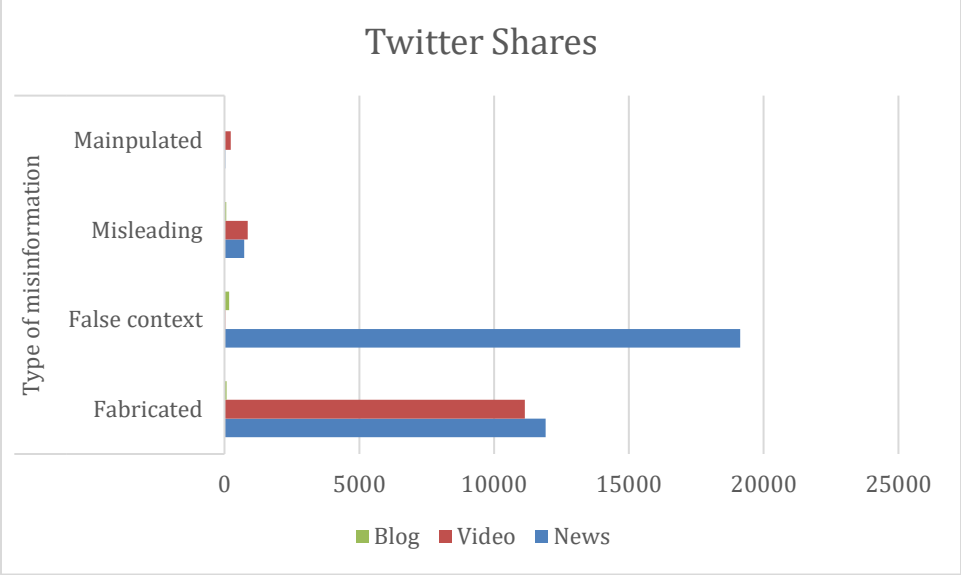

Figure 1

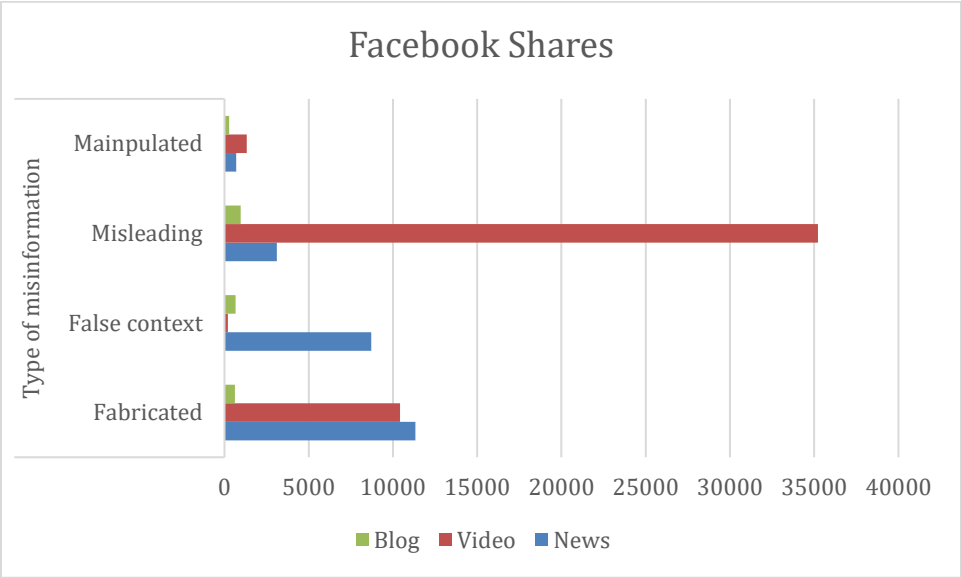

Figure 2

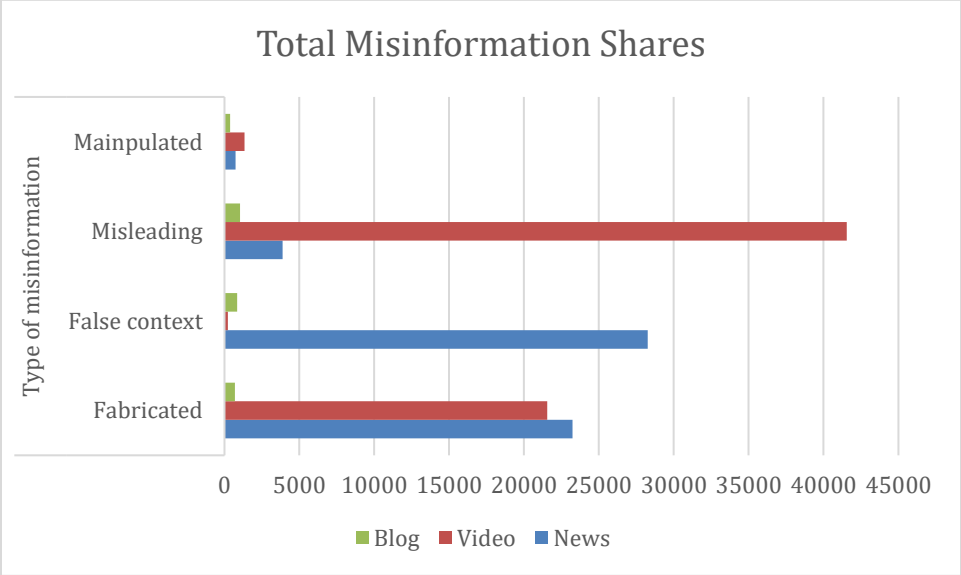

Figure 3

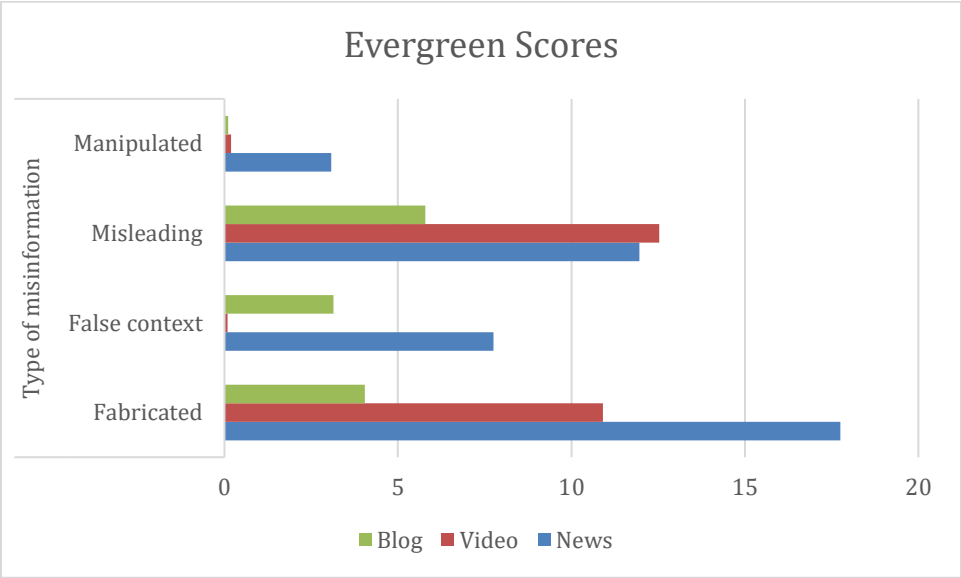

Figure 4

The results show overall misinformation posts are almost twice as likely to be shared on Facebook (n=73549) than on Twitter (n=44417). The most common type of misinformation category is "misleading" information shared on Facebook (n=39312). However, Twitter had a higher number of "fabricated" misinformation (n=23129). Of platform types, videos shared on Facebook were most common (n=47177) whereas most news websites were shared on Twitter (n=31809). News websites had the highest Evergreen score (n=40.5) and the type of misinformation with the highest Evergreen score was "fabricated" (n=32.7). See Appendix C for full data counts.

The second objective of the content analysis was to determine if there was a relationship between the types of misinformation and the types of platforms they are created on. The analysis performed a chi test analysis on the total number of shares (Table 1) and the data's evergreen scores (Table 2). The numbers in the table represent the observed values with the expected values, i.e., the number of shares that would be seen if there is no correlation between the

variables, in parentheses. The null hypothesis for the chi test is that the types of misinformation and the platforms are independent of each other. The alternative hypothesis is that there is a relationship between the two variables.

Total Shares Observed				
Platform	Type of misinformation			
	Fabricated	False context	Misleading	Manipulated
News	51% (46%)	96% (45%)	8% (45%)	30% (53%)
Video	47% (53%)	1% (52%)	89% (52%)	55% (44%)
Blog	2% (1%)	3% (1%)	2% (2%)	15% (3%)

P = 0.

This result shows there is no significant correlation between the type of misinformation and platform in posts with the highest number of shares.

Evergreen Scores Observed				
Platform	Type of misinformation			
	Fabricated	False context	Misleading	Manipulated
News	17.7505241 (34.28379045)	7.75566447 (11.5163865)	11.9562579 (31.7407063)	3.07314859 (1.76515344)
Video	10.9037052	0.09143573	12.5278503	0.19049111

	(20.05615209)	(6.73713136)	(8.75871836)	(1.0326217)
Blog	4.04666579 (7.63929909)	3.13757048 (3.71582347)	5.79111783 (5.12065399)	0.1036716 (0.56953616)

P = 1.23378

Based on this result, we can conclude that the type of misinformation shared is significantly dependent on the platform used for posts with the highest evergreen score.

Discussion

The 12 interview participants identified distinct challenges depending on the type of audience their communications target. These audience categories closely resemble the audience profiles identified by the Yale Program on Climate Change Communications' "Global Warming's Six Americas" (2022).

These six audience profiles include:

- The Alarmed: aware that climate change is occurring, caused by humans and represents an existential threat, but may feel the problem is beyond repair. While this group is highly engaged and trusts the science, they may be difficult to motivate to solutions unless they believe they can be effective.
- The Concerned: understands climate science and supports taking action, however, they believe the problem is in the distant future and doesn't require urgent action.

- The Cautious: does not believe or disbelieve climate science, is not completely convinced climate change is happening, and is not aware of how serious it is.
- The Disengaged: knows little about climate science and is not interested in learning more. They do not follow climate stories in the media or online.
- The Doubtful: either doesn't believe the earth is warming or does not think it has anything to do with human involvement. Therefore, they do not consider climate change to be a risk, nor do they support policies to mitigate climate change.
- The Dismissive: may be the most active group in disseminating misinformation. This group does not believe in climate change and is more likely to believe in conspiracy theories about climate than believe in accepted science.

George Marshall, the founder of Climate Outreach and Information Network, argues that each of these profiles has unique socio-political demographics and distinct values. To change the beliefs of those in each of these groups, communicators must understand how each of these archetypes acquired their views on climate change and how their social identity impacts their views (Marshall, 2014).

One category missing from Yale's six audience profiles, while perhaps a hypothetical persona, is the rational media consumer who understands climate science, supports immediate mitigation and adaptation measures, and, while they understand the urgency, believes human intervention can make a difference. For the purpose of this discussion, this category will be called the "Ideal" public. Most of the interview participants expressed a goal of moving their audience closer to an Ideal public's viewpoint, while targeting publics from various points on Yale's audience profile spectrum (see Figure 1). Each of the participants expressed challenges

and solutions that can be tailored to each profile to maximize the ability to influence the audience.

Figure 1

Climate Change Audience Spectrum

Using data from the literature review, in-depth interviews, and content analysis, the following recommendations may be effective tactics for reaching and engaging each of these groups, in the order in which they sit on the climate change audience spectrum in Figure 1.

Dismissive

This is one of the more difficult audiences to connect with, and one avoided by many of the interview participants. According to research, the demographic of this group tends to be less-educated males with right-leaning political views (Marshall, 2014, The disinformation order: Disruptive communication and the decline of democratic institutions). Interview participants noted efforts to include myth-busting communications and conversations to combat misinformation. However, given the nature of echo chambers in online media (Treen et al., 2020), these messages are unlikely to reach the Dismissive category. Larger-scale efforts to reduce the spread of misinformation online, such as the UN's Pause campaign or advocacy campaigns directed at social media platforms themselves such as the use of warning labels, may be more effective in reducing the prevalence of this group (Smith, 2021). While this group represents approximately 9% of the US population (Yale), techniques such as inoculation

methods (Treen et al., 2020) may help counteract misinformation shared by this group. An interview participant who writes about climate science for general audiences noted that unpacking scientific uncertainties, such as the different aspects of sea-level rise, can help inoculate readers against misinformation if they are the type that may consider a scientific disagreement evidence that climate change is not real. Another participant who promotes the use of renewable energy has found success in communicating the benefits of alternative fuel sources in highly dismissive populations simply by expressing the cost savings and independence these fuels provide. This tactic may not change someone's viewpoint on climate change but may still bring about improved outcomes by changing behaviours such as reducing dependency on oil.

Doubtful

Individuals in this group may have deeply rooted anti-science beliefs that are reinforced by their social group, therefore communications from authoritative sources may be distrusted. Facilitating offline discussions and working with influencers from that social group may be more effective in reaching those in the Doubtful category. As one interview participant expressed: "the only way you can counter those is by a one-on-one engagement, and by having influencers that they respect."

Disengaged

While the Disengaged may be easier to persuade than the previous two Yale audience profile groups, they may be the most difficult to identify and connect with online. Fortunately, according to Yale, in 2021 this represented the smallest of the six profile groups, representing only 5% of the US adult population. While this group may have tuned out of climate change news, they are likely aware of the impacts of global warming, such as extreme weather events. A few of the interview participants touched on these events helping to make climate change real yet

cautioned against using disaster in an opportunistic way. However, helping audiences understand the connection between natural disasters, insurability issues, and mitigation costs may help them realize this is a threat that should not be ignored. Messaging with emotional impact may also help drive the Disengaged closer to Ideal, for example, by using images and stories of nature and animals that are impacted by a changing climate. Messages that are overly complicated or dour may serve to further disengage this group. A campaign with striking images, unexpected methods, and/or humour may be more effective in drawing attention from this group and helping make them aware of environmental issues.

Cautious

Tactics employed for the Disengaged may also be effective for the Cautious. However, this group may be more receptive to scientific communications. While climate change advocacy messaging may be less likely to reach the Cautious through social media, depending on their social networks, working with traditional media may help advocates to communicate the science and the risks of climate change.

The Gateway Belief Model (Maertens et al., 2020) may be an effective tactic in removing uncertainty within this demographic by clarifying misconceptions and highlighting the scientific consensus on global warming. But, as one of the interview participants warned, emphasizing consensus without recognizing areas where there is legitimate disagreement among experts may lead to confusion in less convinced groups. Therefore, maintaining transparency on where disagreements lie, and providing more detail on the humans behind environmental advocacy and science, along with details of how they arrive at their conclusions, may help reduce uncertainty among the Cautious.

Engaging communications that make science understandable plus myth-debunking materials may also be appropriate tactics to communicate with this group to help convince them of climate change's reality and risks. According to one participant who works at the government level sharing scientific research, the most impactful ways to communicate science are through visual data, charts, and graphs. This provides information without requiring too much of the reader and has the most purchase for urgency. Keeping the graphs simple and visual tells the story without jargon or terminology.

Concerned

While the Concerned are well-engaged, receptive audiences, they need clear messaging to show the urgency of climate change and what action they can take. As with the Disengaged, taking abstract concepts and translating them to actual consequences, such as natural catastrophes, may help make the risk appear more real to the Concerned. One participant relayed the remarks of a man from Prince Edward Island who said:

> If you were to come into this town before [Hurricane] Fiona and talk about climate change, it would have been crickets. You come into this town now and talk about climate change, and everybody is an advocate because they've lived it. They've seen this hurricane that was stronger than anything we've seen before. And they've seen their neighbour's or their friend's house get ripped apart.

Another concern the interview participants noted was the effect of information overload. This may hinder an audience's appreciation of risk, given the amount of content generated from the 24-hour news cycle. The participant who works as a science journalist also recognized this challenge. He empathized with the need to share information with a novel angle, such as linking climate change to an endangered species, or an interesting development with a business interest

or infrastructure development, rather than repeating news that has been covered in other outlets. While the Concerned audience may be distracted by other issues, emphasizing how global sustainability can overlap with other issues that affect humans may also be an effective tactic to link a perceived distant threat with current disasters.

Although the Concerned group may be less susceptible to misinformation, participants flagged that fuel industries actively downplay the urgency of climate change and cast doubt on scientific predictions as a way to delay action for as long as possible. Using messaging to alert the Concerned to this misinformation tactic may help to improve their understanding of the imminent risks.

Ideal

While this category was not identified as one of Yale's six audience profile groups, audiences under this group may include those who follow climate change advocates online, subscribe to newsletters, donate to environmental non-profits, and vote for leaders who promise environmental action. Many of the interview participants conceded that often their communications targeted this group, even though it is already highly engaged and informed on the issues. This group may be an easy and rewarding audience to engage with. However, efforts to persuade or convert less engaged audiences will be less impactful, unless the Ideal group can be mobilized. Communications efforts toward the Ideal audience should be aimed at helping them to share the advocacy messages in their own networks and providing them with guidance on speaking to less engaged individuals with whom they are connected. One participant detailed the effectiveness of community meetings and real-life collaboration on environmental solutions. While this tactic may be effective, it can be difficult for an organization to actualize on a large scale. However, the Ideal audience may open up avenues into local communities to enable

smaller-scale grassroots activities. Helping engage the Ideal group in their own mini-campaigns, for example organizing in-person community events or political activity during an election period, may help optimize this supporter group and expand climate change advocates' reach.

Alarmed

Perhaps a sign of climate advocates' success, the Alarmed group is now the largest cohort of the Yale Six Americas audience profiles (Yale Program on Climate Change Communication, 2022) at 33%. This group is convinced of both the science and the urgency, but not of their own powers to effect change. Getting this group to understand that climate change is an existential problem is easy but getting them on board with changes to the way we must collectively organize ourselves is a completely different challenge. Given the size of this group, it may be an advocate's best opportunity to increase their Ideal audience through empowering and optimistic messaging. Many of the interview participants choose to focus on this audience, which believes climate change is too expensive to address or that it's too late to stop climate change. This group may feel that their personal footprint is quite small compared to the impact of a large corporation, creating skepticism about the impact of reducing their own footprint. Messaging that creates anxiety can also backfire by leading to resistance. Instead, action-oriented messaging is more appropriate to move the Alarmed towards the Ideal category. The communication should let people know what they can do that has a meaningful impact, showing how small contributions can build up over time while being transparent about what else needs to change to meet larger-scale targets and goals. The Alarmed should be informed about the importance of voting and pushing for larger-scale changes that will complement individual actions.

Content Analysis Discussion

While the content analysis results may seem contradictory, the higher evergreen score shows a higher degree of dependency between the type of misinformation and the platform where it is shared. This may indicate that the more connected the agent of misinformation is, the more their choice of platform and communication tactics are dependent on each other. For example, news websites with a large following may be able to conduct more audience analysis and present the type of misinformation likely to be shared. Those with a high number of shares but lower reach may be more likely to create highly sharable content by accident, rather than careful consideration of their fans.

Communications experts looking to find the source of misinformation will find most data on Facebook through misleading videos. “This result also provides further evidence of the need for social media platforms to provide context notes and improved content moderation to reduce the amount of misinformation circulating” (Stop Funding Heat, 2021). Fabricated reports through alternative news sources such as Infowars and the Countersignal are gaining larger audiences, as evidenced by their evergreen score and the number of Twitter shares and should therefore be closely monitored on all platforms to understand what emerging falsehoods may require inoculating messaging.

For Further Study

While there are several theories on why misinformation is created, shared, and becomes closely held beliefs, along with proposed strategies to counteract misinformation and effectively communicate the need for climate change mitigation, there has been little research conducted to test these theories with real-world behaviour on social media. Giving climate change advocates actionable strategies to test may provide opportunities to develop best practices for both

combating misinformation and providing accurate information to the public in a way that is persuasive enough to impact personal behaviours and public policy. For example, climate change advocates working on pilot projects with NGOs could improve the accessibility of scientific literature, spokespeople with similar cultural identities to their audience could provide insights into how climate change messages are received, and journalists could test the validity of inoculation methods. Similarly, the communications tactics listed in the discussion section of this paper should be tested through quantitative studies to further refine messaging and measure any actual changes in behaviour. Message testing and/or field experiments can help to determine which form of misinformation is likely to resonate with which of the Six Americas groups. The content analysis showed where and how misinformation is shared, however, further analysis may help to identify which of the Six Americas groups are engaging in these platforms, allowing communicators to target them with counter-misinformation strategies. As a high percentage of misinformation was in the "misleading" category, further analysis may show why this type of communication is effective and leads to more sharing than other types of misinformation.

Limitations

Due to the limited number of interview participants, the limited timeframe in which to collect data, and the varied nature of their organizations and professions, data collection did not reach a saturation point. While there were several cases where responses overlapped, there was no case where two or more participants were in complete agreement, indicating results of this research are unlikely to be fully replicable.

The content analysis was also limited by its small sample size and lack of intercoder reliability. While the code book attempted to clarify the different categories of misinformation,

the nature of the online content led to several cases of overlapping categories and ambiguity, which may have resulted in the low agreement between the researcher and the code retester. Many large-scale influencers (on both the denier and advocate perspectives) were not included; their inclusion may have produced extremely different results. Furthermore, posts marked as likely to be misinformation were not fact-checked due to limitations on time and resources.

Conclusion

This study looked at the joint issues of climate change and misinformation, which are further exacerbated through online communications. The literature review examined the nature of misinformation, why it is shared, and what factors make some audiences more likely to believe falsehoods. It also considered several solutions proposed in research papers and theories to prevent the spread of misinformation, such as inoculation tactics and pressuring social media companies to implement policies to reduce the spread of falsehoods. The qualitative part of the study drew insights from 12 climate change advocates and communications professionals to learn how misinformation impacts their work, what other challenges affect communicating climate change information, and effective strategies they have identified to overcome these challenges. The quantitative research involved a content analysis, that looked at social media posts discussing climate change to examine which were more likely to be shared and the size of the audience reached. The results of both methods show that there are vast differences in climate change audiences, and that messages to create support for environmental advocacy need to be tailored accordingly. Further study should look at testing these methods to determine how well they can impact behavioural and attitudinal relationships with climate change action.

This research may contribute to the body of public relations knowledge by developing a tactical framework upon which to combat misinformation. While the climate change models may

not fit other types of misinformation, such as medical or political, the process of analyzing the audience types, their motivations, and the categories of misinformation offer communicators a more effective means of planning strategies and executing informational campaigns. For public relations professionals developing messaging to counter misinformation, a similar process as this research has illustrated may be beneficial:

- Identify the origin of misinformation, including the actors that are creating and disseminating it, and their motives;
- Identify the audiences with whom this misinformation would likely resonate and why;
- Place the different audience types along a spectrum and identify what the ideal position is;
- Identify who will be most likely to further disseminate these messages, in what formats and on which platforms; and
- Create a communications strategy to reach each audience type along the spectrum, using anti-misinformation techniques such as inoculation, to avoid the misinformation from spreading further.

Identifying and limiting misinformation would ideally happen before it becomes widely adopted, however, this is no longer possible for climate change misinformation. Forces that create headwinds for climate change advocates, such as social media echo chambers, divisive politics, and misinformation campaigns from industries that benefit from fossil fuel use, may now be a permanent reality. The nature of climate change is inherently difficult to appreciate, given the complex scientific nuance and seeming distance of the threats. However, by understanding these forces that work to reduce awareness of the risk of climate change, communications professionals can shape campaigns to resonate with the right audiences and

inspire supporters to take necessary action to mitigate its worst effects. While the literature and interview participants show varying opinions of how much climate change can be reversed or slowed down, humanity will need to work together to find solutions and embrace cooperative action for the best chance of survival. While cultural differences between right- and left-wing politics, oil-sand workers and environmentalists, generations, and genders may create disparate opinions on what's real and what should be done, advocates will need to find common ground on priorities, while employing highly tailored and targeted communications campaigns to reach every corner of society. In the words of George Marshall, "the real battle for mass action will not be won through enemy narratives…we need to find narratives based on cooperation, mutual interests, and our common humanity" (2014, p. 42).

References

Andi, S. (n.d.). How people access news about climate change. *Reuters Institute for the Study of Journalism.* University of Oxford. https://www.digitalnewsreport.org/survey/2020/how-people-access-news-about-climate-change/

Banas, J. & Rains, S. (2010, September 22). A Meta-Analysis of Research on Inoculation Theory. *Communication Monographs, 77:3,* 281-311, DOI: 10.1080/03637751003758193

Basch, C., Yalamanchili, B. & Fera, J. (2021, September 20). #Climate change on TikTok: A content analysis of videos. *Journal of Community Health, 47,* 163–167. https://doi.org/10.1007/s10900-021-01031-x

Bennet, L. & Livingston, S. (2018, April 2). The disinformation order: Disruptive communication and the decline of democratic institutions. *European Journal of Communication (London)*, *33*(2), 122–139. https://doi.org/10.1177/0267323118760317

Bienert, S. (2016, October). Climate change implications for real estate portfolio allocation industry. Urban Land Institute. Perspectives. https://europe.uli.org/climate-change-implications-real-estate-portfolio-allocation-industry-perspectives/

Buchanan, T. (2020, October 7). Why do people spread false information online? The effects of message and viewer characteristics on self-reported likelihood of sharing social media disinformation. *Plos One, 15(10), e0239666.* https://doi.org/10.1371/journal.pone.0239666

BuzzSumo (n.d.). What is an "Evergreen Score"? https://help.buzzsumo.com/en/articles/1633304-what-is-an-evergreen-

score#:~:text=It%20measures%20the%20growth%20in,month%2C%20the%20higher%20the%20score).

Climate Action Against Disinformation (n.d.). The impacts of climate disinformation on public perception. https://caad.info/wp-content/uploads/2022/11/The-Impacts-of-Climate-Disinformation-on-Public-Perception.pdf

Climate Proof Canada (n.d.). Home. https://www.climateproof.ca/

Cook, J., Lewandowsky, S., Ecker, U. (2017, May 5). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. PLoS ONE 12(5): e0175799. https://doi.org/10.1371/journal.pone.0175799

Crestodina A.(n.d.). [New Research] Social media psychology: Why do we follow? Why do we share? Here are 5 Things Marketers Miss. Orbit Media.com. https://www.orbitmedia.com/blog/social-media-psychology-research/

Dale, A., Clifton-Ross, J., Jost, F., Hodson, J., Leighton, H., & Bernard, M. (2021, November 2). Communicating environmental research: Harnessing the power of curation. Journal of Community Engagement and Scholarship. Special Issue No. 2. https://storage.googleapis.com/jnl-s-j-jces-files/journals/1/articles/74/62e2b8e5ab0ab.pdf

Edelman (n.d.) 2022 Edelman Trust Barometer. https://www.edelman.com/trust/2022-trust-barometer.

Facebook (n.d.). News hero. https://www.facebook.com/thenewshero/

Goldberg, M., Gustafson, A., Rosenthal, S., & Leiserowitz, A. (2021, July) Shifting Republican views on climate change through targeted natural climate change. *Nature.* https://doi.org/10.1038/s41558-021-01070-1

Hassan, I., Musa, R.M., Latiff, A., Abdullah, R., Yusoff, S. (2023, January 2). Analysis of climate change disinformation across types, agents and media platforms. *Information Development (*Advance online publication). https://doi.org/10.1177/02666669221148693

Iosifidis, P., & Nicoli, N. (2019, October 10). The battle to end fake news: A qualitative content analysis of Facebook announcements on how it combats disinformation. *International Communication Gazette, Volume 82, Issue 1,* 60–81. https://doi.org/10.1177/1748048519880729

Influence Maps. (2021, September 30). *Oil and gas lobbyists flood Facebook with anti-climate ads.* https://influencemap.org/pressrelease/Oil-and-Gas-Lobbyists-Flood-Facebook-with-Anti-Climate-Ads-f136b6fd72b7ee2ec756e87fe7b7808d

Institute for Public Relations (2022). *Third annual disinformation in society report.* https://instituteforpr.org/wp-content/uploads/Disinformation-Study-MARCH-2022-FINAL.pdf

Intergovernmental Panel on Climate Change (2023). *Synthesis Report of the IPCC Sixth Assessment Report (AR6).* https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf

King, J., Janulewicz, L., & Arcostanzo, F., (2022, June 9). Deny, deceive, delay: Documenting and responding to climate disinformation at COP26 and beyond. Institute for Strategic Dialogue. https://www.isdglobal.org/wp-content/uploads/2022/06/Summative-Report-COP26.pdf

León, B., Bourk, M., Finkler, W., Davis, L., & Boykoff, M. (2021, October). Strategies for climate change communication through social media: Objectives, approach, and interaction. *Media International Australia*. Advance online publication. DOI: 10.1177/1329878X211038004

Lewandowsky, S. (2020). Climate change disinformation and how to combat it. *Annual Review of Public Health.* University of Bristol. doi/10.1146/annurev-publhealth-090419-102409

Maertens, R., Anseel, F., & van der Linden, S. (2020, August). Combatting climate change misinformation: Evidence for longevity of inoculation and consensus messaging effects. *Journal of Environmental Psychology, Volume 70 (2020)* 101455. https://doi.org/10.1016/j.jenvp.2020.101455

Maharasingam-Shah, E., & Vaux (2021). 'Climate Lockdown' and the Culture Wars: How COVID-19 sparked a new narrative against climate action. *Institute for Strategic Dialogue.* https://www.isdglobal.org/wp-content/uploads/2021/10/20211014-ISDG-25-Climate-Lockdown-Part-1-V92.pdf

Marshall, G. (2014). *Don't even think about It: Why our brains are wired to ignore climate change.* Bloomsbury, New York.

Mavrodiea, A., Rachman, O., Harahap, V., & Shaw, R. (2019, October 16). Role of social media as a soft power tool in raising public awareness and engagement in addressing climate change. *Climate 2019, 7(10),* 122. https://doi.org/10.3390/cli7100122

Mills, E. (2007). Synergisms between climate change mitigation and adaptation: An insurance perspective. *Mitigation and Adaptation Strategies for Global Change, 12(5),* 809–842. https://doi.org/10.1007/s11027-007-9101-x

Merriam-Webster (n.d.). *Merriam-Webster.com dictionary*. Retrieved March 26, 2023. https://www.merriam-webster.com/dictionary/astroturfing

NASA (n.d.). *Scientific consensus: Earth's climate is warming.* https://climate.nasa.gov/scientific-consensus/

Pennycook, G., Epstein, Z., Mosleh, M., Arechar, A., Eckles, D., Rand, D., (2020) Understanding and reducing the spread of misinformation online. *Advances in Consumer Research. Volume 48,* 863-867. https://www.acrwebsite.org/volumes/v48/acr_vol48_2662454.pdf

Schmid-Petri, H. & Bürger, M. (2021) The effect of misinformation and inoculation: Replication of an experiment on the effect of false experts in the context of climate change communication. *Public Understanding of Science, 31(2),* 152–167. Available at: https://doi.org/10.1177/09636625211024550.

Scribber. (n.d.). *Chi-Square (X^2) Tests | Types, Formula & Examples.* https://www.scribbr.com/statistics/chi-square-tests/

Stacks, D. (2017). *Primer of public relations research, Third Edition.* The Guildford Press.

Stop Funding Heat (2021). *In denial – Facebook's growing friendship with misinformation.* https://stopfundingheat.info/wp-content/uploads/2021/11/in-denial-v2.pdf

Treen, K.M., Williams, H.T. & O'Neill, S.J. (2020, May 14). Online misinformation about climate change. *WIREs Clim Change*. 2020; 11:e665. https://doi.org/10.1002/wcc.665

United Nations Environment Program (n.d.) *The Montreal protocol.* https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol

Vosoughi, S., Roy, D., & Aral, S. (2018, March 9). The spread of true and false news online. *Science (American Association for the Advancement of Science)*, *359*(6380), 1146–1151. https://doi.org/10.1126/science.aap9559

Wardle, C. & Derakhshan, H. (2017, September 27). Information disorder: Toward an interdisciplinary framework for research and policy making Information Disorder Toward an interdisciplinary framework for research and policymaking. *Council of*

Europe report DGI (2017) 09. https://www.researchgate.net/publication/339031969_INFORMATION_DISORDER_Toward_an_interdisciplinary_framework_for_research_and_policy_making_Information_Disorder_Toward_an_interdisciplinary_framework_for_research_and_policymaking#fullTextFileContent

Wieteska-Rosiak, B. (2020). Real estate sector in the face of climate change adaptation in major Polish cities. *Real Estate Management and Valuation, 28(1),* 51–63. https://doi.org/10.2478/remav-2020-0005

Woetzel, J., Pinner, D., Samandari, H., Engel, H., Krishnan, M., Kampel, C., & Graabak, J. (2020, August 31). Could climate become the weak link in your supply chain? *McKinsey & Company.* Retrieved July 24, 2022, from https://www.mckinsey.com/business-functions/sustainability/our-insights/could-climate-become-the-weak-link-in-your-supply-chain

World Economic Forum (2014). *Outlook on the Global Agenda 2014.* https://www3.weforum.org/docs/WEF_GAC_GlobalAgendaOutlook_2014.pdf

Yale Program on Climate Change Communications (n.d.). *Global Warming's Six Americas*. https://climatecommunication.yale.edu/about/projects/global-warmings-six-americas/

Appendix A: Interview Participants

Interview participants were senior members of the following organizations:

- United Nations Environment Programme
- World Wildlife Fund
- Nature Conservatory of Canada
- Sierra Club Canada
- The Intact Centre for Climate Change (2 participants)
- The Globe and Mail
- The Canadian Centre for Policy Alternatives
- The Canadian Renewables Association
- C40 Centre for City Climate Policy and Economy
- The David Suzuki Foundation

One participant chose to remain anonymous.

Appendix B: Summarized Interview Results

The following is a summary of the participants' answers. Not all participants were able to provide relevant answers to all questions and some were therefore excluded from some of the summaries. Others provided more than one relevant answer per question, and their additional answers are included in the summaries.

Q1: What are some of the main goals of your climate change advocacy work?

- Echo the call to action that you would see from many other environmental groups, or climate scientists, action from governments, importance of climate justice, show how transition to sustainability is possible, promoting climate policies that consider inequality
- Be the touchstone with science to provoke conversations amongst scientists, columnist practitioners, and mayoral policy advisors, and to try to help science speak quickly to power; and have a particular focus on economics, because it's their view that the current neoliberal economic system is part of the cause of climate change
- End coal power and engage in advocacy around water and nature
- Support donor marketing, communicate with the organization's supporters, and raise awareness of the general public to enable conservation solutions
- Use science-based communication to raise awareness and encourage stakeholders to take action, targeting governments, also religious organizations and youth and educational organizations
- Work towards a net zero economy, primarily at the federal government level focusing on oil and gas, transportation, building and renewable energy, with some general public outreach but not advocacy

- Ensure that Canada meets international commitments to decarbonize fully by mid-century and decarbonize by half by 2030 and transition from fossil fuels to renewable energy
- Engage in federal and provincial government advocacy to deploy renewable energy and strengthen carbon prices
- Support fundraising and general awareness of climate change and nature issues
- Work with all levels of government and the business community, particularly the capital markets and institutional investors, and provide advice and direction on how to incorporate physical climate risk into institutional investment decision-making
- Work as a science journalist.

Q2: What communications tactics do you use to inform the public about climate change and why?

- Does outreach by speaking at conferences and in rural communities, and media relations
- Communicates with supporter base through email and social media, arms them with information and messaging to be ambassadors, tries to identify audiences that perhaps don't have their minds made up about climate change but are open to learning more
- Uses offline tactics such as assemblies and participatory democracy, i.e., working with citizens to collaborate on climate solutions, research and education; produces videos, and develop curriculum materials for high school students
- Creates publications, media releases and social media, but not specific to climate project, research reports, website information, blogs and op-eds
- Provides municipal governments with the scientific facts and narrative they need to strengthen their voices when working with the international community, UN, etc.

- Holds a masterclass for mayors on climate science and arms them with the latest climate science
- Uses podcasts and videos on various topics including climate change myths, social media, media relations, word-of-mouth, and in-person events
- Produces a quarterly magazine, annual report, and website; has no owned social media but creates sharable content; uses strategic media relations and government relations
- Synthesizes science into accessible formats and reports; uses high-quality editorial and visuals to create easy-to-read formats; shares information via media and creates content for social such as videos, infographics, and quote cards
- Has an active social media presence, using Twitter, Facebook, and LinkedIn as primary channels; does extensive media outreach
- Uses a proactive and reactive media relation; translates policy material into accessible language for a general audience
- Uses web, email, social media, and media relations as main communications channels—email, and to some extent social media; communicates mostly to current supporters, almost like an internal audience, while media relations is a way to acquire new audiences
- Uses social media as primary communications channel (Twitter and LinkedIn), media relations, website, and some TV and social media advertising; uses organization's newsletters to communicate to members and public for advocacy; and provides people with the tools to do their own advocacy and start conversations
- Uses traditional social (Facebook, Twitter, IG, LinkedIn and TikTok), newsletters, email, and proactive and reactive media relations.

- Does extensive media relations, 200 to 300 interviews a year with major outlets; produces carefully written content that can mostly be understood through the executive summary—reports include a hook to get government or media attention; does proactive media outreach for new reports and after coverage is received they are shared on social or sent directly to key contacts; promotes media coverage on social channels to increase position as an influential leader on climate change; focuses on media to help establish credibility with governments; and has key audiences as LinkedIn followers
- Makes sure people understand how we know what we know, and if something is uncertain, explains to what degree the uncertainty is. Unpacking some of these details can inoculate readers against misinformation.

Q3: Do you believe the spread of misinformation about climate change hinders your mission? If yes, what is the nature of the misinformation and what methods do you find effective to counteract this? Provide examples if possible.

- Respondent doesn't see many people saying that climate change is not happening but acknowledges there are other forms around denial about it. Some people know it's happening but feel it's too late to do anything about it.
- Industries have been very successful in maintaining profitability by stopping or slowing certain policies or just muddying the waters of the public debate. They use narratives such as a "net zero commitment for 2050" but are disingenuous about climate commitments.

- There is a documented deliberate effort by some in the fossil fuel industry to confuse delay, obfuscate, and misinform the public. Some in the fossil fuel industry/lobbyists are the source of deliberate disinformation.
- There is a systematic effort to minimize the science. There's an organized, very well-funded effort to minimize it, which has been going on for a long time.
- There are efforts to support pushback against particular climate actions undertaken by various entities, governments, and private business now. Misinformation is funded or supported and amplified by the same groups.
- The denialists' strategy is often "whataboutism," e.g., pointing to actions of others, such as China.
- The industry uses stalling and denial tactics, minimizing the problem, and greenwashing.
- Environmental action and climate change, in a very general sense, can lead to misunderstanding.
- Is not overly concerned with climate change deniers. Can't spend too much time worrying about it. Often supporters will correct online misinformation.
- Misinformation/disinformation is a significant barrier.
- In isolation: no, it doesn't. But also finds counternarratives on social media that find would qualify as misinformation, which require hammering home the same points and being very evidence-based.
- There can be a bit of a blurring between myths and misinformation and a difference of opinion—sometimes the terms can be used interchangeably. This may not be a deliberate attempt to misinform, so much as a difference on how and the pace at which goals should be achieved. The current concern is less about climate denial (though it does exist) and

more about climate delay: people want to soften the targets and will invest in decarbonizing, but not yet. This attitude likely comes from industry due to change requiring a very different business model.

- Misinformation is the biggest problem we're up against. Believes oil and gas companies are the source of it, creating sharable social posts and astroturfing campaigns.
- Misinformation is a huge challenge. The level of misinformation probably varies by province. Misinformation is more of a challenge than disinformation, especially in Alberta.
- A common misbelief is that wind and solar are new technologies and not regulated and can be built anywhere without rules. Therefore, there is often community resistance to renewable energy projects. Believes this is a misunderstanding rather than a deliberate attempt to block renewable energy.
- Doesn't argue with or react to trolls, but some arguments happen in the comments of their social networks. The organization prefers not to bring any more attention to the arguments.
- Chooses to focus on audiences who believe climate change is too expensive to address, or that it’s too late to change, rather than on whether or not it’s happening. People are coming around to the fact that their personal footprint is actually quite small compared to the impact of large corporations, creating skepticism about the impact of reducing their own footprint.
- Believes it’s not misinformation, but it’s misunderstanding. Initiatives like net zero and carbon pricing can lead to the delusion that we’ve solved the problem, but they really only slow down the rate of climate change. The challenge is to make it such that people

aren't deluded. Wants to drive the case that we need to prepare for extreme weather, and we need to prepare rapidly.

- Misinformation has more to do with one's social group and how they perceive themselves in relation to others. Disagreeing with a social group can have high costs. So even more educated people will identify as a climate denier if that conforms to their social group and will appeal to their education to undermine arguments. The deniers' approach that has been around for 30 years is to stall, then deny that it exists, then deny that it's us causing it. The final stage is to admit that it's real but it's now too late to do anything about it.
- Misinformation is absolutely a problem, and it comes from several sources. One is the non-curated aspect to social media, where people can perpetuate falsehoods, and then ascribe them to elites and other influences, which then appeals to people's emotional systems, their belief systems. And as a result, you get irrational attachment to things that are entirely illogical and irrational in terms of empirical evidence.
- Faces skepticism about climate change and renewable technology from the public. Encountered belief that wind turbines run on gas generators.

Q4: What other challenges do you face in communicating your organization's mission?

- We need to get people to use slow thinking that is the deliberative, rational, and somewhat time intensive, as compared to intuitive routine and other aspects. We need to think differently about high-energy consumption.
- Using deliberative rational thinking takes time and energy, and we are limited to how much information we can absorb at a time.

- It's hard to ask people to give up something for an intangible risk. People deal with information overload, difficulty in curating/selecting information, and focusing for more than a short period.
- People outsource their thinking to a mobile device. Those who are already passive in nature aren't taking an active role in their thinking.
- Example: People are rebuilding homes that were destroyed in hurricanes and fires even though they're not able to get insurance for their property, which should be a clear indicator to not rebuild there, yet they are still engaging in an irrational investment.
- How do you get something that is ongoing and existential to resonate with people? We need sustained action, but people act in short-term contexts.
- There may not be a general audience any more in media, as people pick and gravitate towards their political news sources.
- The most difficult element is getting information on what motivates the recipient: Is it social? Is it belief? Is it emotional? Is it economic? Identification with a peer group? This knowledge is needed to avoid the wrong messaging.
- It's a very diverse media environment, which makes is difficult to get attention. Small NGOs are under-resourced and less able to purchase media.

- People have busy lives. They have a limited amount of time and attention to pay to things that are not on the front burner.

- Very few people are going to read a 50-page research report or even the four-page summary. It's not accessible for a lot of people because they're busy or not necessarily interested in climate. And it's a pretty depressing read.

- It's so much easier to make misinformation easier to read and more interesting than the truth because the truth might be a 50-page scientific document. But a picture of, you know, Greta Thunberg, on a on a yacht gets a lot more shares, because it's an instant message.

- The truth is also contested terrain when it comes to science and perspectives. Climate change is special, because if the science is complex, the policy solutions offered to address it are similarly complex. And as a result, it's fairly easy for politicians to use media and soundbites to create the perception they're helping solve the problem when they're really not.

- Connecting this existential problem, that most people agree really needs to be addressed, with changing the way we do things is a difficult issue. In some ways, it is the biggest communications challenge at the moment. Because it's very easy for those who don't want action to create friction and with enough friction, nothing happens.

- There is a tendency to communicate to those already in agreement with the message, the supporter base, and difficulty reaching out to more challenging audiences and getting people to see the seriousness of the issue.

- Hard to be heard with other issues dominating the media, lack of emotional response to climate change. Need to be able to reach the people who will understand the problem.

- Finding effective ways to speak beyond the sort of the echo chamber. Climate change is quite partisan, need to find ways to reach those not typically engaged through climate change science messaging.

- Making complicated topics accessible is an ongoing challenge.
- Need to invest in the tools to counter misinformation but challenge is when industry groups can outspend non-profits.
- Climate anxiety and apathy, which leads to resistance.

Q5: What do you believe are some of the best practices for countering misinformation and educating the public about the urgency of climate change?

- Take the time to debunk individual climate myths, be willing to engage with what people are hearing. Avoid arguing with those who don't want an actual debate but find people open to a conversation.
- Engaging people and having conversations about what can be done in their community, how to stop contributing to the problem.
- Locally tailored solutions
- Communicate the costs of climate disasters such as wildfires and floods.
- Create a cohesive movement that understands the science and then repeats the science to people.
- Misinformation on social is often self-correcting.
- Using evidence-based information, making it more tangible
- Need to communicate science effectively and efficiently as possible to reach a broad audience. Created "Pause" campaign, encouraging internet users to pause and verify information before sharing. Putting pressure on social media companies to find ways to reduce the spread of misinformation and disinformation. Engage with journalists to reduce misinformation in media.

- Need to find a way of engaging people in conversations without alienating them, e.g., talking about clean jobs may concern people who work in the oil or gas industry.
- Inform audience that demand for oil and gas will diminish over time. Production will be forced to decline. Now is the time to invest in clean energy, retrain the workforce.
- Let people know what they can do that does have impact, showing how it builds up, but then also being real about what else needs to change to meet these larger-scale targets and goals. Talk about the importance of voting and pushing for larger scale changes that will complement individual actions.
- To avoid misunderstanding, talk about the benefits of renewable energy and affordability, doesn't always link it to climate change. This frames it in a way that makes sense to the audience, e.g., price, investment, jobs etc.
- Does a keynote that begins with painting the picture of the former stability of the challenge, that climate change is real, it has happened is happening and will continue to happen to solidify that or explain why we hold that, then turns to the increasing costs associated with climate change both the financial and the social costs. And on the financial, uses catastrophic loss insurable claims data. Then turns to the psychosocial or the mental stress costs associated with a disaster such as residential basement flooding. Uses a combination of science, of irreversibility of climate change, combined with an what the financial costs look like using catastrophic loss, insurable claims are sort of a proxy for overall financial risk, combined with psychosocial data that this stuff is really bad. Then explains positive developments, progress made.
- Communicators may not have room in every piece of content to explain that climate change is real but can continuously make sure information is well-grounded in facts.

Avoid saying things are generally well-understood, as that hides the fact that there's legitimate differences of opinion on certain aspects of the science.

- Need to use the right influencers and test the results. Motives and messages need to be tested on an ongoing basis.
- Issue needs to be framed in a way that gives people a reference point, e.g., is change needed relative to their traditional behaviour, ideal behaviour, what's important.
- Communications campaigns need to consider people's beliefs and how emotional the issue is.
- Those more open to an NGO's message more likely to accept information from a scientist or recognized expert, compared to someone populist, right of centre needs an influencer they can identify with to counter misinformation. One way to counter deeply held beliefs is by one-on-one engagement, having influencers they respect.
- A study (Goldberg et. al, 2021) cited republicans communicating climate risk in more personal terms, lifestyles being affected, opportunities for leisure activities, etc.
- Countering misinformation does not mean the audience is less educated, but we need to consider what they're exposed to and what is driving their opinion. Be as specific as possible: use research that shows this isn't anonymous scientists with an agenda/financial interest. Personify the researchers who've contributed to reports and the research they do, show how the forecasting models work, use transparency. Science should be reproducible so communicators can show their work that anyone could repeat to get the same results.
- People need action on ways they can help themselves avoid disaster through adaptations, solutions.

- People can be distracted by other issues, but global sustainability can overlap with other issues that affect humans. Can be hard to make the link to broader global management, dealing with other people as well as the finite nature of the planet that sustains us, but is interesting on an intellectual level.

- We need to understand motives, continually test strategies, and embrace different types of approaches as a result of that testing. If you don't do that, the message gets to be staid, and you get to be identified in the wrong way.

- With younger people on social media such as TikTok, a strategy needs a novelty or unique aspect to get attention.

- Avoid messaging that is overly dour or apocalyptic. Need to convince people they have agency, instill a sense of social responsibility in peer groups, social proof, i.e., people will act in ways they see their peers acting.

- "Open-ended" penalties mean people can't simply assess the cost of anti-social behaviour, i.e., telling people climate change will cause their insurance to go up means they can accept the cost, but if told they can no longer get insurance, it makes it harder to estimate the risk.

- Using simpler messaging when explaining the cost of climate change, easy to figure out and see the meaning / bottom line behind the numbers increases the ability to resonate with audience. Demonstrate what it means in terms of insurance costs, energy bills etc.

- Explain the loss of leisure activities, e.g., snowmobiling, if average winter temperatures are above freezing.

- Messaging has to be personalized, in a way people can relate to. Health care messaging, such as being hospitalized for breathing problems because of heat risk. Use images to associate with the risk, such as someone in hospital wearing a mask for COPD. Makes it real and emotional and immediate. People don't have patience, don't take time to analyze.

- The most impactful are visual data, charts, graphs, informs without requiring too much of the reader, has most purchase for urgency. Keeping the graphs fairly simple and visual tells the story without jargon, terminology, etc. Looks authoritative and credible. Work with media that is a trusted news source, sometimes doing background work/coaching with a reporter before agreeing to an interview to make sure information is presented in an understandable way.

- To connect that understanding of people with the actions that are required to address it in a way that creates support for those actions when the people have to do them themselves, not forcing somebody else to do something, when they have to do them themselves.

- Having people understand that climate change is an existential problem. And having them be on board with changes to the way we collectively have to organize ourselves is a completely different thing.
- Counters residence in renewables through transparency about their flaws but shows the benefits, confronts lack of understanding.

Appendix C: Content Analysis Tables

Total shares

News websites	Observed
Fabricated	23247
False Context	28259
Misleading	3889
Manipulated	735
Total	**56130**

Video	Observed
Fabricated	21561
False Context	230
Misleading	41559
Manipulated	1335
Total	**64685**

Blog	Observed
Fabricated	694
False Context	836
Misleading	1036
Manipulated	374
Total	**2940**

Facebook shares

News websites	Observed
Fabricated	11329
False Context	8717
Misleading	3115
Manipulated	701
Total	**23862**

Video	Observed
Fabricated	10415
False Context	200
Misleading	35231
Manipulated	1331
Total	**47177**

Blog	Observed
Fabricated	618
False Context	657
Misleading	966
Manipulated	269
Total	**2510**

Twitter shares

News websites	Observed
Fabricated	11916
False Context	19133
Misleading	727
Manipulated	33
Total	**31809**
Video	Observed
Fabricated	11137
False Context	30
Misleading	864
Manipulated	232
Total	**12263**
Blog	Observed
Fabricated	76
False Context	179
Misleading	70
Manipulated	20
Total	**345**

Evergreen score

News	
websites	Observed
Fabricated	17.7505241
False Context	7.75566447
Misleading	11.9562579
Manipulated	3.07314859
Total	**40.5355951**
Video	
Fabricated	10.9037052
False Context	0.09143573
Misleading	12.5278503
Manipulated	0.19049111
Total	**23.7134824**
Blog	
Fabricated	4.04666579
False Context	3.13757048
Misleading	5.79111783
Manipulated	0.10362716
Total	**13.0789813**