Climate Fiction, Real Impact: Causal Evidence for Narrative Climate Content's Longitudinal Effect

Anirudh Tiwathia[*1], Rakhim Rakhimov[1], Stylianos Syropoulos[2,3], and Erik Thulin[1]

[1]Center for Behavior & the Environment, Rare, USA

[2]Department of Psychology and Neuroscience, Boston College, USA

[3]The Schiller Institute for Integrated Science and Society, Boston College, USA

Abstract

Featuring climate content on screen is believed to be a highly efficient strategy for shifting audiences' climate beliefs, attitudes, and behaviors. With this objective, major studios and other media organizations have launched initiatives to increase the prevalence of climate content. Despite various psychological theories proposed for *how* climate content may influence beliefs resulting in climate action, many studies assessing the empirical evidence for this pathway rely on cross-sectional analyses with severely limited causal attribution and nearly all studies only measure the impact at a single point in time, limiting our understanding of the persistence of any estimated impact. In this study, we address these limitations through a longitudinal randomized controlled trial ($N = 1,014$), estimating the impact of watching narrative climate content (a climate focused episode of the television series Madam Secretary) on a set of climate beliefs and attitudes, including belief in climate change, endorsement of government action, social norms around climate action, and other drivers of personal action. These measures were assessed at baseline, as well as three later points (immediately post-viewing, 3-5 days post-viewing, and 7-10 days post-viewing). We find that watching narrative climate content can significantly increase pro-climate beliefs and attitudes. While these positive changes tend to decline across time, they often persist 7-10 days post-viewing. This finding lends credible causal evidence for the claim that on-screen narrative climate fiction has the power to shift relevant climate beliefs and attitudes, even significantly post-viewership, and may be an effective tool supporting large scale social change towards climate action.

Keywords: climate change communication, media impact, narrative persuasion, climate fiction

Introduction

Climate change is one of the most pressing global challenges of our time. The 2023 Intergovernmental Panel on Climate Change (IPCC) has agreed that, unless we change course, we risk vast societal upheaval, the loss of millions of lives, and rampant environmental degradation. Successful mitigation will require unprecedented collective action and dramatic societal changes in a very short timescale (Intergovernmental Panel on Climate Change, 2023a). Yet, there is a worrisome gap between the current level of behavior adoption and the large collective action (Beckage et al., 2022) required to mitigate the worst outcomes (United Nations Environment Programme, 2022). Recent polling reveals that, despite a broad consensus among Americans about the urgency of climate change, the adoption of meaningful action remains limited to a small minority (Leiserowitz, A. et al., 2024). Climate change is also largely absent from the political priorities of the US electorate – raking 19th out of 28 issues (Leiserowitz, A. et al., 2024).

While legislation (Bistline et al., 2023) can and must meaningfully alter structural (Averchenkova et al., 2024), economic (Hallegatte et al., 2023) and logistical barriers (Thøgersen, 2021) to action, there is a growing recognition that successful adaptation and mitigation efforts will require demand-side solutions (Intergovernmental Panel on Climate Change, 2023b). To address this *demand deficit,* structural changes may need to be paired with broad-based cultural change (Pisor et al., 2023) i.e. changes in cultural salience, identity, norms, and values (Bouman et al., 2021; Charness & Chen, 2020; Cialdini & Jacobson, 2021; Hornung, 2022). For instance, large-scale behavior-change interventions are needed to increase individual demand for low-carbon lifestyles (van Valkengoed et al., 2022) as well as collective demand for greater institutional and political action (Campbell et al., 2023; Jenny & Betsch, 2022).

There is a wide-spread intuition that Hollywood, as one of the most influential entertainment industries in the world, has enormous potential to catalyze and accelerate such large-scale cultural change. In response, a rapidly growing - albeit nascent - ecosystem of organizations have begun to focus on the use of mass media, especially entertainment, as a pathway to drive climate action (Amanda Shendruk, 2023; Gammon, 2023). This includes UN agencies (United Nations Framework Convention on Climate Change, 2023a, 2023b, 2023c), a growing network of NGOs (Townsend, 2023), major industry guilds (Producers Guild of America, 2023a; Screen Actors Guild - American Federation of Television and Radio Artists, 2023; Writers Guild of America - West, 2023), talent agencies (Aziz, 2024; Creative Artists Agency, 2023), and industry academies (British Academy of Film and Television Arts, 2023; Television Academy, 2023). In recent years, there has also been dramatic progress in terms of industry buy-in. In the UK, all 12 of the largest media organizations have pledged to include more climate content in their programming (We Are Albert, 2021). In the US, many major studies have rolled out individual initiatives for on-screen content (Brown, 2023; Guzik, 2023; NBC Universal, 2023a, 2023b; Paramount, 2023; PBS Publicity, 2023; Pener, 2023; Stewart, 2022;

Weprin, 2023). In addition, 12 of the studios have launched an industry alliance (Sustainability Entertainment Alliance, 2024) to increase the visibility of climate change and climate solutions on screen (Climate On Screen, 2024; Read, 2024; Stewart, 2024) – marked by a PSA narrated by Meryl Streep (Gardner, 2024) to encourage adoption of climate integration by the broader industry. This is a drastic change. Between 2016-2020, climate change was conspicuously absent from programming, appearing only in 0.6% of scripted TV and film (Giaccardi et al., 2022). But, those trends have been changing (Schneider-Mayerson et al., 2024). Recent years have featured blockbuster movies (Adam McKay, 2021), independent films (Benedikt Erlingsson, 2018; Daniel Goldhaber, 2022) and TV shows (Scott Z. Burns et al., 2023) with explicit climate themes that drew top-tier star talent (David Canfield, 2022; Lattanzio, 2023). These efforts have also captured the imagination of the mainstream press with positive coverage across most major US and UK publications (Amanda Shendruk, 2023; Herzog, 2019; Michelle Ma & Caelyn Pender, 2023; Riley-Adams, 2023; Rowley, 2024a, 2024b; Ryzik, 2017; Sammy Roth, 2024; Shoard, 2023; Solnit, 2023; Townsend, 2022a, 2022b; Warner, 2022; Weinstein et al., 2024). And, critically, there is widespread audience support for such industry efforts - with approximately 70% of US audiences (Tiwathia et al., 2024) and 80% of UK audiences (Londakova et al., 2021) reporting that they are in favor of the entertainment industry including more climate-positive action on screen specifically to encourage climate action among viewers.

Given these trends, film and TV may now be a viable and as-yet untapped opportunity to actively engage audiences on climate change. In theory, if deployed effectively and at scale, it could be a means of shifting a broad constellation of key psychosocial antecedents to behavior change (Akerlof et al., 2013; Block & Keller, 1997; Bostrom, 2017; Bouman et al., 2021; Campbell et al., 2023; Cialdini & Jacobson, 2021; Gregersen et al., 2021; Herrnstadt & Muehlegger, 2014; Hurst Loo & Walker, 2023; Lee et al., 2015; Rinscheid et al., 2021; Spence et al., 2011; van Valkengoed et al., 2022). Previous work has suggested that media interventions have successfully boosted issue awareness (Baym & Holbert, 2019; Durkin et al., 2022), issue salience (Brewer & McKnight, 2015; Madsen & Niessner, 2019), threat perception (Leiserowitz, 2004), personal-relevance (Hoffner & Cohen, 2023), normative beliefs, social norms (Arias, 2019), self-efficacy (Nabi & Thomas, 2013), and outcome-efficacy (Agha, 2003) across a variety of domains. And, under the right circumstances - with either sustained, pervasive, or highly salient exposures (Kearney & Levine, 2015) - media consumption can shift consumer preference (Junzhao Ma et al., 2020; Weir & Kessler, 2022), encourage trial of novel environmental action (Jacobsen, 2011) or may even alter culturally-engrained behaviors (Jensen & Oster, 2009).

Entertainment has been theorized to be particularly effective at persuasion due to its ability to develop strong bonds between audiences and characters – for long-running series, the character bonds sometimes spanning decades (Marsh, 2023). These audience interactions with well-known and beloved characters may mirror and behave similarly to real-world social relationships in many ways (Horton & Wohl,

1956). The sense of intimacy and emotional connection that "parasocial relationships" with the fictional characters engender can also resulting in the development of deep trust between viewer and audience (Demetriades et al., 2023; Liebers & Schramm, 2019). Previous research from political and advertising campaigns suggests that exposure to messages from trusted sources can be uniquely persuasive, with evidence suggesting that such messages can have lasting effects even for populations that tend to be more skeptical about climate change (Goldberg et al., 2021). Further, personal narratives are recognized as particularly potent persuasive tools for changing people's opinions on climate change (Gustafson et al., 2020). For audiences where parasocial bonds and character identification are notably strong, entertainment is expected to have increased persuasive impact (Tukachinsky et al., 2020) – and, in some cases, evidence suggests that it may even influence behavioral outcomes (Demetriades et al., 2023; Hoffner & Cohen, 2023).

Adding to this work is research that finds that videos can be effective methods for communicating scientific agreement (i.e., consensus) on climate change (Goldberg et al., 2019, 2022) – including through comedy news shows (Anderson & Becker, 2018; Brewer & McKnight, 2015). This has been shown to also strengthen belief in anthropogenic climate change (Chinn et al., 2018). Other research has found that information about changing norms in society can facilitate behavioral change (Sparkman & Walton, 2019). And, seeing evidence of an emerging social consensus can reduce ideological biases on climate change (Goldberg et al., 2020). Not only is entertainment able to deliver messages from familiar, trusted characters – it is particularly well suited to casually embedding the depiction of new norms into unrelated programming and increasing the perception of social consensus around emerging ones. Such initiatives have been successfully implemented in the past, most famously, the coordinated inclusion of "designated driving" into nearly 160 prime-time shows across all major networks (Harvard - Center for Health Communication, 2017; Koh & Yatsko, 2017)

In addition, highly entertaining narrative fiction - due to its ability to transport viewers - may also be particularly well-suited to messaging on topics where counter-attitudinal reactance is high. Highly entertaining narratives cause audiences to lose track of the real world – leaving them engrossed with the events unfolding in the storyline (Gerrig, 1993; M. C. Green & Brock, 2000). Evidence suggests that narrative transportation may reduce the detection of counter-attitudinal messages, suppress reactance, and reduce motivation for counterarguing (Slater & Rouner, 2002) - and, in the process can facilitate the adoption of story-consistent beliefs (Kennedy et al., 2011; Murphy et al., 2011), even for controversial issues (Slater et al., 2006). However, as with parasocial relationships, the evidence supporting the link between transportation, absorption, and persuasion is mixed (Hinyard & Kreuter, 2007; Nabi & Moyer-Gusé, 2012). And, under certain circumstances, high levels of transportation appear to facilitate counterarguing (Hart & Nisbet, 2012; Moyer-Gusé & Nabi, 2010).

In the face of conflicting data, more recent models propose that a variety of psychological mechanisms (e.g., identification, parasocial interaction, perceived persuasive intent) may work in concert to diminish different sources of persuasive resistance (Moyer-Gusé, 2008). This suggests that the persuasive success may be highly contingent on the entertainment value, the narrative capture, the level of character bonding, and the degree to which the persuasive intent is obtrusive. For this reason, entertainment-forward narrative fiction (i.e. narrative fiction that first and foremost seeks to satisfy the entertainment compact with the audience) will not just have larger reach, it may also have unique persuasive advantages when compared with other forms of education-oriented media (e.g. documentaries, entertainment-education, news). This may be especially true for highly polarized topics like climate change - where climate skeptic audiences are also more likely to consume climate misinformation (Feldman et al., 2012). In an era where even mainstream news coverage of climate change has become more polarized (Chinn et al., 2020), scripted entertainment could prove to be an exceptionally useful alternative for changing beliefs and preferences across a broad audience (Gammon, 2023), especially in the realm of climate policy.

Yet, the sobering reality is that there is currently very limited empirical data to support the idea that entertainment can causally and meaningfully impact climate attitudes beyond the time of viewing. While some previous work has examined the influence of media consumption on climate attitudes, beliefs and behaviors, approaches in this domain are often qualitative and tend to focus on documentaries rather than scripted entertainment (Bieniek-Tobasco et al., 2019). In other cases where quantitative investigations were conducted, the focus was limited to immediate effects (Brewer & McKnight, 2015). Although informative, these investigations cannot speak to the long-run influence that such exposure may have. Other studies compared people who *chose* to see a movie that focused on climate change and environmental destruction ("The Day After Tomorrow") with those who chose not to see it. In this case, self-selection remains a major concern – and, causal conclusions cannot be drawn (Leiserowitz, 2004). In general, despite some encouraging findings and compelling psychological models, much of the evidence for the impact of media on behavior is often hindered by methodological concerns (e.g. Jaeger et al., 2018; Kahn-Lang & Lang, 2018; Kearney & Levine, 2018). There are also significant limits in the ability to extrapolate lessons across contexts and behavior domains (Chatterjee et al., 2017; D. Green, 2021) As such, we do not have good empirical evidence that consuming climate-relevant entertainment causally increases pro-climate attitudes, beliefs and intentions. Nor do we know how short-lived the effects would be. And, finally, we do not know which (if any) climate-relevant attitudes, beliefs or behaviors can be stably influenced in the mid-to-long run. Given the tendency for people's attitudes to regress back to the mean and that most behavioral interventions on climate outcomes tend to have small effects at the time of the intervention itself (Nisa et al., 2019; Van Der Linden & Goldberg, 2020), we should reasonably expect that such effects would be quite temporary.

In the current study, we addressed this gap in causal attribution and effect persistence through a first of its kind longitudinal randomized controlled study on the impact of narrative climate fiction on key climate beliefs. We randomly assigned participants to view a climate action focused episode of the television series "Madam Secretary" or a non-climate focused episode of the same series and measured 21 climate beliefs and attitudes (including beliefs about climate change, climate action social norms, propensity to take climate action, and support for government action) before viewing, immediately post, 3-5 days post, and 7-10 days post. This study design allowed us to estimate both the immediate impact of viewing fictional climate content across a wide range of variables and the durability of these effects. This research provides a critical empirical test of the theory of change implicit to the movement among studios and other media creators of the possible role for these mediums in shifting key climate states through narrative fiction.

Methods

Procedure

In June 2023, we invited 1,014 US adults to a 4-part longitudinal study on the Prolific.com platform. We surveyed study participants at four points in time: before watching the show; immediately after viewing; 3-5 days post-viewing; and 7-10 days post-viewing.

First, study participants completed a series of questions measuring climate change-related beliefs and attitudes, listed in Table 1. 3-5 days later, in the second survey, participants were randomly assigned to either the control or the treatment condition. Regardless of the assigned condition, participants watched an episode of "Madam Secretary" in English. In the control condition, participants viewed Season 5 - Episode 15 titled "Between the Seats" which focused on the resolution of a tense situation in the Middle East. In the treatment condition, participants viewed Season 5 - Episode 16 titled "The New Normal" ("the climate episode"). In this episode a destructive hurricane fully submerged the island nation of Nauru underwater, leading to the displacement of its people. The episode actively discusses climate change, immigration due to climate change, the role of the government in preventing climate change, as well as the political climate around the topic.

Immediately after watching the episode (lasting approximately 40 minutes), study participants responded to the same survey questions as before. Participants were then surveyed 3-5 days later, and 7-10 days later on the same outcome measures. In addition to climate outcome measures, we collected demographic data, including age, gender, household income, etc.

Participants

A total of 1,014 people participated in the study. From this sample, 745 participants provided complete responses to the second wave, immediately after watching the show (27% attrition). 685 participants completed the third wavc, and 721 participants completed the last wave, 7-10 days after watching the show.

Analytical Strategy

To address missing data due to participant attrition, we employed the Multiple Imputation by Chained Equations (MICE) method using the "mice" package in R (Buuren & Groothuis-Oudshoorn, 2011). MICE was chosen for its flexibility in handling different variable types, its ability to account for complex missing data patterns, and its ability to present confidence estimates that account for the uncertainty introduced through imputation. We created 30 imputed datasets (m = 30), aligning with recommendations to use at least as many imputations as the percentage of missing data (with our dataset having an overall missing data percentage of 27%). We applied a Predictive Mean Matching (PMM) model due to it imputing values that resemble those found in the original data, producing more realistic distributions. This was run for 30 iterations, ensuring that imputed values remained within the plausible range of observed data.

In addition to analyzing each of the variables individually, following imputation we constructed a composite variable aggregating across all 21 outcomes to assess the overall impact of the narrative climate content on climate beliefs and attitudes. This was done by standardizing each outcome to a mean of 0 and a standard deviation of 1 and then taking the mean for each participant across all outcomes. We then conducted linear regression analyses for each climate outcome (as well as on the composite measure) on each of the 30 imputed datasets. We estimated standardized linear regression models for all outcomes to facilitate easier interpretation and comparison of the effect sizes. Results were pooled across the imputed datasets using Rubin's rules (Rubin, 2004), as implemented in the "pool" function of the "mice" package. This approach combines within- and between-imputation variability to produce valid standard errors and confidence intervals. The estimates from pooled regression results are presented in Table 2.

Measures

All climate outcome variables used in the study are described below (Table 1). For the majority of the outcomes, to increase our confidence in participants' naiveté, we included the same measure for two additional topics, irrelevant to our investigation: international conflicts and large-scale immigration.

Table 1: A summary of survey questions with response options measuring climate outcomes

| Measure	Range	Scale	Lowest value label	Highest value label
How certain are you that climate change poses a significant threat to society?	0-10	Slider	Not at all certain	Completely certain
How worried are you about climate change?	0-10	Slider	Not at all worried	Extremely worried
Imagine 10 Americans. If you had to guess, how many of them currently take action to address climate change?	0-10	Slider	0	10
Imagine 10 Americans. If you had to guess, how many of them think that other people should take action to address climate change because it is the right thing to do?	0-10	Slider	0	10
Do you think that people should take action to address climate change because it is the right thing to do?	Yes/No	Binary	No	Yes
How confident are you in your ability to personally make a difference to address climate change?	0-100	Slider	Not at all confident	Extremely confident
How confident are you that people - working together - can make a difference on climate change?	0-100	Slider	Not at all confident	Extremely confident
How likely it is that you will take action to address climate change in the next 6 months?	0-100	Slider	Not at all likely	Extremely likely
How much of an effort (e.g. time, money, etc.) would you be willing to make to address climate change?	0-100	Slider	Not a lot	A lot
Do you support or oppose robust government action to address climate change?	-100 to 100	Slider	Strongly oppose	Strongly support
Imagine a political party or candidate that agrees with you on the vast majority of other topics. However, they oppose robust action to address climate change. Could you ever vote for them?	Yes/No	Binary	No, I could not vote for them	Yes, I could still vote for them
Would you like to receive more information via email on how you can take action against climate change?	Yes/No	Binary	No	Yes
In general, how much do you trust government officials to act in the best interests of the public?	0-100	Slider	Not at all	A great deal
How likely is it that governments across the world follow through with their commitment to combat climate change?	-100 to 100	Slider	Extremely unlikely	Extremely likely
Do you believe that smaller, poorer, and developing nations are disproportionately vulnerable to the effects of climate change compared to richer, larger nations?	-100 to 100	Slider	Strongly disagree	Strongly agree
In your opinion, what percentage of religious, conservative Americans are interested in working to address climate change?	0-100	Slider	0%	100%
The United States is one of the world's leading emitters of greenhouse gases. Do you support or oppose the United States Government, financially compensating vulnerable countries for the damage caused by our greenhouse gas emissions?	-100 to 100	Slider	Strongly oppose	Strongly support
The United States is one of the world's leading emitters of greenhouse gases. Do you support or oppose the United States Government, accepting migrants when climate change makes their country uninhabitable?	-100 to 100	Slider	Strongly oppose	Strongly support
The United States is one of the world's leading emitters of greenhouse gases. Do you support or oppose the United States Government, providing swift aid in emergencies (e.g., hurricanes, tsunami waves, etc.) to poorer countries?	-100 to 100	Slider	Strongly oppose	Strongly support
The United States is one of the world's leading emitters of greenhouse gases. Do you support or oppose the United States Government, creating a resilience fund to help protect those in danger from ecological disaster?	-100 to 100	Slider	Strongly oppose	Strongly support

Results

We first assessed the impact of watching the climate episode on the composite measure of climate outcomes by building a series of linear regression models for each post-treatment measurement period. Each linear regression model was adjusted for the pre-exposure composite measure to increase estimate precision.

Figure 1 presents the standardized treatment effects on the composite climate measure across the three post-treatment time points. Immediately after watching the climate episode, participants showed a statistically significant increase in the composite measure ($\beta = 0.072$, 95% CI [0.037, 0.107], $p < 0.001$), compared to the control group. While attenuated, the effect of viewership remained positive and statistically significant at both 3-5 days ($\beta = 0.044$, 95% CI [0.011, 0.077], $p = 0.01$) and 7-10 days after exposure ($\beta = 0.047$, 95% CI [0.012, 0.082], $p = 0.009$).

Figure 1: The effects of watching the climate episode on the composite measure of climate outcomes
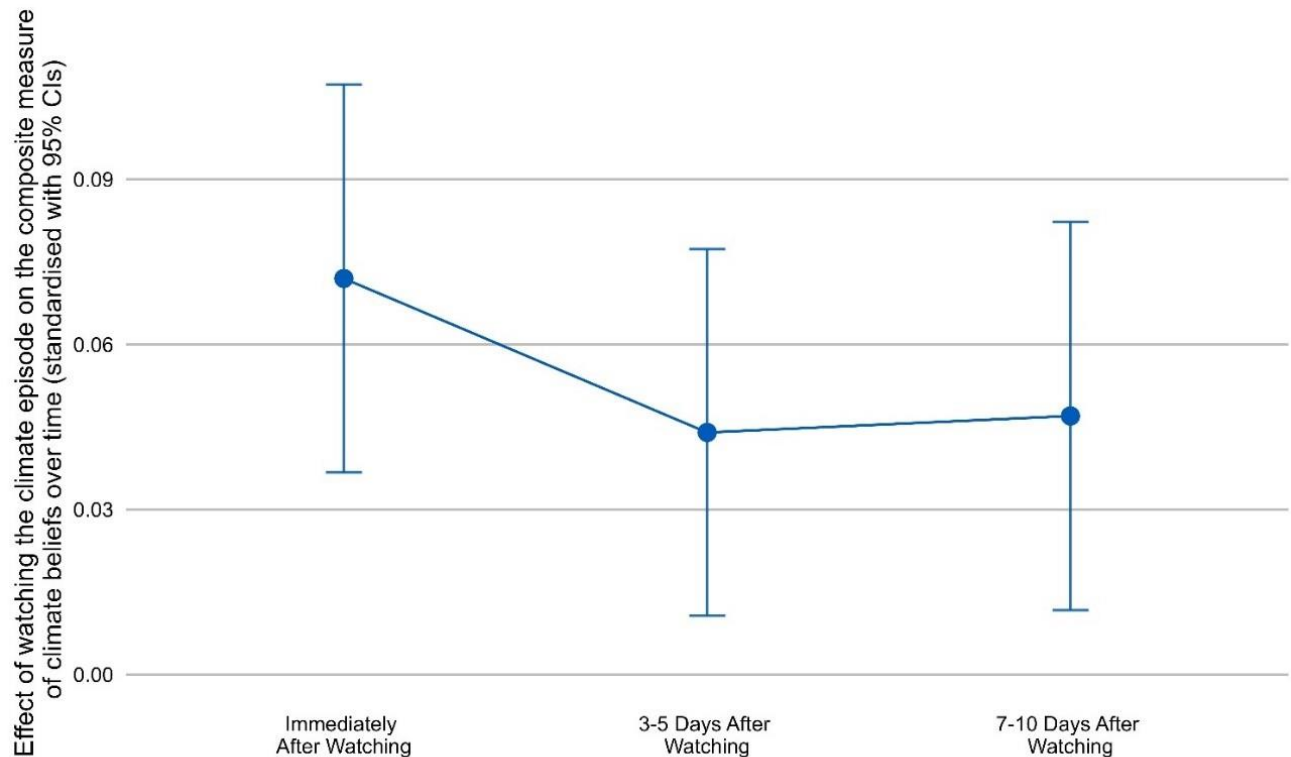
In addition to estimating the treatment effects on the aggregated measure of climate beliefs, we estimated the effects of watching the climate episode on each individual climate outcome, which we grouped into four broad categories: *climate perceptions* (e.g., "How certain are you that climate change poses a significant threat to society?"), *climate norms* (e.g., "Imagine 10 Americans. If you had to guess, how many of them currently take action to address climate change?"), *climate action* (e.g., "How likely it is that you will take action

to address climate change in the next 6 months?", and *governmental outcomes* (e.g., "Do you support or oppose robust government action to address climate change?").

Similar to the above, we built a series of linear regression models on each imputed data set predicting the impact of watching the climate episode on the individual climate outcomes, adjusted for pre-exposure measures. Watching the climate episode had positive effects across a range of key measures. Figures 2A – 2D present the pooled estimates from regression models for each group of climate outcomes. Table 2 presents the treatment effects and confidence intervals across climate measures.

Climate Perceptions

Watching the climate episode resulted in a statistically significant increase in worry about climate change and belief in its threat. While the treatment effects reduced over time, they remained statistically significant and positive. There was a small boost in the belief in disproportionate impacts of climate change immediately after viewing, but these effects became non-significant at 3-5 days post-viewing.

Figure 2A: The effects of watching the climate episode on the climate change perception outcomes over time
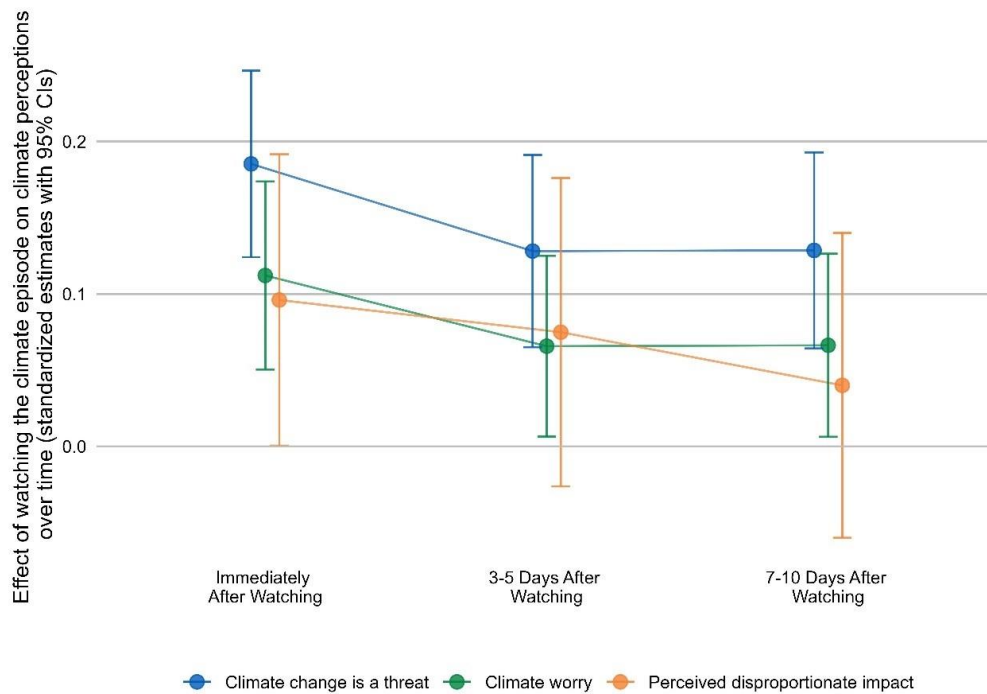

Climate Norms

Our results indicate no statistically significant changes in social norms surrounding climate change. In addition, watching the climate episode did not significantly impact the perception of climate support among conservative Americans. The climate episode focused on government action and did not address the role of individuals, potentially explaining the lack of change in climate norms.

Figure 2B: The effects of watching the climate episode on the climate change norms outcomes over time
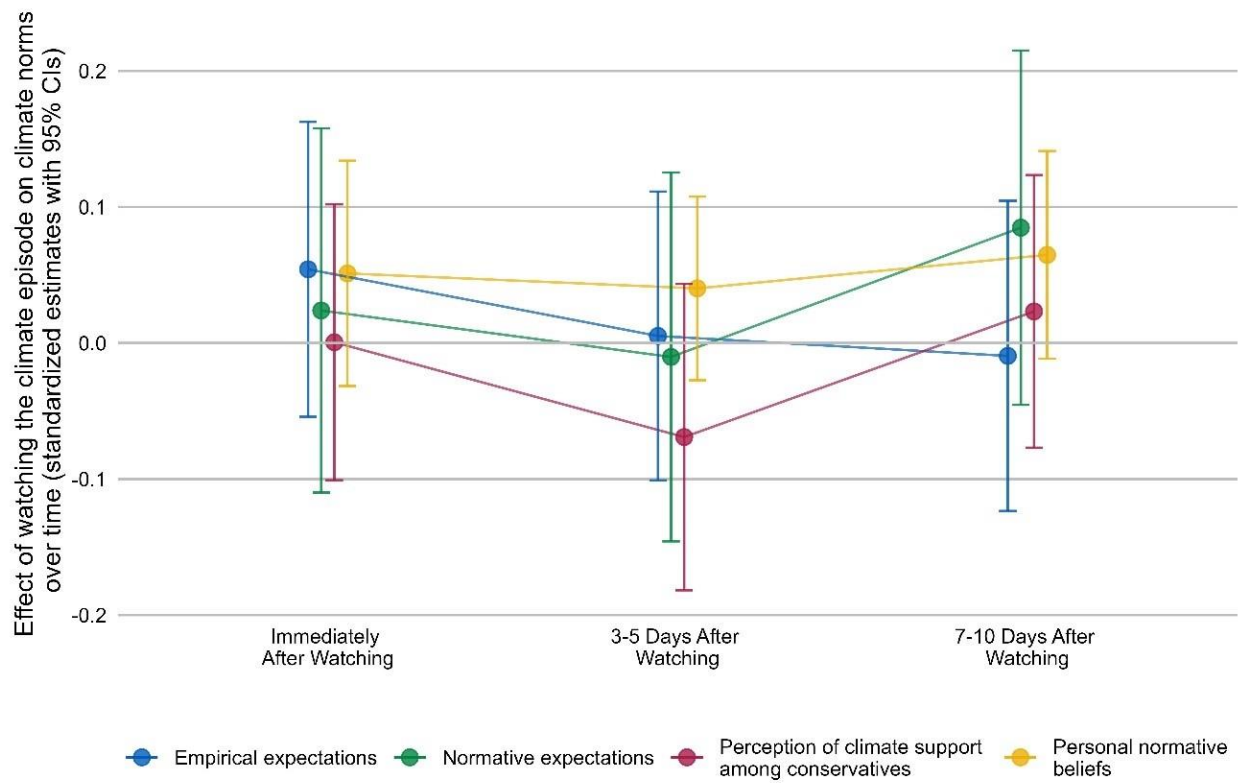
Climate Action

Watching the climate episode had a positive and statistically significant effect on the reported likelihood of taking climate action, immediately and 3-5 days post-viewing. However, this effect became nonsignificant at 7-10 days after exposure. In addition, immediately after watching the climate episode, participants were more likely to identify as climate single-issue voters, meaning they would only vote for a candidate if they were willing to take action on climate change. This effect remained positive and statistically significant at both 3-5 days and 7-10 days after exposure. We observed no significant effects on other climate action measures.

Figure 2C: The effects of watching the climate episode on the climate change action outcomes over time
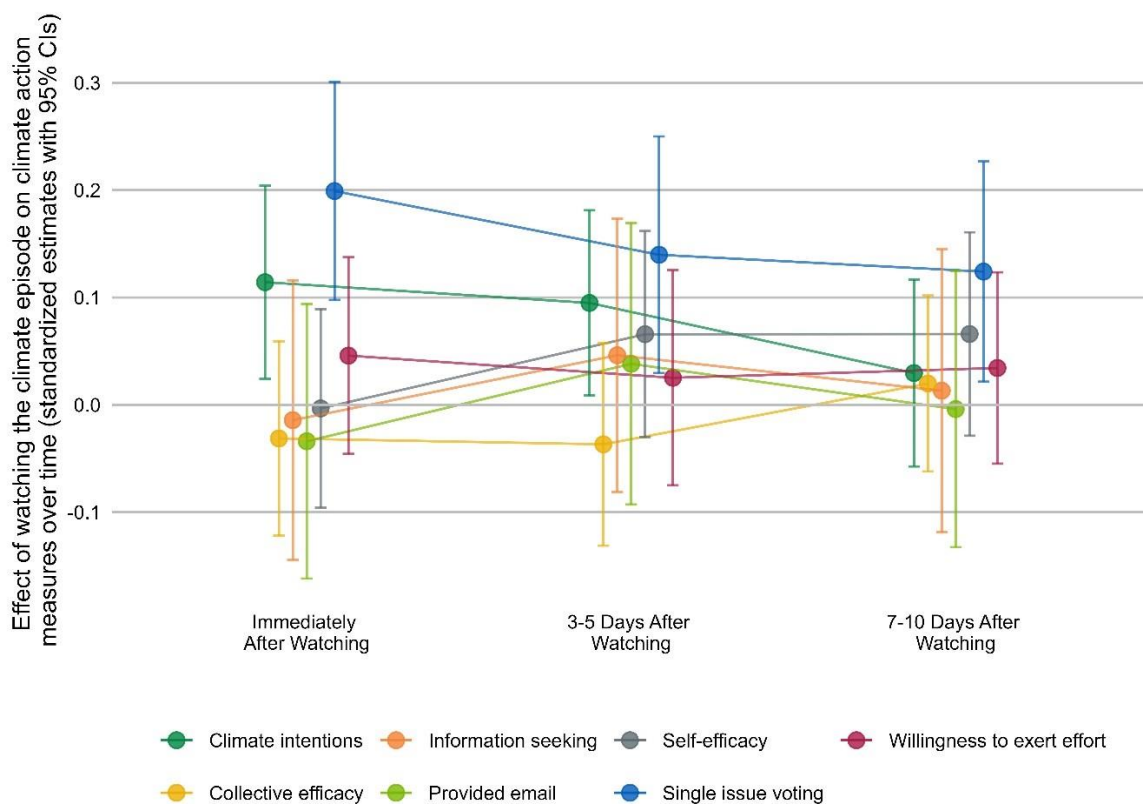
Governmental Outcomes

The climate episode statistically significantly increased both the support for the United States government providing resilience aid to protect from ecological disasters and providing emergency aid to victims of climate disasters in poorer nations. These effects persisted over time.

While we saw immediate increases in support for government climate action and support for the US to accept climate migrants these effects became smaller and nonsignificant at later time points. While the climate episode showed successful government action and trustworthy government officials, watching the climate episode did not increase general trust in the government or impact perceptions about government officials.

Figure 2D: The effects of watching the climate episode on the governmental outcomes over time
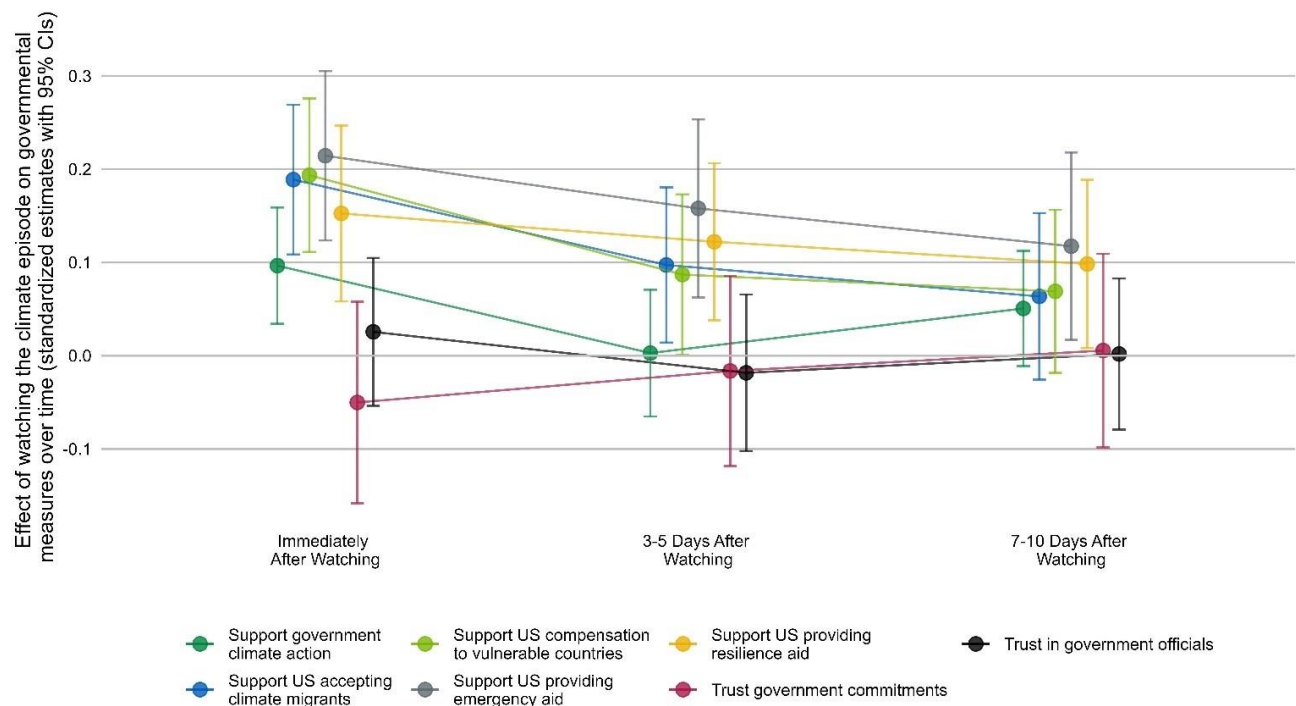
Table 2: The effects of watching the climate episode on climate measures over time

	Immediately after watching				3-5 days after watching				7-10 days after watching			
	Estimate	*Lower CI*	*Upper CI*	*p-value*	*Estimate*	*Lower CI*	*Upper CI*	*p-value*	*Estimate*	*Lower CI*	*Upper CI*	*p-value*
Composite measure	0.072	0.037	0.107	*0.001*	0.044	0.011	0.077	*0.01*	0.047	0.012	0.082	*0.009*
Climate change threat	0.185	0.124	0.246	*<0.001*	0.128	0.065	0.191	*<0.001*	0.129	0.064	0.193	*<0.001*
Climate worry	0.112	0.050	0.174	*<0.001*	0.066	0.006	0.125	*0.030*	0.066	0.006	0.126	*0.030*
Disproportionate impact	0.096	0.001	0.192	*0.049*	0.075	-0.026	0.176	*0.146*	0.040	-0.060	0.140	*0.431*
Empirical expectations	0.054	-0.054	0.163	*0.326*	0.005	-0.101	0.111	*0.923*	-0.009	-0.124	0.105	*0.870*
Normative expectations	0.024	-0.110	0.158	*0.725*	-0.010	-0.146	0.125	*0.882*	0.085	-0.045	0.215	*0.201*
Personal normative beliefs	0.051	-0.032	0.134	*0.225*	0.040	-0.027	0.108	*0.243*	0.065	-0.011	0.141	*0.096*
Perception of action among conservatives	0.001	-0.101	0.102	*0.992*	-0.069	-0.182	0.043	*0.227*	0.023	-0.077	0.123	*0.649*
Climate intentions	0.114	0.024	0.204	*0.013*	0.095	0.009	0.181	*0.031*	0.030	-0.057	0.117	*0.503*
Willingness to exert effort	0.046	-0.046	0.137	*0.326*	0.025	-0.075	0.125	*0.621*	0.034	-0.055	0.123	*0.450*
Single issue voting	0.199	0.098	0.301	*<0.001*	0.140	0.030	0.250	*0.013*	0.124	0.022	0.227	*0.018*
Information seeking	-0.014	-0.145	0.116	*0.829*	0.046	-0.081	0.173	*0.476*	0.013	-0.119	0.145	*0.844*
Provided an email	-0.034	-0.162	0.094	*0.601*	0.038	-0.093	0.169	*0.567*	-0.004	-0.133	0.125	*0.951*
Self-efficacy	-0.003	-0.096	0.089	*0.943*	0.066	-0.030	0.162	*0.179*	0.066	-0.029	0.161	*0.172*
Collective efficacy	-0.031	-0.122	0.059	*0.497*	-0.037	-0.131	0.058	*0.443*	0.020	-0.062	0.102	*0.635*
Support govt. action	0.097	0.034	0.159	*0.002*	0.003	-0.065	0.071	*0.936*	0.051	-0.011	0.112	*0.108*
Trust in govt. commitments	-0.050	-0.158	0.058	*0.361*	-0.016	-0.118	0.085	*0.751*	0.005	-0.098	0.109	*0.918*
Govt. accepts migrants	0.189	0.108	0.269	*<0.001*	0.097	0.014	0.180	*0.022*	0.064	-0.026	0.153	*0.162*
Government provides emergency aid	0.214	0.124	0.305	*<0.001*	0.158	0.062	0.253	*0.001*	0.117	0.017	0.218	*0.022*
Government compensation	0.194	0.111	0.276	*<0.001*	0.087	0.001	0.173	*0.048*	0.069	-0.018	0.156	*0.122*
Government provides resilience aid	0.153	0.058	0.247	*0.002*	0.122	0.038	0.206	*0.005*	0.098	0.008	0.189	*0.033*
Trust in government officials	0.025	-0.054	0.105	*0.527*	-0.018	-0.102	0.065	*0.665*	0.002	-0.079	0.083	*0.966*

Note: Treatment effects are represented by standardized pooled linear regression coefficients from multiple (m = 30) imputed datasets using mice and the Predictive Mean Matching. The estimates are adjusted for the relevant climate measure (composite or individual) estimated before watching the episode; bolded variables show a significant effect at one or more time points.

Discussion

A groundswell of professional on screen storytelling organizations, from studios to guilds to industry academies, have begun to focus on including climate content on screen, with the implicit theory of change that this can shift the relevant psychological and social states necessary for driving climate action (NBC Universal, 2023a; Paramount, 2023; PBS Publicity, 2023; Producers Guild of America, 2023b; Stewart, 2022; We Are Albert, 2021). With streaming platforms currently estimated to reach over a billion subscribers (Statista, 2023), the potential reach for transformative impact is hard to overstate. Various psychologically plausible theories have been proposed for how this change may occur. However, past empirical tests of the effectiveness of media for shifting these critical states often rely on cross-sectional data limiting causal inference and focusing only in the immediate rather than longitudinal impacts. Answering what impact this shift towards climate content can and is having is critical for not only the field testing of psychological theory but for informing the choices of practitioners in the field.

The general finding that climate narrative fiction can indeed shift climate beliefs and attitudes, and that although those effects attenuate over time, they do often persist, lends credibility to the case for climate narrative story telling as a tool for shifting culture around climate change. Investigating the specific patterns, we see among individual measures helps us further understand how that impact may occur. Our observation that the content moved perceptions of the threat of climate change as well as concern around it not only immediately but up to 10 days later may be due to the ability for engaging content to narratively transport an individual into a highly visceral experience of the risks of climate change (Gerrig, 1993; M. C. Green & Brock, 2000).

Drawing on Social Norms Theory (Bicchieri, 2016), we measured empirical expectations (belief others are taking climate action), normative expectations (belief that others think you *should* take action), and personal normative beliefs (belief that people should take action), as well as specifically empirical expectations concerning conservatives. Here we see consistent null effects, finding no shift in the constituent elements of social norms. The content of the episode paired with parasocial theories of media influence (Demetriades et al., 2023; Horton & Wohl, 1956; Liebers & Schramm, 2019) may explain this lack of effect. While the episode focuses on climate change, the characters themselves are highly influential members of government, rather than normal individuals. This likely results in any parasocial relationship with the character not mapping onto the relevant reference network for the viewers' own behavior, resulting in no effect on their own social norm perceptions. This analysis supports careful consideration in narrative and character crafting when designing climate narrative fiction to match the qualities needed for influencing specific psychological state.

We only find minimal evidence for shifts in the beliefs and attitudes most commonly found to drive individual action, such as self-efficacy, collective efficacy, and information-seeking behavior. While we do see

a general increase in intention to take climate action, this has dissipated by days 7-10. This can likely be explained by the content of the programming focusing on political action around climate change, rather than that of the individual, further supporting the conclusion that we cannot expect all climate content to drive all factors, but rather need carefully tailored climate content to influence specific elements. Consistent with this analysis, the only behavioral measure that did move, and was one of the largest effects observed in the data, was stating that one is a single-issue voter on climate, unwilling to vote for any politician who fails to take robust action on climate change. That this is the only behavioral measure to respond suggests the political framing of the episode shown through, with the viewer analyzing their own behavior through that lens.

Measures focused on political perceptions and attitudes around climate change shifted the most through viewership, consistent with the previously discussed themes of the episode. These include the US providing emergency and resilience climate aid, compensating vulnerable countries, and accepting climate migrants. More general measures around political efficacy, such as trust in government officials and commitments, failed to move. Given the high degree of polarization around issues like foreign aid, migration, and climate change, the degree to which these were shifted in a persistent way by a single piece of content is rather notable. This may support research findings that compelling narrative transportation can serve to depolarize sensitive topics (Kennedy et al., 2011; Murphy et al., 2011; Slater & Rouner, 2002).

While this study rigorously evaluated the impact of a given piece of narrative climate fiction, it is important to recognize the limitation that the effects, both significant and nonsignificant, may not replicate to other pieces of content. Instead, this work serves as both an empirical as well as methodological demonstrative case. These results show the *general* capability of narrative climate fiction to shift climate beliefs and attitudes, while also showcasing how a given piece is unlikely to shift *all* key climate beliefs and attitudes, pointing to the need to precisely tailor content to the target states and audiences. This research also demonstrates the methodological possibility of moving beyond the common practice of cross-sectional evaluation for improved causal attribution and longitudinal data collection for determining if the persistence of shifts that would be necessary for meaningful change is in fact present in the media being evaluated. We hope this demonstration supports others in conducting similar investigations into other climate content, giving a far finer grained understanding of what content shifts what beliefs for what durations.

Going forward, rigorous empirical research has a critical role to play in support this nascent movement. Targeted research – especially research focused on high-quality, highly-entertainment content – is required to help provide robust evidence that pure entertainment programming can service as a viable pathway for positively influencing audience beliefs around climate change. And, given both the *persuasive importance* and the *practical importance* of entertainment-forward content, parallel research streams are required to identify how different types of story-driven and character-driven narrative fiction is best suited to address

different components of the "demand deficit." for climate solutions. Dedicated attention to practitioner-oriented research that not only helps build robust theoretical frameworks, but also provides practical guidance on how behaviorally-sophisticated depictions can be used to amplify the impact of fleeting, low-touch, unobtrusive, on-screen climate placement – the kind that can be embedded across most genres and can thus achieve high-saturation throughout the media ecosystem (for examples, see the Clips Example Library, Rare, 2024).

References

Adam McKay (Director). (2021). *Don't Look Up* [Video recording].

Agha, S. (2003). The impact of a mass media campaign on personal risk perception, perceived self-efficacy and

on other behavioural predictors. *AIDS Care*, *15*(6), 749–762.

https://doi.org/10.1080/09540120310001618603

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally

experience" global warming, and if so how, and does it matter? *Global Environmental Change*, *23*(1),

81–91. https://doi.org/10.1016/j.gloenvcha.2012.07.006

Amanda Shendruk. (2023, May). Audiences want a different climate change message. Hollywood should deliver.

Washington Post. https://www.washingtonpost.com/opinions/interactive/2023/climate-change-disaster-

movies-narrative/

Anderson, A. A., & Becker, A. B. (2018). Not Just Funny After All: Sarcasm as a Catalyst for Public Engagement

With Climate Change. *Science Communication*, *40*(4), 524–540.

https://doi.org/10.1177/1075547018786560

Arias, E. (2019). How Does Media Influence Social Norms? Experimental Evidence on the Role of Common

Knowledge. *Political Science Research and Methods*, *7*(3), 561–578. https://doi.org/10.1017/psrm.2018.1

Averchenkova, A., Higham, C., Chan, T., & Keuschnigg, I. (2024). *Impacts of Climate Framework Laws:*

Lessons from Germany, Ireland and New Zealand. Grantham Research Institute on Climate Change and

the Environment, London School of Economics and Political Science.

Aziz, A. (2024, April 30). How The CAA Foundation Is Making Change At The Speed (And Scale) Of Pop

Culture. *Forbes*. https://www.forbes.com/sites/afdhelaziz/2024/04/30/how-the-caa-foundation-is-making-

change-at-the-speed-and-scale-of-pop-culture/

Baym, G., & Holbert, R. L. (2019). Beyond Infotainment: Political-Entertainment Media and Electoral

Persuasion. In E. Suhay, B. Grofman, & A. H. Trechsel (Eds.), *The Oxford Handbook of Electoral*

Persuasion. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190860806.013.18

Beckage, B., Moore, F. C., & Lacasse, K. (2022). Incorporating human behaviour into Earth system modelling. *Nature Human Behaviour*, *6*(11), 1493–1502. https://doi.org/10.1038/s41562-022-01478-5

Benedikt Erlingsson (Director). (2018). *Woman at War* [Comdey; Feature Length Film]. Vintage Pictures. https://www.imdb.com/title/tt7279188/

Bicchieri, C. (2016). *Norms in the Wild: How to Diagnose, Measure, and Change Social Norms*. Oxford University Press.

Bieniek-Tobasco, A., McCormick, S., Rimal, R. N., Harrington, C. B., Shafer, M., & Shaikh, H. (2019). Communicating climate change through documentary film: Imagery, emotion, and efficacy. *Climatic Change*, *154*(1–2), 1–18. https://doi.org/10.1007/s10584-019-02408-7

Bistline, J., Mehrotra, N., & Wolfram, C. (2023). *Economic Implications of the Climate Provisions of the Inflation Reduction Act* (Working Paper 31267). National Bureau of Economic Research. https://doi.org/10.3386/w31267

Block, L. G., & Keller, P. A. (1997). Effects of Self-Efficacy and Vividness on the Persuasiveness of Health Communications. *Journal of Consumer Psychology*, *6*(1), 31–54. https://doi.org/10.1207/s15327663jcp0601_02

Bostrom, A. (2017, June 28). *Mental Models and Risk Perceptions Related to Climate Change*. Oxford Research Encyclopedia of Climate Science. https://doi.org/10.1093/acrefore/9780190228620.013.303

Bouman, T., Steg, L., & Perlaviciute, G. (2021). From values to climate action. *Current Opinion in Psychology*, *42*, 102–107. https://doi.org/10.1016/j.copsyc.2021.04.010

Brewer, P. R., & McKnight, J. (2015). Climate as Comedy: The Effects of Satirical Television News on Climate Change Perceptions. *Science Communication*, *37*(5), 635–657. https://doi.org/10.1177/1075547015597911

British Academy of Film and Television Arts. (2023). *BAFTA albert: Leading Sustainable Production*. https://wearealbert.org

Brown, E. N. (2023, March 24). How Studios Are Making Sustainability the Default. *The Hollywood Reporter*. https://www.hollywoodreporter.com/business/business-news/amazon-studios-hbo-green-sony-pictures-sustainability-efforts-1235358067/

Buuren, S. V., & Groothuis-Oudshoorn, K. (2011). **mice**: Multivariate Imputation by Chained Equations in *R*. *Journal of Statistical Software*, *45*(3). https://doi.org/10.18637/jss.v045.i03

Campbell, E., Kotcher, J. E., Myers, T., Munson, S., Borth, A. C., Rosenthal, S. A., Leiserowitz, A., & Maibach, E. (2023). The potential role of descriptive and dynamic norms in promoting climate change advocacy. *Oxford Open Climate Change*, *3*(1), kgad001. https://doi.org/10.1093/oxfclm/kgad001

Charness, G., & Chen, Y. (2020). Social Identity, Group Behavior, and Teams. *Annual Review of Economics*, *12*(1), 691–713. https://doi.org/10.1146/annurev-economics-091619-032800

Chatterjee, J. S., Sangalang, A., & Cody, M. J. (2017). Entertainment-Education. In P. Rössler, C. A. Hoffner, & L. Zoonen (Eds.), *The International Encyclopedia of Media Effects* (1st ed., pp. 1–12). Wiley. https://doi.org/10.1002/9781118783764.wbieme0067

Chinn, S., Hart, P. S., & Soroka, S. (2020). Politicization and Polarization in Climate Change News Content, 1985-2017. *Science Communication*, *42*(1), 112–129. https://doi.org/10.1177/1075547019900290

Chinn, S., Lane, D. S., & Hart, P. S. (2018). In consensus we trust? Persuasive effects of scientific consensus communication. *Public Understanding of Science*, *27*(7), 807–823. https://doi.org/10.1177/0963662518791094

Cialdini, R. B., & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences*, *42*, 1–8. https://doi.org/10.1016/j.cobeha.2021.01.005

Climate On Screen. (2024). *Climate On Screen: Engaging Audiences with Climate and Sustainability Onscreen*. ClimateOnScreen.org. https://www.climateonscreen.org/

Creative Artists Agency. (2023). *Social Responsibility: CAA Foundation*. https://www.caa.com/social-responsibility

Daniel Goldhaber (Director). (2022). *How to Blow Up a Pipeline* [Thriller, Drama; Film]. Neon.

David Canfield. (2022, January 27). Don't Look Up Ensemble: A Hollywood Feature on a Blockbuster Cast. *Vanity Fair*. https://www.vanityfair.com/hollywood/2022/01/awards-insider-dont-look-up-ensemble-feature

Demetriades, S. Z., Walter, N., & Cohen, J. (2023). Parasocial Experiences in the Political Arena. In R. Tukachinsky Forster (Ed.), *The Oxford Handbook of Parasocial Experiences* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197650677.013.15

Durkin, S. J., Brennan, E., & Wakefield, M. A. (2022). Optimising tobacco control campaigns within a changing media landscape and among priority populations. *Tobacco Control*, *31*(2), 284–290. https://doi.org/10.1136/tobaccocontrol-2021-056558

Feldman, L., Maibach, E. W., Roser-Renouf, C., & Leiserowitz, A. (2012). Climate on Cable: The Nature and Impact of Global Warming Coverage on Fox News, CNN, and MSNBC. *The International Journal of Press/Politics*, *17*(1), 3–31. https://doi.org/10.1177/1940161211425410

Gammon, K. (2023, March 16). *Climate Activists Are Turning Their Attention to Hollywood*. The Atlantic. https://www.theatlantic.com/science/archive/2023/03/climate-change-movies-television-shows-public-opinion/673415/

Gardner, C. (2024, September 23). Meryl Streep Promotes Eco-Conscious Storytelling in New PSA: "Climate Change Is Scary." *The Hollywood Reporter*. https://www.hollywoodreporter.com/lifestyle/lifestyle-news/meryl-streep-psa-eco-conscious-storytelling-climate-change-1236007740/

Gerrig, R. J. (1993). *Experiencing narrative worlds: On the psychological activities of reading* (pp. xi, 273). Yale University Press.

Giaccardi, S., Rogers, A., & Rosenthal, E. L. (2022). *A Glaring Absence: The Climate Crisis is Virtually Non-Existent in Scripted Entertainment* (p. 27) [Research Report]. Norman Lear Center - Media Impact Project. https://learcenter.org/wp-content/uploads/2022/10/GlaringAbsence_NormanLearCenter.pdf

Goldberg, M. H., Gustafson, A., Rosenthal, S. A., & Leiserowitz, A. (2021). Shifting Republican views on climate change through targeted advertising. *Nature Climate Change*, *11*(7), 573–577. https://doi.org/10.1038/s41558-021-01070-1

Goldberg, M. H., Gustafson, A., van der Linden, S., Rosenthal, S. A., & Leiserowitz, A. (2022). Communicating the Scientific Consensus on Climate Change: Diverse Audiences and Effects Over Time. *Environment and Behavior*, *54*(7–8), 1133–1165. https://doi.org/10.1177/00139165221129539

Goldberg, M. H., van der Linden, S., Ballew, M. T., Rosenthal, S. A., Gustafson, A., & Leiserowitz, A. (2019). The Experience of Consensus: Video as an Effective Medium to Communicate Scientific Agreement on Climate Change. *Science Communication*, *41*(5), 659–673. https://doi.org/10.1177/1075547019874361

Goldberg, M. H., van der Linden, S., Leiserowitz, A., & Maibach, E. (2020). Perceived Social Consensus Can Reduce Ideological Biases on Climate Change. *Environment and Behavior*, *52*(5), 495–517. https://doi.org/10.1177/0013916519853302

Green, D. (2021). In Search of Entertainment-Education's Effects on Attitudes and Behaviors. In L. B. Frank & P. Falzone (Eds.), *Entertainment-Education Behind the Scenes: Case Studies for Theory and Practice* (pp. 195–210). Springer International Publishing. https://doi.org/10.1007/978-3-030-63614-2_12

Green, M. C., & Brock, T. C. (2000). The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology*, *79*(5), 701–721. https://doi.org/10.1037/0022-3514.79.5.701

Gregersen, T., Doran, R., Böhm, G., & Poortinga, W. (2021). Outcome expectancies moderate the association between worry about climate change and personal energy-saving behaviors. *PLoS ONE*, *16*(5), e0252105. https://doi.org/10.1371/journal.pone.0252105

Gustafson, A., Ballew, M. T., Goldberg, M. H., Cutler, M. J., Rosenthal, S. A., & Leiserowitz, A. (2020). Personal Stories Can Shift Climate Change Beliefs and Risk Perceptions: The Mediating Role of Emotion. *Communication Reports*, *33*(3), 121–135. https://doi.org/10.1080/08934215.2020.1799049

Guzik, J. A. (2023, March 22). Behind Netflix and GM's Plan to Give EVs More Screen Time. *The Hollywood Reporter*. https://www.hollywoodreporter.com/tv/tv-features/netflix-gm-electric-vehicles-bridgerton-stranger-things-1235352364/

Hallegatte, S., Godinho, C., Rentschler, J., Avner, P., Dorband, I. I., Knudsen, C., Lemke, J., & Mealy, P. (2023). *Within Reach: Navigating the Political Economy of Decarbonization*. World Bank. http://hdl.handle.net/10986/40601

Hart, P. S., & Nisbet, E. C. (2012). Boomerang Effects in Science Communication: How Motivated Reasoning and Identity Cues Amplify Opinion Polarization About Climate Mitigation Policies. *Communication Research*, *39*(6), 701–723. https://doi.org/10.1177/0093650211416646

Harvard - Center for Health Communication. (2017). *Harvard Alcohol Project: Designated Driver* [Research Report]. Harvard University. https://www.hsph.harvard.edu/chc/harvard-alcohol-project/

Herrnstadt, E., & Muehlegger, E. (2014). Weather, salience of climate change and congressional voting. *Journal of Environmental Economics and Management*, *68*(3), 435–448. https://doi.org/10.1016/j.jeem.2014.08.002

Herzog, K. (2019, October 3). How Climate Change Became The Affair's Most Consequential Character. *Vulture*. https://www.vulture.com/2019/10/the-affair-climate-change-sarah-treem-interview.html

Hinyard, L. J., & Kreuter, M. W. (2007). Using Narrative Communication as a Tool for Health Behavior Change: A Conceptual, Theoretical, and Empirical Overview. *Health Education & Behavior*, *34*(5), 777–792. https://doi.org/10.1177/1090198106291963

Hoffner, C. A., & Cohen, E. L. (2023). Effects of Parasocial Experiences on Health Outcomes. In R. Tukachinsky Forster (Ed.), *The Oxford Handbook of Parasocial Experiences* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197650677.013.14

Hornung, J. (2022). Social identities in climate action. *Climate Action*, *1*(1), 1–12. https://doi.org/10.1007/s44168-022-00005-6

Horton, D., & Wohl, R. R. (1956). Mass communication and para-social interaction; observations on intimacy at a distance. *Psychiatry*, *19*(3), 215–229. https://doi.org/10.1080/00332747.1956.11023049

Hurst Loo, A. M., & Walker, B. R. (2023). Climate change knowledge influences attitude to mitigation via efficacy beliefs. *Risk Analysis*, *43*(6), 1162–1173. https://doi.org/10.1111/risa.14026

Intergovernmental Panel on Climate Change. (2023a). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)* (P. R. Shukla, J. Skea, R. Slade, A. A. Khourdajie, R. van Diemen, D. McCollum, M.

Pathak, S. Some, P. Vyas, E. Huntley, J. P. Pereira, K. Riahi, & K. Hashemi, Eds.). IPCC.

https://www.ipcc.ch/report/ar6/syr/

Intergovernmental Panel on Climate Change (Ed.). (2023b). Demand, Services and Social Aspects of Mitigation.

In *Climate Change 2022—Mitigation of Climate Change* (1st ed., pp. 503–612). Cambridge University

Press. https://doi.org/10.1017/9781009157926.007

Jacobsen, G. D. (2011). The Al Gore effect: An Inconvenient Truth and voluntary carbon offsets. *Journal of

Environmental Economics and Management*, *61*(1), 67–78. https://doi.org/10.1016/j.jeem.2010.08.002

Jaeger, D. A., Joyce, T. J., & Kaestner, R. (2018). *A Cautionary Tale of Evaluating Identifying Assumptions: Did

Reality TV Really Cause a Decline in Teenage Childbearing?* (Working Paper 24856). National Bureau

of Economic Research. https://doi.org/10.3386/w24856

Jenny, M. A., & Betsch, C. (2022). Large-scale behavioural data are key to climate policy. *Nature Human

Behaviour*, *6*(11), 1444–1447. https://doi.org/10.1038/s41562-022-01479-4

Jensen, R., & Oster, E. (2009). The Power of TV: Cable Television and Women's Status in India. *The Quarterly

Journal of Economics*, *124*(3), 1057–1094.

Junzhao Ma, Junzhao Ma, Ma, J., Seenivasan, S., Satheesh Seenivasan, & Yan, B. (2020). Media influences on

consumption trends: Effects of the film Food, Inc. On organic food sales in the U.S. *International Journal

of Research in Marketing*, *37*(2), 320–335. https://doi.org/10.1016/j.ijresmar.2019.08.004

Kahn-Lang, A., & Lang, K. (2018). *The Promise and Pitfalls of Differences-in-Differences: Reflections on '16

and Pregnant' and Other Applications* (Working Paper 24857). National Bureau of Economic Research.

https://doi.org/10.3386/w24857

Kearney, M. S., & Levine, P. B. (2015). Media Influences on Social Outcomes: The Impact of MTV's "16 and

Pregnant" on Teen Childbearing. *American Economic Review*, *105*(12), 3597–3632.

https://doi.org/10.1257/aer.20140012

Kearney, M. S., & Levine, P. B. (2018). *A Comment on Jaeger, Joyce, and Kaestner (2018) Did Reality TV Really

Cause a Decline in Teenage Childbearing?* https://data.nber.org/data-

appendix/w19795/KL_Response_to_JJK-JBES-July_2018_FINAL.pdf

Kennedy, M. G., Turf, E. E., Wilson-Genderson, M., Wells, K., Huang, G. C., & Beck, V. (2011). Effects of a television drama about environmental exposure to toxic substances. *Public Health Reports (Washington, D.C.: 1974)*, *126 Suppl 1*(Suppl 1), 150–159. https://doi.org/10.1177/00333549111260S119

Koh, H., & Yatsko, P. (2017). *Jay Winsten and the Designated Driver Campaign* (ALI013-PDF-ENG; Harvard Business School Case Study). Harvard University. https://www.hsph.harvard.edu/chc/2017/02/01/jay-winsten-and-the-designated-driver-campaign/

Lattanzio, R. (2023, February 15). 'Extrapolations' Trailer: What's Going on with the Stacked Cast for Apple's Climate Change Drama? *IndieWire*. https://www.indiewire.com/features/general/extrapolations-trailer-apple-climate-change-drama-series-cast-1234810246/

Lee, T. M., Markowitz, E. M., Howe, P. D., Ko, C.-Y., & Leiserowitz, A. A. (2015). Predictors of public climate change awareness and risk perception around the world. *Nature Climate Change*, *5*(11), Article 11. https://doi.org/10.1038/nclimate2728

Leiserowitz, A. A. (2004). Day After Tomorrow: Study of Climate Change Risk Perception. *Environment: Science and Policy for Sustainable Development*, *46*(9), 22–39. https://doi.org/10.1080/00139150409603663

Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goddard, E., Carman, J., Ballew, M., Verner, M., Myers, T., Marlon, J., Lee, S., Goldberg, M., Badullovich, N., & Thier, K. (2024). *Climate Change in the American Mind: Beliefs & Attitudes, Spring 2024* (Climate Change in the American Mind:). Yale University and George Mason University. https://climatecommunication.yale.edu/wp-content/uploads/2024/07/climate-change-american-mind-beliefs-attitudes-spring-2024.pdf

Liebers, N., & Schramm, H. (2019). Parasocial interactions and relationships with media characters–an inventory of 60 years of research. *Communication Research Trends*, *38*(2), 4–31.

Londakova, K., Jake Reynolds, Alice Farrell, Jordan Whitwell-Mak, Elena Meyer zu Brickwedde, Mottershaw, \ Abigail, Loke, \ Tania, & Park, \ Toby. (2021). *The Power of TV: Nudging Viewers to Decarbonise their Lifestyles: An Evidence-Based Guide for Broadcasters* [Research Report]. The Behavioural Insights Team. https://www.bi.team/wp-content/uploads/2021/10/Broadcasters-Report.pdf

Madsen, J., & Niessner, M. (2019). Is Investor Attention for Sale? The Role of Advertising in Financial Markets. *Journal of Accounting Research*, *57*(3), 763–795. https://doi.org/10.1111/1475-679X.12257

Marsh, C. (2023, November 30). For These TV Procedurals, the Formula Still Works. *The New York Times*. https://www.nytimes.com/2023/11/30/arts/television/ncis-sydney-law-and-order.html

Michelle Ma & Caelyn Pender. (2023, June 28). Hollywood Grapples With How to Use Its Climate Superpowers. *Bloomberg.Com*. https://www.bloomberg.com/news/articles/2023-06-28/jane-fonda-other-hollywood-stars-talk-climate-change-storytelling-and-impact

Moyer-Gusé, E. (2008). Toward a Theory of Entertainment Persuasion: Explaining the Persuasive Effects of Entertainment-Education Messages. *Communication Theory*, *18*(3), 407–425. https://doi.org/10.1111/j.1468-2885.2008.00328.x

Moyer-Gusé, E., & Nabi, R. L. (2010). Explaining the effects of narrative in an entertainment television program: Overcoming resistance to persuasion. *Human Communication Research*, *36*(1), 26–52.

Murphy, S. T., Frank, L. B., Moran, M. B., & Patnoe-Woodley, P. (2011). Involved, transported, or emotional? Exploring the determinants of change in knowledge, attitudes, and behavior in entertainment-education. *Journal of Communication*, *61*(3), 407–431. https://doi.org/10.1111/j.1460-2466.2011.01554.x

Nabi, R. L., & Moyer-Gusé, E. (2012). The Psychology Underlying Media-Based Persuasion. In K. E. Dill (Ed.), *The Oxford Handbook of Media Psychology* (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780195398809.013.0016

Nabi, R. L., & Thomas, J. (2013). The Effects of Reality-Based Television Programming on Diet and Exercise Motivation and Self-Efficacy in Young Adults. *Health Communication*, *28*(7), 699–708. https://doi.org/10.1080/10410236.2012.711510

NBC Universal. (2023a). *NBC Universal, Universal Filmed Entertainment Group To Launch GreenerLight Program*. NBC Universal. https://www.nbcuniversal.com/article/universal-filmed-entertainment-group-launch-greenerlight-program

NBC Universal. (2023b, March 9). *Universal Filmed Entertainment Group To Launch GreenerLight Program*. NBCUNIVERSAL MEDIA. https://www.nbcuniversal.com/article/universal-filmed-entertainment-group-launch-greenerlight-program

Nisa, C. F., Bélanger, J. J., Schumpe, B. M., & Faller, D. G. (2019). Meta-analysis of randomised controlled trials testing behavioural interventions to promote household action on climate change. *Nature Communications*, *10*(1), 4545. https://doi.org/10.1038/s41467-019-12457-2

Paramount. (2023). *Paramount Releases 2022-2023 Environmental, Social, and Governance (ESG) Report*. Paramount. https://ir.paramount.com/news-releases/news-release-details/paramount-releases-2022-2023-environmental-social-and-governance

PBS Publicity. (2023). *PBS Announces Unprecedented Multiyear Commitment to Environmental and Climate Programming*. https://www.pbs.org/about/about-pbs/blogs/news/pbs-announces-unprecedented-multiyear-commitment-to-environmental-and-climate-programming/

Pener, D. (2023, March 9). Universal Filmed Entertainment Group Launches GreenerLight Sustainability Program (Exclusive). *The Hollywood Reporter*. https://www.hollywoodreporter.com/business/business-news/universal-filmed-entertainment-greenerlight-sustainability-program-1235346745/

Pisor, A., Lansing, J. S., & Magargal, K. (2023). Climate change adaptation needs a science of culture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *378*(1889), 20220390. https://doi.org/10.1098/rstb.2022.0390

Producers Guild of America. (2023a). *Resources for Producers: Rewrite the Future*. https://producersguild.org/resources-for-producers-nrdc-rewrite-the-future/

Producers Guild of America. (2023b). *Resources for Producers: Rewrite the Future*. https://producersguild.org/resources-for-producers-nrdc-rewrite-the-future/

Rare. (2024). *Climate Clip Library* [Examples Library]. Rare Entertainment Lab. https://rare.org/rare-entertainment-lab-clip-library/

Read, S. (2024, September 25). *Climate Rising: The Role of Storytelling in Climate Action* [Audio recording]. https://www.hbs.edu/environment/podcast/Pages/podcast-details.aspx?episode=2420299705

Riley-Adams, E. (2023, August 21). Can a New Genre of Eco-Thrillers Inspire Climate Action? *The New York Times*. https://www.nytimes.com/2023/08/21/t-magazine/climate-change-movies-film.html

Rinscheid, A., Pianta, S., & Weber, E. U. (2021). What shapes public support for climate change mitigation policies? The role of descriptive social norms and elite cues. *Behavioural Public Policy*, *5*(4), 503–527. https://doi.org/10.1017/bpp.2020.43

Rowley, M. J. (2024a, February 22). How Hollywood Is Crafting A New Climate Change Narrative. *Rolling Stone*. https://www.rollingstone.com/culture-council/articles/how-hollywood-is-crafting-new-climate-change-narrative-1234972469/

Rowley, M. J. (2024b, September 11). A New Era of Climate-Driven Storytelling Is Here And Companies Should Jump On Board. *Rolling Stone*. https://www.rollingstone.com/culture-council/articles/new-era-climate-driven-storytelling-here-companies-should-jump-board-1235098827/

Rubin, D. B. (2004). *Multiple Imputation for Nonresponse in Surveys*. John Wiley & Sons.

Ryzik, M. (2017, October 2). Can Hollywood Movies About Climate Change Make a Difference? *The New York Times*. https://www.nytimes.com/2017/10/02/movies/mother-darren-aronofsky-climate-change.html

Sammy Roth. (2024, August 1). Check out the TV shows nudging people to act on climate. *Los Angeles Times*. https://www.latimes.com/environment/newsletter/2024-08-01/column-check-out-the-tv-shows-nudging-people-to-act-on-climate-boiling-point

Schneider-Mayerson, M., Lim, J., Bellido, D., Stringer, M., Wilson, A., & Zhou, Z. (2024). *Climate Reality On-Screen: The Climate Crisis in Popular Films, 2013-22* (p. 58). Buck Lab for Climate and Environment, Colby College and Good Energy. https://www.colby.edu/wp-content/uploads/2024/06/Schneider-Mayerson-et-al-Climate-Reality-On-screen.pdf

Scott Z. Burns, Nicole Holofcener, Gregory Jacobs, Ellen Kuras, Richie Mehta, & Michael Morris (Directors). (2023). Extrapolations [Episodic TV]. In *Extrapolations*. Apple TV+. https://www.imdb.com/title/tt13634682/

Screen Actors Guild - American Federation of Television and Radio Artists. (2023). *Good Planet: SAG-AFTRA Climate Action Initiatives*. https://www.sagaftra.org/good-planet

Shoard, C. (2023, December 10). A vegan morality tale? Chicken Run sequel puts factory farming in spotlight. *The Guardian*. https://www.theguardian.com/film/2023/dec/10/a-vegan-morality-tale-chicken-run-sequel-puts-factory-farming-in-spotlight

Slater, M. D., & Rouner, D. (2002). Entertainment-education and elaboration likelihood: Understanding the processing of narrative persuasion. *Communication Theory*, *12*(2), 173–191. https://doi.org/10.1093/ct/12.2.173

Slater, M. D., Rouner, D., & Long, M. (2006). Television Dramas and Support for Controversial Public Policies: Effects and Mechanisms. *Journal of Communication*, *56*(2), 235–252. https://doi.org/10.1111/j.1460-2466.2006.00017.x

Solnit, R. (2023, January 12). 'If you win the popular imagination, you change the game': Why we need new stories on climate. *The Guardian*. https://www.theguardian.com/news/2023/jan/12/rebecca-solnit-climate-crisis-popular-imagination-why-we-need-new-stories

Sparkman, G., & Walton, G. M. (2019). Witnessing change: Dynamic norms help resolve diverse barriers to personal change. *Journal of Experimental Social Psychology*, *82*, 238–252. https://doi.org/10.1016/j.jesp.2019.01.007

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change*, *1*(1), 46–49.

Statista. (2023). *Video Streaming Worldwide* [Dataset]. https://www.statista.com/topics/7527/video-streaming-worldwide/#topicOverview

Stewart, E. (2022). *Flip the Script on Sustainability Storytelling*. https://about.netflix.com/en/news/flip-the-script-on-sustainability-storytelling

Stewart, E. (2024, September 11). *Telling Climate Stories at Scale: Netflix's Strategy for Sustainability and Impact* [Audio recording]. https://www.hbs.edu/environment/podcast/Pages/podcast-details.aspx?episode=7769967539

Sustainability Entertainment Alliance. (2024). *The Sustainable Entertainment Alliance: Transforming the Screen Industry's Environmental Impact*. Sustainability Entertainment Alliance. https://www.sustainableentertainmentalliance.org/

Television Academy. (2023). *Television Academy: Sustainability and Climate Action*. https://www.televisionacademy.com

Thøgersen, J. (2021). Consumer behavior and climate change: Consumers need considerable assistance. *Current Opinion in Behavioral Sciences*, *42*, 9–14. https://doi.org/10.1016/j.cobeha.2021.02.008

Tiwathia, A., Watamanuk, E., Syropoulos, S., Dodson, S., & Thulin, E. (2024). *A Majority of Americans Supports Climate-Friendly Content in Entertainment* [Research Report].

Townsend, S. (2022a, July 9). Storytellers For Sustainability Needed. *Forbes*. https://www.forbes.com/sites/solitairetownsend/2022/07/09/storytellers-for-sustainability-needed/

Townsend, S. (2022b, November 12). Change The Story, Save The World? Let's Flip The Script On Climate. *Forbes*. https://www.forbes.com/sites/solitairetownsend/2022/11/12/change-the-story-save-the-world-lets-flip-the-script-on-climate/

Townsend, S. (2023, March 19). *68 Climate Leaders Changing The Film And TV Industry*. Forbes. https://www.forbes.com/sites/solitairetownsend/2023/03/19/68-climate-leaders-changing-the-film-and-tv-industry/

Tukachinsky, R., Walter, N., & Saucier, C. J. (2020). Antecedents and Effects of Parasocial Relationships: A Meta-Analysis. *Journal of Communication*, *70*(6), 868–894. https://doi.org/10.1093/joc/jqaa034

United Nations Environment Programme. (2022). *Emissions Gap Report 2022: The Closing Window—Climate crisis calls for rapid transformation of societies*. United Nations Environment Programme. https://www.unep.org/emissions-gap-report-2022

United Nations Framework Convention on Climate Change. (2023a). *Entertainment and Culture for Climate Action*. https://unfccc.int/climate-action/sectoral-engagement/entertainment-and-culture-for-climate-action

United Nations Framework Convention on Climate Change. (2023b). *Film & Television for Climate Action*.

   https://unfccc.int/climate-action/sectoral-engagement/entertainment-and-culture-for-climate-action/film-

   television-for-climate-action

United Nations Framework Convention on Climate Change. (2023c). *Sports for Climate Action*.

   https://unfccc.int/climate-action/sectoral-engagement/sports-for-climate-action

Van Der Linden, S., & Goldberg, M. H. (2020). Alternative meta-analysis of behavioral interventions to promote

   action on climate change yields different conclusions. *Nature Communications*, *11*(1), 3915.

   https://doi.org/10.1038/s41467-020-17613-7

van Valkengoed, A. M., Abrahamse, W., & Steg, L. (2022). To select effective interventions for pro-

   environmental behaviour change, we need to consider determinants of behaviour. *Nature Human

   Behaviour*, *6*(11), 1482–1492. https://doi.org/10.1038/s41562-022-01473-w

Warner, B. (2022, October 23). The climate films shaping society. *BBC*.

   https://www.bbc.com/future/article/20221021-how-climate-change-in-film-shape-society

We Are Albert. (2021). *Broadcasters and streamers sign up to the Climate Content Pledge*. We Are Albert.

   https://wearealbert.org/2021/11/03/broadcasters-and-streamers-sign-up-to-the-climate-content-pledge/

Weinstein, A. B., Heather Fipps,Ali, Begalman, A., Fipps, H., & Weinstein, A. (2024, June 24). How Hollywood

   Can Make Climate Stories Sexy. *The Hollywood Reporter*.

   https://www.hollywoodreporter.com/business/business-news/hollywood-climate-stories-shows-movies-

   1235924830/

Weir, S., & Kessler, S. E. (2022). The making of a (dog) movie star: The effect of the portrayal of dogs in movies

   on breed registrations in the United States. *PLOS ONE*, *17*(1), e0261916.

   https://doi.org/10.1371/journal.pone.0261916

Weprin, A. (2023). Netflix to Feature General Motors EVs in TV Shows and Movies in Deal That Kicks Off at

   Super Bowl. *Hollywood Reporter*. https://www.hollywoodreporter.com/business/business-news/netflix-

   gm-ev-alliance-super-bowl-ad-1235315381/

Writers Guild of America - West. (2023). *Climate Crisis: Take Action*. https://www.wga.org/writers-room/on-the-

web/guilds-organizations/climate-crisis-take-action