

PAPER • OPEN ACCESS

Transforming the stories we tell about climate change: from 'issue' to 'action'

To cite this article: Kris De Meyer *et al* 2021 *Environ. Res. Lett.* **16** 015002

View the [article online](#) for updates and enhancements.

You may also like

- [Alteration of neural action potential patterns by axonal stimulation: the importance of stimulus location](#)
Patrick E Crago and Nathaniel S Makowski
- [Analysis of Electrical Cell-to-Cell Communication Using the Aggregate of Model Cells](#)
Issei Kasai, Yuki Kitazumi, Kenji Kano et al.
- [Physics of Finance: Gauge Modelling in Non-Equilibrium Pricing](#)
Cosma Shalizi

UNITED THROUGH SCIENCE & TECHNOLOGY



The Electrochemical Society
Advancing solid state & electrochemical science & technology

248th ECS Meeting Chicago, IL October 12-16, 2025 *Hilton Chicago*



Science + Technology + YOU!

Register by
September 22
to **save \$\$**

REGISTER NOW

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

OPEN ACCESS

RECEIVED

31 August 2020

REVISED

3 November 2020

ACCEPTED FOR PUBLICATION

24 November 2020

PUBLISHED

23 December 2020

Original content from this work may be used under the terms of the [Creative Commons Attribution 4.0 licence](#).

Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.



Transforming the stories we tell about climate change: from ‘issue’ to ‘action’

Kris De Meyer^{1,2} , Emily Coren³ , Mark McCaffrey⁴ and Cheryl Slean⁵¹ Geography, King's College London, London WC2B 4BG, United Kingdom² Earth Sciences, University College London, London WC1E 6BS, United Kingdom³ Psych/General Psychiatry and Psychology (Adult), Stanford University, Stanford, California CA 94305, USA⁴ ECOS, UN Climate Change Community for Education, Communication and Outreach Stakeholders, Kiskágyon 3046, Hungary⁵ Communications, Natural Resources Defense Council, New York, NY 10011-4211, USAE-mail: kris.de_meyer@kcl.ac.uk and emilycoren@gmail.com**Keywords:** climate communication, environmental education, storytelling, public engagement, outreach, social psychology, communication infrastructure

Abstract

By some counts, up to 98% of environmental news stories are negative in nature. Implicit in this number is the conventional wisdom among many communicators that increasing people's understanding, awareness, concern or even fear of climate change are necessary precursors for action and behavior change. In this article we review scientific theories of mind and brain that explain why this conventional view is flawed. In real life, the relationship between beliefs and behavior often goes in the opposite direction: our actions change our beliefs, awareness and concerns through a process of self-justification and self-persuasion. As one action leads to another, this process of self-persuasion can go hand in hand with a deepening engagement and the development of agency—knowing *how* to act. One important source of agency is learning from the actions of others. We therefore propose an approach to climate communication and storytelling that builds people's agency for climate action by providing a wide variety of stories of people taking positive action on climate change. Applied at scale, this will shift the conceptualization of climate change from ‘issue-based’ to ‘action-based’. It will also expand the current dominant meanings of ‘climate action’ (i.e. ‘consumer action’ and ‘activism’) to incorporate all relevant practices people engage in as members of a community, as professionals and as citizens. We close by proposing a systematic approach to get more reference material for action-based stories from science, technology and society to the communities of storytellers—learning from health communication and technologies developed for COVID-19.

1. Introduction

It is 2030. Around the world, the physical signs of a changing climate have become commonplace. As a concept in the public mind, ‘climate change’ is omnipresent and widely accepted. Popular media report it freely and frequently, mostly through stories of people and communities acting on climate change. Society is decarbonizing at breakneck speed, and stories abound of individuals and communities at local, national and international level discovering new ways to limit or draw down carbon emissions. These discoveries are driven by general ingenuity, natural solutions and technological developments in energy, transport, construction and food. There are

also testimonials of local communities overcoming the inequalities and risks of climate change already underway, and universal stories of challenges confronted and overcome. In brief, climate change has become part of the fabric of everyday life; the backdrop against which life's choices play out.

This picture of 2030 shows the cultural mindset which we imagine would exist in a world doing its level best to tackle climate change. At present, society is far removed from this. Climate change is primarily conceptualized as a threat we should be concerned about (section 2.1), rather than as something we know how to act on. This issue-based conceptualization of climate change, combined with a widespread but mistaken ‘conventional wisdom’ that awareness

and concern are precursors to action (section 2.2) gives rise to three interrelated problems. First, it leads to a ‘poverty of stories’ about climate change. The vast majority of communications about climate change (scientific articles, news reports, other media stories and even entertainment and arts projects) use the same language and overarching narrative which focuses on raising concern among its audiences. This approach, however, leads to the second problem: a widespread ‘lack of agency’ (agency being defined as ‘ability to act’—section 3.2), because raising concern and calling for urgent action in the abstract does little to help people figure out how to respond concretely. Third, as a sign of this lack of agency, the ‘opportunities for citizens to engage in climate action are conceptualized too narrowly as consumer choice and climate activism’—with passionate disagreements raging about which forms of action are meaningful and which are not.

Delivering value to society and accelerating action on climate change (the core topics of this special issue) requires an alternative approach to communication and storytelling about climate change to address all three problems. The planet is changing and our technological advancement is progressing more rapidly than the systems for culturally assimilating that information—systems like science communication, outreach and citizen engagement; knowledge transfer from science to decision makers; formal and informal education; and social media, journalism, media, arts, culture and entertainment. The required change therefore applies to a wide ecosystem of researchers and practitioners in environmental communication, education and policy; technological infrastructure developers; and the content creators working in media and the creative industries.

In this article, we outline elements of a system to shift this researcher/practitioner/citizen ecosystem from an issue-based conceptualization of climate change to an action-based one. Section 3 sets out what compels this shift: evidence from psychology and neuroscience showing that ‘in real life actions drive beliefs’—rather than awareness, beliefs or concern leading to behavior change. We also discuss research showing the effectiveness of stories of people taking action—rather than stories about issues or impacts—as the best way to create ‘agency’. In section 4, we provide two examples of efforts already underway to build the agency of storytellers for an action-based approach to climate storytelling. In section 5, we describe a set of systematic tools to coordinate a flow of reference materials for local and global action-based stories to the desks of communicators, educators and storytellers. Finally, in the conclusion we reflect on how our proposed approach differs from other calls to apply storytelling to climate change. We also reflect on the role that different professional communities (e.g. environmental scientists,

journalists, creative writers, and funders) can play in this transition.

Table 1 provides a summary of the main insights and research fields providing the evidence base for our proposed shift to action-based storytelling. Each concept and research field in the table has been the subject of hundreds or more research studies and review articles. It is not the purpose of this article to provide a systematic review of these research domains, but to establish that there is a strong evidence base for the practice we propose. We also provide signposts into these research fields which are currently relatively unknown in climate communications research and practice. For each concept we provide references in the text to pivotal studies and review articles as entry points to the relevant literature.

A clarification of terminology: we use ‘storytelling’ to cover a broad range of communication practices, from one-way to interactive, in fiction or nonfiction form, and in any media format. We are aware that different academic disciplines and sectors (e.g. the marketing sector) attach specific and sometimes conflicting meanings to words like communication, outreach, engagement, education and story. For our proposed approach, we adopt ‘storytelling’ as a common label to bypass the complications of these disciplinary and sectoral differences. As the focus is on ‘people doing things’, these accounts contain the main elements commonly associated with stories, such as characters and events. In this broad designation, ‘climate storytelling’ includes content produced in journalism and news media, entertainment, arts and culture. It also includes science communication and outreach, environmental education and even policy outputs which are now mostly issue-based but will also benefit from a shift to an action-based perspective.

2. The current state of affairs in practice and research

2.1. Cultural mindsets about climate change

In media and popular culture, climate change is primarily conceptualized through ‘doom and disaster’ narratives—an existential threat to human society, the natural world and even the planet itself. In the first large-scale UK media analysis of climate change, Ereaut and Segnit (2006) wrote:

‘Climate change is most commonly constructed [...] as awesome, terrible, immense and beyond human control. This repertoire is seen everywhere [...] in broadsheets and tabloids, in popular magazines and in campaign literature from government initiatives and environmental groups. It incorporates an urgent tone [...] and uses a language of acceleration and irreversibility.’ Little changed in the following years (Painter 2013, Painter *et al* 2017), and

Table 1. Insights and research fields underpinning the shift to ‘action-based storytelling’.

Concept	Origins	Key ideas
Self-persuasion	Social psychology: cognitive dissonance	Actions can drive beliefs and lead to deep engagement with issues
Agency	Social psychology: social cognitive theory	‘Ability to act’ in a particular context is a precursor to action; it is lacking on climate change
Entertainment education	Entertainment industry and communication research	Use our capacity to learn from stories of other people’s actions as a way to build agency
Positive deviance	Health communication	Start with stories of individuals and groups who have already developed agency (positive outliers)

by 2020, highly evocative words like ‘crisis’, ‘emergency’ and ‘breakdown’ are used among large parts of the public to describe climate change (Bevan *et al* 2020). Opinion surveys show record levels of concern globally (Fagan and Huang 2019, Goldberg *et al* 2020)—which holds up even in times of COVID-19 (Gray and Jackson 2020). People’s willingness to take up pro-environmental behaviors is flat lining, however (ibid.). Instead, feelings of powerlessness run high. ‘But what can I do?’—is a question frequently asked but rarely answered satisfactorily (De Meyer *et al* 2019).

2.2. The unresolved question: how to turn belief and concern into action?

A common view among climate communication researchers and practitioners is that belief in, awareness of or concern about climate change are (or ought to be) drivers of climate-positive behaviors. Among some, this is combined with the recognition that in reality this is not happening much. In a review of climate communication research, Moser (2016) listed as one of the unresolved challenges for communication researchers and practitioners the question of ‘how to move people from understanding, awareness and concern to action?’ Likewise, Hornsey and Fielding (2020) speak of ‘an urgent need to test strategies for increasing climate-related concern in the general public and then translating abstract concern into concrete action.’

There are several alternate versions of this view, each with different proponents and opponents. Some scientists and communicators continue to pursue an ‘information deficit’ approach, assuming that knowledge of the facts and future impacts of climate change will drive action (Pearce *et al* 2015, Seethaler *et al* 2019). Other communicators reject a focus on knowledge alone and speak of a need to connect to people’s emotions. They are divided, however, whether the most productive emotional states are concern or worry (van der Linden 2017), fear and panic (Wallace-Wells 2019), or positive attitudes, like optimism and hope (see Hornsey and Fielding 2020 for a review). Despite their differences, what

all these views have in common is the assumption that a certain mental state (knowledge, understanding, awareness, beliefs, values, positive or negative attitudes and emotions) is the key to unlocking climate action. So far, the evidence for this is in short supply. Be it beliefs about climate change (Hornsey *et al* 2016), concern (Gray and Jackson 2020), worry (Bouman *et al* 2020) or anxiety (Clayton and Karazsia 2020), in each case measures of the respective mental states are only weakly to moderately correlated with climate-positive behaviors (though the correlation with support for abstract climate policies tends to be stronger).

None of the questions, findings or differences of opinion in recent climate communication research and practice are surprising if one looks at the older research literature in environmental psychology and education, or the wider neuro-, psychological and social sciences. Two decades ago, environmental policy and education researchers were writing about an environmental ‘value-action’ or ‘attitude-behavior’ gap (Blake 1999, Kollmuss and Agyeman 2002). Worse, the weak to moderate relationship between environmental attitudes and behavior was already evident in environmental education research from the late 1970s (Marcinkowski and Reid 2019). In social psychology more generally, the study of attitude-behavior gaps can be traced back even further, to Lapiere (1934). Elsewhere, psychologists have warned against seeing emotions as simple levers of behavior (Chapman *et al* 2017) or have explained why ‘fear appeals’ can be counterproductive and lead to apathy or denial instead of action (Witte 1992, Witte and Allen 2000, Aronson 2008).

3. The basis for an alternative approach

3.1. In real life, actions usually come before beliefs

If belief in and concern about climate change do not automatically lead to action, then what can be done instead? Starting with cognitive dissonance research in the 1950s, the realization emerged among some psychologists that belief, attitude change and emotional responses are often the *consequence* of behavior,

rather than the causation of it. As Aronson (1997) wrote:

‘Dissonance also changed the way we think about attitudes and behavior. Prior to 1957, the general wisdom among psychologists was that, if you want people to change their behavior, you must first get them to change their attitudes. [...] Contrary to the general wisdom, dissonance theorists bravely asserted that a more powerful approach [...] would be to induce people to change their behavior first—and their attitudes will follow [...].’

A range of lab-based and real-world experiments provided evidence for the behavior-induced attitude change which cognitive dissonance theory predicted (Aronson 1997, Petty and Wegener 1998, Crano and Prislin 2006). The ‘general wisdom’ which Aronson referred to proved harder to dislodge, primarily because there seems to be so much evidence (empirical and anecdotal) in favor of it. To cut short a long and experiment-driven debate among psychologists, the conventional view (‘beliefs drive actions’) holds when attitudes are strong, and the available actions feel doable and meaningful. The converse (‘actions drive beliefs’) happens when attitudes are weak, we face a difficult choice, or do something that threatens our identity and self-image (the view we have of ourselves as smart, competent, ethical, kind, loyal, etc). Under these conditions, an initial decision or action—perhaps taken without conviction at first—can initiate a cycle of self-justification which leads to further action and self-justification, meanwhile strengthening our attitudes, beliefs, feelings and knowledge about the issue. This gradual process of *self-persuasion* generally leads to deeper engagement, and to more profound behavior change and attitude change than what communication and persuasion can achieve (Aronson 1999). That in real life action often precedes ideology and commitment to a cause has also been noticed by social movement researchers (Munson 2008) and political campaigners (Goldsworthy 2020).

Between the 1970s and 1990s, research in environmental psychology and education, influenced by social psychology and dissonance research, occasionally experimented with the idea that actions drive beliefs. In more recent climate and environmental communication research, the conventional view is again pervasive. We found only one recent experiment testing the notion that environmental behaviors might change attitudes (Ertz and Sarigöllü 2019). Why is this so? On a high-stakes issue like climate change, examples abound of passionate advocates who believe strongly in what they do. On the surface, this seems to support the view that to change people’s behavior, we need to change their attitudes. However, communication campaigns which focus on building awareness or concern do not lead to the same deep engagement as self-persuasion, nor do they

necessarily set people on a path of self-persuasion. What is needed for that is the *opportunity* and *capability* to engage in action which is experienced as meaningful. For many people both of these are missing when it comes to climate change.

3.2. Agency

The second concept of importance is *agency*, which was developed by social psychologist Albert Bandura (1982, 2006, 2018) as part of his *social cognitive theory*. It means ‘knowing how to act in order to bring about an intended effect’ and is a fundamental aspect of human functioning. Agency is exercised in three forms (ibid.): *individual* agency applies to someone’s personal sphere of control; *proxy* agency applies to situations where people try to influence others to act on their behalf; *collective* agency happens when people pool their knowledge and skills to act in concert.

In social cognitive theory, an important source of agency is *social learning* (ibid.), meaning that we often develop our own agency as we learn from the actions and experiences of others. Social learning, agency and its related concept self-efficacy (the *belief* one has in one’s ability to act) have been very influential across the social sciences; for example, in the study of work-related performance (Stajkovic and Luthans 1998), or to structure interventions promoting positive health behaviors (World Bank 2015). However, they are rarely applied in the context of climate change, a few recent exceptions notwithstanding. For example, Doherty and Webler (2016) found efficacy beliefs to be strong predictors of various types of public climate action (voting, protesting etc).

3.3. Self-persuasion leads to the development of agency—but only in a concrete manner

Self-persuasion is a double-edged sword. It has led many intelligent and good people to become stuck in unhelpful or harmful ideas (Tavris and Aronson 2020). However, in its positive forms, as one action inspires the next, it is accompanied by a deepening of one’s agency and efficacy in dealing with a situation. Both the cycle of actions someone engages in as part of a self-persuasion process and the agency which develops as a consequence tend to be concrete and specific. For instance, self-efficacy which follows from easy water conservation behavior can result in people taking on harder water conservation actions (Lauren et al 2016). However, an action like using reusable shopping bags does not automatically lead to unrelated actions like energy conservation (Poortinga et al 2013). Self-persuasion and agency do not make one a master of tackling climate change in the abstract—but only in the concrete, through the types of actions one engages in.

3.4. Expanding the domains of climate agency

On climate change, there are two domains in which a sizable minority of the public have undergone self-persuasion behavior change and developed a degree of agency. The first domain is the reduction of one's own carbon footprint through changes in the consumption of goods and energy. As an example of the adoption of this kind of behavior, a recent US opinion survey showed that, on a number of food-related choices, on the order of 5%–25% of participants 'always' or 'often' took certain pro-environmental actions, such as buying local food products or from companies which take steps to reduce their environmental impacts (Leiserowitz *et al* 2020). The second domain is climate activism, which can take several forms: from lobbying politicians to non-violent direct action. In a US survey on activism, 3% of respondents reported they were 'currently participating in a campaign to convince elected officials to take action on climate change' (Leiserowitz *et al* 2019). Beyond such isolated data points, it is not possible to provide comprehensive numbers for who is doing what. Public opinion research tends to focus on attitudes (e.g. support for a certain policy) and intentions to act, but rarely asks about actual behavior. What is important, however, is that the actions which people become engaged in through self-persuasion (be they certain consumer actions or activism) are easily rejected as not doable or meaningful by others—even if by those who share a high degree of concern about climate change. The often-heard question 'But what can *I* do about climate change?' may flummox those who *are* engaged in some form of action. However, this is the nature of self-persuasion. What comes to feel doable and meaningful to one person does not automatically feel so to others.

This problem goes beyond the sphere of personal consumer choices or civic engagement. In our work, we frequently encounter people who say, 'I am very concerned about climate change personally, but I cannot see how I can do anything about it in my work or professional context.' Some—perhaps surprising—professional communities we have heard this sentiment from were creative writers, journalists, teachers, architects, business consultants, health professionals, lawyers, pension fund managers, senior managers in oil companies and even elected politicians. These individuals may have plenty of agency in their job context, but it does not extend to climate action.

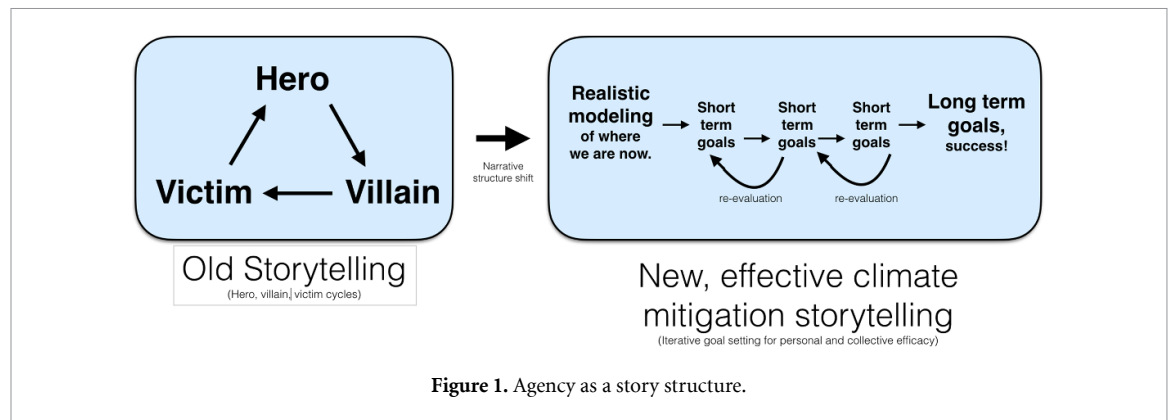
What is needed to break through this lack of agency is a systematic approach to support the development of new, concrete ways of 'knowing how' to act on climate change. Rather than telling people *what* to do, they need to be supported in discovering *how* to bring climate action into the personal, professional and civic forms of agency, the social roles and identities they already have (De Meyer *et al* 2019). Instrumental to this context-dependent broadening of climate action is Wenger's (1998) 'communities

of practice' idea. He defined it as groups of people who have a shared concern or passion and become better at tackling a situation through learning from each other, as a community. Here, we propose that both place-based, localized action storytelling, and practice-based action storytelling have a role to play in expanding climate agency. As examples of the latter, for creative writers and journalists the required agency would be about knowing how to make action on climate change part of their stories; for architects, how to bring climate change into building design; for teachers, how to teach about climate action within the constraints of the curriculum; for fund managers, how to bring climate risk into their investment decisions; for health professionals, to support the creation of place-based community systems that respond to the health impacts of climate change. These examples of communities of practice provide different opportunities and challenges to expand the notions of climate action beyond the current notions of consumer choice and activism. Others have started to apply a 'communities of practice' lens to the creation of climate agency, e.g. for health professionals (El Amiri *et al* 2020) or weathercasters (Maibach 2020). We will return frequently to this concept below, as it is an important lever to build agency in communities of people with shared expertise and concerns.

There are different aspects to creating agency, as 'ability to act' requires both 'opportunity' and 'capability', and there is more than one way to foster either of these. In this article we focus on one way to operationalize the idea: by telling stories about people discovering how to act within a specific place- or practice-based context. In the following subsection, we will describe some of the evidence demonstrating that stories of 'people taking action' can create agency in others.

3.5. Education entertainment and positive deviance

Bandura's ideas about social learning as a vehicle for the development of agency became the foundation of *entertainment-education* (Singhal and Rogers 2002). It is an integrated communications approach that uses a fictional story (frequently broadcast via television or radio) as one piece of a larger strategy to build audience engagement around important topics of public concern, usually in the domain of health or social development. Despite having a fictional component, entertainment-education stories deliver reliable content from reputable sources. They model desired changes through the actions and experiences of the story characters. With a strong focus on entertainment value, there are many examples of projects which have been commercially successful, while also having large positive effects on public behaviors such as enrollment in adult literacy classes, adoption of family planning methods, and gender equality (Nariman 1993, Singhal *et al*



2011, 2013). The approach has proliferated over the past 40 years to thousands of projects globally, becoming an influential health promotion strategy (Kincaid 2002, Moyer-Gusé 2008, World Bank 2015). In recent years, entertainment-education projects have also become *transmedia*—coordinating stories across multiple platforms, including social media (Lutkenhaus *et al* 2020).

A crucial aspect of entertainment-education narratives is that they are structured to facilitate the development of agency through social learning. A story character (called the ‘transition’ character) models a desired change of attitudes and behavior against a backdrop of support and opposition of other story characters (modeling ‘positive’ and ‘negative’ attitudes and behavior, respectively). Viewers or listeners, through their identification with the transition character, develop their own sense of agency and efficacy with respect to the change the transition character experiences.

Singhal and Dura (2009) integrated another health communication practice into the entertainment education story structure: *positive deviance* (Marsh *et al* 2004). Positive deviance starts from the premise that every community (place- or practice-based) has individuals or groups who are positive outliers—who on their own account have developed novel solutions or behaviors to deal with certain problems (Singhal and Dura 2017). Entertainment education narratives incorporating positive deviance thus start from existing knowledge of what works in a given community, rather than assuming that information needs to come from outside experts.

3.6. Agency as a story structure

Putting together the ideas of self-persuasion and agency with the established practices of entertainment education and positive deviance, we propose to apply ‘agency as a story structure’ to climate change storytelling (see figure 1). In this narrative structure, stories need to start from where people are; be tailored to a particular place- or practice-based context; be action-based; and follow a structure of ‘iterative goal setting’ (Coren and Safer 2020), showing individuals and communities solving concrete climate-related

challenges one short-term goal at the time. Many such storylines may be interwoven to produce stories with rich and complex parallel plots (*ibid.*). Modeling the behavior of the positive outliers in each community ensures that actions are perceived as realistic, doable and meaningful by others. Stories can be fictional but do not have to be. They can also be the factual accounts of real people. What is crucial, however, is that they are not simply issue-based. They do *not* have as their prime objective the raising of concern as a precursor to action. Instead, they would take climate change as given. Against the backdrop of this reality, they model opportunities for people to engage in concrete actions to solve a specific challenge in a local context or in the context of a specific community of practice. Despite its prevalence in health communication and social development, this kind of storytelling has not been formally applied to climate change. One exception is ‘Rhythm and Glue’, a prototype developed by one of the authors (Coren and Safer 2020). We will describe this in more detail in section 4.2. In the first instance, this approach can focus on generating agency among people who are already concerned about climate change but do not know what to do—providing them with opportunities to take their first steps of a self-persuasive process that enables them to develop their own agency.

Adopting this approach for climate storytelling resolves the three problems outlined in section 1. By creating stories which embed climate action into a wide variety of societal contexts, it resolves the poverty of stories. By focusing on the development of agency, it resolves the lack of agency. Finally, by focusing on developing agency that fits with different place- and practice-based contexts, it expands the range of opportunities for citizens to engage in climate action.

4. Building the agency of storytellers for action-based climate storytelling

Creative professionals, journalists and other content creators are key communities of practice which have a pivotal role to play in helping society to

shift to an action-based conceptualization of climate change. Here we describe two examples of projects already underway to help those communities build their agency for action-based storytelling. The first is a training program for creative professionals; the second is a prototype of an entertainment-education series that shows how to bring place-based climate action and health communication approaches together.

4.1. Climate storytelling training for Hollywood creative professionals

One of the authors (CS) works closely with creative professionals (e.g. TV screenwriters) in the entertainment industry, having recently co-founded 'Rewrite the Future', a new climate storytelling capacity building initiative (NRDC 2020). The program aims to help entertainment professionals see that they, uniquely, can answer the question 'What can I do about climate change?' with their creative work—the stories that writers and producers choose to pitch and develop, and those that the studio executives choose to greenlight.

We have found that getting Hollywood professionals interested in inventing and programming climate stories is requiring a shift of thinking within an industry that has heretofore resisted climate content. While there is growing interest in social impact entertainment (SIE)—that is, content and promotional campaigns that add social impact 'surplus' to a product's entertainment value (UCLA Skoll 2019)—it has been primarily focused on social justice, diversity and inclusion and remains a small proportion of the entertainment landscape. Our content advocacy is therefore partly educational—exposing content creators to the large range of possible climate angles that can be mined for stories; and partly aspirational—calling upon the industry to embrace and leverage the powerful cultural influence they have toward elevating climate action and justice in the Zeitgeist.

The entertainment professionals we have spoken to have, without exception, expressed great concern about climate change. However, it either has not occurred to them that their stories could engage with the topic, or else it has, and the prospect is perceived as too daunting, off-putting or unrelated to their current portfolio. More than once we have heard 'I'd love to tell stories about climate, but I do not know how'—exemplifying the lack of agency discussed earlier. Content creators express worry that they may impair their story's entertainment value by focusing too much on the *issue* of climate change which they equate with didacticism, fact-based dullness, or polemic.

Entertainment value often corresponds to how well the narrative imaginatively transports the viewer into the world of the story (Carpenter and Green 2012). In a successful story, any information has to be required by the story, not tacked on by some desired

educational outcome. In response to these constraints and opportunities, we start with the assurance that storytellers should lead with their usual aims to entertain the audience with 'good stories well-told.' Good stories are about people, not issues. For a writer it can be overwhelming to think about telling a story about something as vast, issue-based and seemingly impersonal as global warming. The antidote is to invite creators to do what they do best—keep telling stories about people. People made the climate crisis, people are impacted by it, and people can act on it too. In our workshops and story consultations, we unpack climate storytelling as the innumerable specific ways that people interact with situations of crisis and their solutions, including intersections with social issues that may be easier for a writer to personalize, like racial and economic injustice, women and families, immigration, national security, and health.

We offer lay-language information such as climate storytelling tip sheets and customized memos that may include narrative case studies, data visualizations and profiles of activists, thought leaders and sustainability innovators. In rare cases these real-world stories may be optioned for adaptation to the screen; mostly they provide inspiration for fictional characters, events, plots and subplots that weave through storylines of existing shows or inform new projects in development.

We create frameworks and relationships that allow a writer's imagination to freely engage with the information we provide about green jobs, climate psychology, regional impacts, or the range of possible climate futures. We provide individual consultations, both with writers on specific projects, and in meetings with executives to help grow a buyer's market, as well as industry panels and workshops. These various forms of content education are meant to creatively explore the various climate angles that are available to almost any genre and time frame of story, from recent past to contemporary to near and far future fictions. Our intention is not just to support more meaningful climate entertainment but to nourish a community of climate story practitioners who bring their experience and knowledge into every writers' room and project. At some point we expect the industry to become self-educating.

4.2. Rhythm and Glue

The entertainment-education series *Rhythm and Glue* was developed by one of the authors (EC) as a prototype example of a health communication strategy with multiple, parallel climate interventions. The story is based on audience profiling following the Global Warming Six America's audience segmentation (Goldberg *et al* 2020) to mimic perspectives from each of the six groups (from 'alarmed' to 'dismissive') in proportionate representation to match the intended audience.

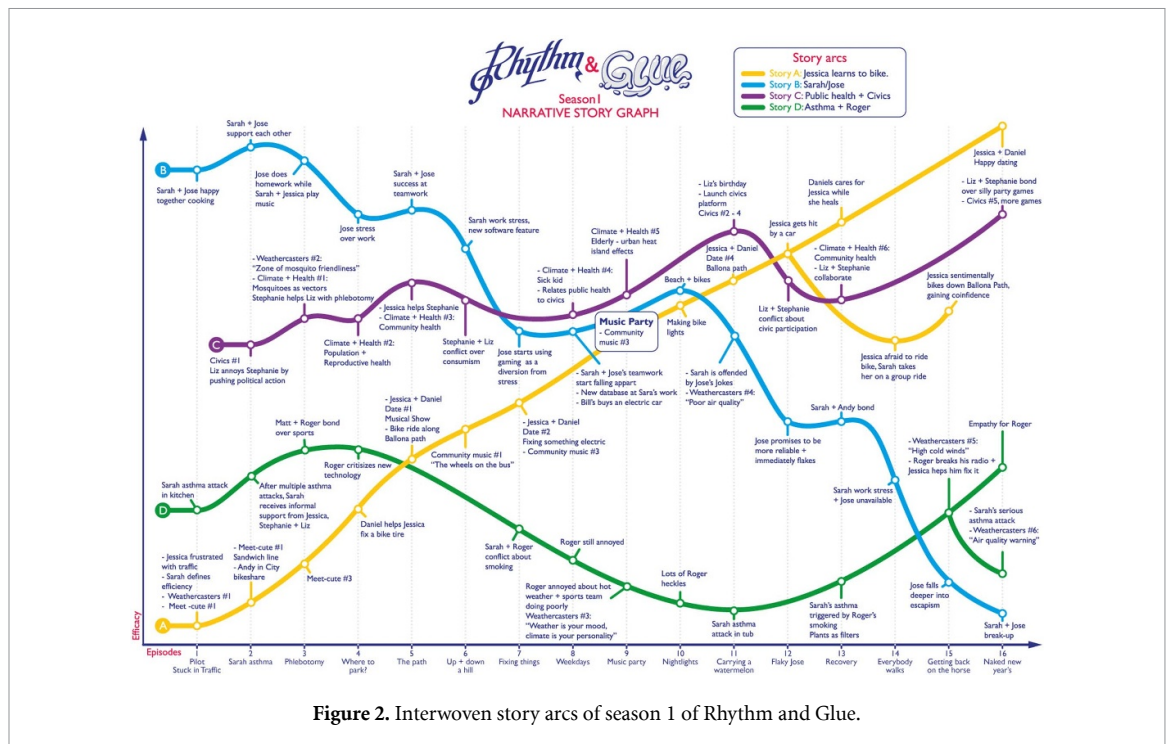


Figure 2. Interwoven story arcs of season 1 of Rhythm and Glue.

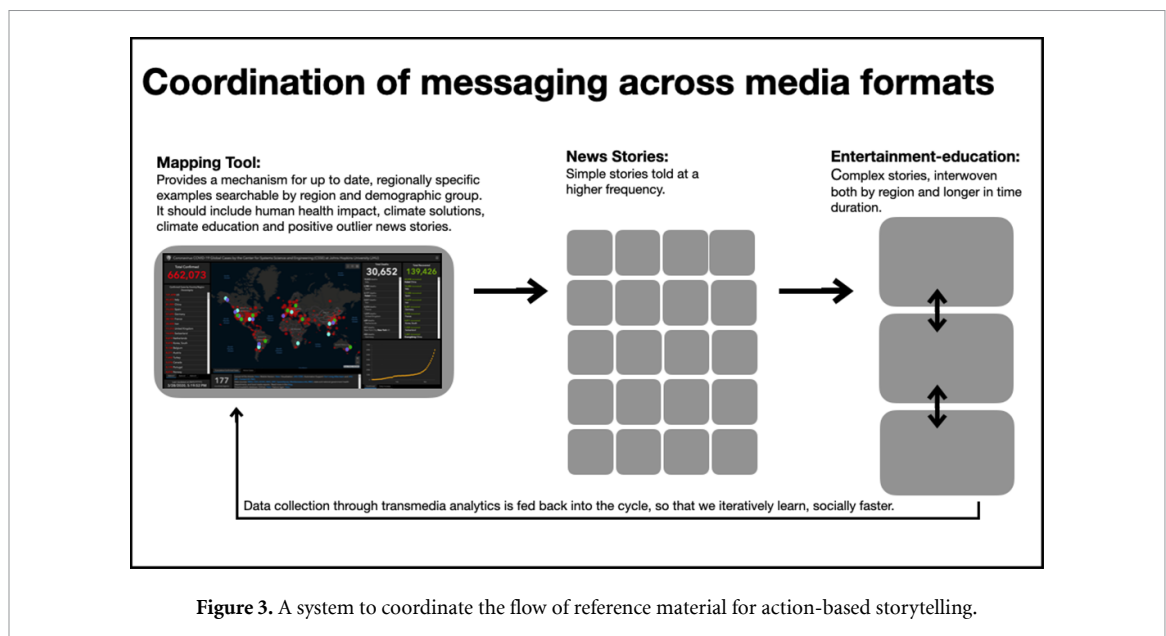


Figure 3. A system to coordinate the flow of reference material for action-based storytelling.

Set in Los Angeles, Rhythm and Glue tells the story of a community of twenty-somethings growing into adults as they learn to collaborate, sharing their skill sets, to build a safer city. The story follows the characters through multiple parallel behavioral interventions at individual and collective levels. Slapstick, romantic entanglements, and career advancement anchor the story. Real-time

participation would drive audience engagement with climate topics. Each season presents an overarching climate change issue. Season 1 tackles transportation and the current health effects of climate change, with subsequent seasons addressing: energy, water, food and waste. The show highlights the

day-to-day realities of climate change and models realistic solutions and behaviors that citizens can take to mitigate those effects, for themselves and their communities.

Figure 2 shows the multiple interwoven story arcs for season 1. These different storylines model different types of agency, from personal agency to make lifestyle changes, to agency for climate action in community, professional or civic contexts. Storyline A (yellow) models iterative goal setting where one friend guides another to learn to navigate active and multimodal urban transport. Storyline B (blue) is the introduction to social-emotional skill building for the character Sarah, who by season 5 of the show

Table 2. Elements of the message coordination system explained. References to the health communication literature where some of these elements are used already are included.

Element	Description
Mapping	A database with reference materials for place- and practice-based climate action stories. The visual mapping front-end accommodates regional variations. Geographic information system (GIS) tools can overlay cultural visualizations of place-based positive outliers. There is a long history of geospatial analysis in public health analysis and intervention (Davenhall and Kinabrew 2011, Graham <i>et al</i> 2011) but this has not yet expanded to include comprehensive climate actions and solutions. Recent applications of GIS in health communication for managing COVID-19 demonstrate how fast these tools can now be built and applied (Perkel 2020). The sweet spot/best fit for most climate solutions of Project Drawdown (Hawken 2017) seems to lie between 10 000 and 100 000 people (Bhowmik <i>et al</i> 2020). Stories told at this scale of place-based community may provide the optimal scale to connect local solutions with the global problem of climate change.
Markers	Purposely incorporating digital ‘markers’—new words, phrases, visual representations, and practices that are well-aligned with a project’s social objectives—promote new social realities and can also be used to track how audience members engage with them over time. Markers need to connect to events in the real world to be effective (Bouman <i>et al</i> 2012, Lutkenhaus <i>et al</i> 2020), so real events and the narrative fiction should be interwoven. For climate communication, this would include markers for each of the actionable behaviors.
Physical nudges	Local level markers can be incorporated into the built environment, similar to guides for navigating a metro system, to help people discover action pathways more easily. This assists people who would like to participate, find pathways for them accommodating their relative interest, time availability and skill levels. While visual nudges are common and recommended, to accommodate a diversity of learning styles, including other sensory guides (visual, auditory, sensory) will improve accessibility and equity for people unable to participate in digital resources (Dreibelbis <i>et al</i> 2016).
Glue	People who serve to coordinate and curate the system. Content curators for the database can be based on existing models, such as Wikipedia’s. These include local/regional coordinators and community-of-practice coordinators, who localize and mobilize place-based and practice-based climate responses. A third type of coordinator, transmedia story coordinators, track and support the integration of campaigns across media types and territories (Lutkenhaus <i>et al</i> 2020). To fit with the optimal scale for local action/solution stories, there should be at least one regional curator for every 100 000 people. For the US, that would translate to around 3500 local coordinators.

grows from a computer programmer into a community leadership role eventually getting elected to local office. Storyline C (purple) demonstrates local health impacts for a variety of community members in a medical procedural setting. In storyline D (green), air quality conflicts in a residential setting lead a climate skeptic to collaborate in solar panel installation in his apartment complex due to his support for energy independence.

As a prototype, Rhythm and Glue was developed to demonstrate how the storytelling approaches of entertainment-education can be applied to action-based storytelling for climate change. A range of stories following this structure can be designed for a variety of regionally and demographically specific groups, then linked together through transmedia platforms. The transmedia approach provides the opportunity for facilitating a broad conversation from a variety of stakeholder perspectives. Improving the coordination between programs through a transmedia interface can help them ‘click’ into a coordinated series synchronizing the real-world responses and the digital storytelling. This strategy would result in a much more intentional storytelling format that can work in conjunction with

climate journalism programs focusing on actions and solutions.

5. Tools to accelerate and coordinate delivery of action-based storytelling

The agency of storytellers to bring an action-based perspective to climate storytelling is one factor. Another requirement is sufficient reference material to feed a constant stream of relatively simple action-based news stories told at high frequency through journalism and various forms of media, and more complex entertainment-education stories which run over longer time periods. To coordinate such a flow of reference materials for all place- and practice-based communities, a systematic approach is required. Based on expertise in entertainment-education, health communication research, and developments in response to COVID-19, figure 3 and table 2 propose the outline and elements of a system to accelerate the delivery of action-based stories from society to the desks of communicators, journalists and storytellers.

The goal of this system is to deliver ‘clear simple messages told often from a variety of trusted sources’ (Maibach 2019). To achieve that kind

of messaging density, while still maintaining two-way public engagement ideals of science communication, is going to require more sustained communication resources to build and maintain these efforts. This is not one static set of stories; it allows for a fast-moving set of stories full of cultural nuances. The speed of the collective response to COVID-19 demonstrates our ability to rapidly collaborate in service of public health goals. This speed applied to climate collaborations can provide transformative public health benefits.

6. Conclusion

There have been many calls before for the application of storytelling, literature, drama and the arts to the communication of climate change (e.g. Mckibben 2005), resulting in a profusion of projects. For a series of reviews, see (Johns-Putra 2016, Nurmis 2016, Hawkins and Kanngieser 2017, Galafassi *et al* 2018). However, simply applying creative storytelling to climate communication is insufficient. A recent study showed that the reading of climate fiction may have short-term positive effects on attitudes and beliefs about climate change, but after one month, those attitude changes had drifted back to baseline (Schneider-Mayerson *et al* 2020). The same effects were observed with film (Howell 2014) and news reports (Happer and Philo 2016): immediate attitude shifts occur but rarely lead to long-lasting changes in either attitudes or behavior. The issue is therefore not just one of pitting fact-based accounts against creative narratives, nor of looking for the ‘right’ media format (e.g. written or visual). Rather, the problem is that in the absence of an action-based conceptualization of climate change, many creative storytelling and arts projects themselves fall prone to an issue-based conceptualization. Notable exceptions can be found in the *solarpunk* arts movement (Springett 2018, Johnson 2020) which, unfortunately, remains a fringe phenomenon.

In contrast, our proposed ‘agency as story structure’ differs from the generic application of creative storytelling to climate communication. It places ‘people taking action’ at the heart of each story, fact-based or fictional, and regardless of level of interactivity or media format. In section 3, we provided the scientific evidence base for this alternative approach. Firstly, there are the concepts of self-persuasion and ‘actions driving beliefs’. They are rooted in experimental traditions in social psychology going back to the 1950s and challenge the currently widespread conventional wisdom that awareness and concern are precursors to climate action. Secondly, there is the proposition from social cognitive theory that people develop agency through learning from the actions of others. Thirdly, the projects in entertainment-education provide the empirical evidence that stories

about people taking action—when told well—do succeed in creating agency in others.

There have been calls before to include an action perspective in climate communication, education and storytelling, e.g. (Nesta 2008, Vaughter 2016, de Vries 2020). These have not had the required effects yet. There are two reasons for this: the capability among content creators to shift their storytelling style from issue to action; and the availability of enough reference material to craft the variety of action-based stories needed. We addressed both requirements in sections 4 and 5.

Like storytelling professionals, climate and environmental scientists have an important role to play in the ecosystem shift from issue-based to action-based communication. In most domains of science communication, scientists and communicators naturally adopt an action perspective. Scientific information is often communicated through stories of the day-to-day research activities that scientists take part in. In climate and environmental sciences, however, the issue and impact framing dominates science communication, thereby reinforcing the ‘poverty of stories’ problem. Climate scientists could be a rich source of reference material for other storytellers (journalists, writers etc.), but not if they focus on the issues alone and forget to communicate the rich variety of research activities they undertake to come to their conclusions. Although the ‘doing’ in this context is different from the ‘doing’ that models context-specific forms of climate action for different communities, adopting an action perspective in climate science communication is another lever to address the poverty of stories problem.

A final community of practice with a role to play in the ecosystem shift are funders. Overland and Savacool (2020) analyzed research grant funding allocations, observing that the split between natural and social science funding for climate change research has been roughly 95% to 5%. These numbers are indicative of the imbalance that exists between science in discovery mode versus delivery mode—which is the central topic that this special issue set out to address. To deliver the transformation to an action-based conceptualization will require rebalancing of the discovery/delivery modes, with more support for the implementation and evaluation of initiatives to foster action-based storytelling. This shift will require the development of skills and agency in key communities of practice, of infrastructure and curation to coordinate the flow of reference materials for stories, and of multidisciplinary strategies such that we can cooperate more effectively across academic disciplinary boundaries, but also with practitioners in other communities of practice.

At present, climate communication and storytelling, with their focus on the transfer of information, awareness or concern, are not having the required effects of mobilizing climate action across

society. In the absence of agency, awareness and concern do not automatically lead to action. Rather, they can lead to long-term anxiety, apathy or denial. In this article we proposed an alternative to the currently dominant approach to climate storytelling, one that is rooted in how people develop a sense of deep engagement and agency in other areas of life.

A focus on actions and agency does not make accurate information about the science and impacts of climate change obsolete. What it does mean, however, is that people who engage with climate change through a self-persuasive process are intrinsically motivated to engage with climate change information—rather than that they need to be persuaded to care. The focus should be on providing people with opportunities for action to allow them to start a self-persuasive process and develop agency. Rather than telling them what to do, climate storytelling should support them in discovering *how* to act. As a community we need to create an array of agency-provoking stories of existing positive outliers across different communities, supported by transmedia coordination strategies proportionately scaled to the magnitude of the public health impacts. What is needed now are not the menus—but the recipes, cookbooks, and cooking classes of climate action.

Data availability statement

No new data were created or analyzed in this study.

ORCID iDs

Kris De Meyer  <https://orcid.org/0000-0003-4351-8937>

Emily Coren  <https://orcid.org/0000-0003-1982-6809>

Mark McCaffrey  <https://orcid.org/0000-0001-6724-1368>

References

- Aronson E 1997 Back to the future: retrospective review of Leon Festinger's 'a theory of cognitive dissonance' *Am. J. Psychol.* **110** 127
- Aronson E 1999 The power of self-persuasion *Am. Psychol.* **54** 875–84
- Aronson E 2008 Fear, denial and sensible action in the face of disasters *Soc. Res.* **75** 855–72
- Bandura A 1982 Self-efficacy mechanism in human agency *Am. Psychol.* **37** 122–47
- Bandura A 2006 Toward a psychology of human agency *Perspect. Psychol. Sci.* **1** 164–80
- Bandura A 2018 Toward a psychology of human agency: pathways and reflections *Perspect. Psychol. Sci.* **13** 130–6
- Bevan L D, Colley T and Workman M 2020 Climate change strategic narratives in the United Kingdom: emergency, extinction, effectiveness *Energy Res. Soc. Sci.* **69** 101580
- Bhowmik A K, McCaffrey M S, Ruskey A M, Frischmann C and Gaffney O 2020 Powers of 10: seeking 'sweet spots' for rapid climate and sustainability actions between individual and global scales *Environ. Res. Lett.* **15** 094011
- Blake J 1999 Overcoming the 'value-action gap' in environmental policy: tensions between national policy and local experience *Local Environ.* **4** 257–78
- Bouman M P A, Drossaert C H C and Pieterse M E 2012 Mark my words: the design of an innovative methodology to detect and analyze interpersonal health conversations in web and social media *J. Technol. Hum. Serv.* **30** 312–26
- Bouman T, Verschoor M, Albers C J, Böhm G, Fisher S D, Poortinga W, Whitmarsh L and Steg L 2020 When worry about climate change leads to climate action: how values, worry and personal responsibility relate to various climate actions *Glob. Environ. Change* **62** 102061
- Carpenter J M and Green M C 2012 Flying with Icarus: narrative transportation and the persuasiveness of entertainment *The Psychology of Entertainment Media* ed Shrum L J (New York: Routledge) pp 169–194
- Chapman D A, Lickel B and Markowitz E M 2017 Reassessing emotion in climate change communication *Nat. Clim. Change* **7** 850–2
- Clayton S and Karazsia B T 2020 Development and validation of a measure of climate change anxiety *J. Environ. Psychol.* **69** 101434
- Coren E and Safer D L 2020 Solutions stories: an innovative strategy for managing negative physical and mental health impacts from extreme weather events *Climate Change, Hazards and Adaptation Options Climate Change Management*, ed W Leal Filho, G J Nagy, M Borga, P D Chávez Muñoz and A Magnuszewski (Cham: Springer) pp 441–62
- Crano W D and Prislin R 2006 Attitudes and persuasion *Annu. Rev. Psychol.* **57** 345–74
- Davenhall W F and Kinabrew C 2011 GIS in health and human services *Springer Handbook of Geographic Information Springer Handbooks*, ed W Kresse and D M Danko (Berlin: Springer) pp 557–78
- De Meyer K, Jackson A, Hubble-Rose L, Gingold P and Rapley C 2019 New ways to shape meaningful action on climate change? *UCL Policy Commission on Communicating Climate Science* (available at: <https://bit.ly/ccspcmaw2019>)
- de Vries G 2020 Public communication as a tool to implement environmental policies *Soc. Issues Policy Rev.* **14** 244–72
- Doherty K L and Webler T N 2016 Social norms and efficacy beliefs drive the alarmed segment's public-sphere climate actions *Nat. Clim. Change* **6** 879–84
- Dreibelbis R, Kroeger A, Hossain K, Venkatesh M and Ram P 2016 Behavior change without behavior change communication: nudging handwashing among primary school students in Bangladesh *Int. J. Environ. Res. Public Health* **13** 129
- El Amiri N, Abernethy P, Spence N, Zakus D, Kara T-A and Schuster-Wallace C 2020 Community of practice: an effective mechanism to strengthen capacity in climate change and health *Can. J. Public Health* (<https://doi.org/10.17269/s41997-020-00400-8>)
- Ereaut G and Segnit N 2006 Institute for Public Policy Research Warm Words: how are we telling the climate story and can we tell it better? (<https://www.ippr.org/publications/warm-words-how-are-we-telling-the-climate-story-and-can-we-tell-it-better>)
- Ertz M and Sarigöllü E 2019 The behavior-attitude relationship and satisfaction in proenvironmental behavior *Environ. Behav.* **51** 1106–32
- Fagan M and Huang C 2019 A look at how people around the world view climate change Pew Research Centre (<https://pewrsr.ch/2UpGcq7>)
- Galafassi D, Kagan S, Milkoreit M, Heras M, Bilodeau C, Bourke S J, Merrie A, Guerrero L, Pétursdóttir G and Tàbara J D 2018 'Raising the temperature': the arts on a warming planet *Curr. Opin. Environ. Sustain.* **31** 71–79
- Goldberg M, Gustafson A, Rosenthal S, Kotcher J, Maibach E and Leiserowitz A 2020 For the first time, the alarmed are now the largest of global warming's six Americas *Yale Program Clim. Change Commun.*

- (available at: <https://climatecommunication.yale.edu/publications/for-the-first-time-the-alarmed-are-now-the-largest-of-global-warmings-six-americas/>)
- Goldsworthy A 2020 Depolarizing *Four Thought* (available at: www.warepolespart.com/depolarizing_for_bbc_radio_4)
- Graham S R, Carlton C, Gaede D and Jamison B 2011 The benefits of using geographic information systems as a community assessment tool *Public Health Rep.* **126** 298–303
- Gray E and Jackson C 2020 Two thirds of citizens around the world agree climate change is as serious a crisis as coronavirus *Ipsos* (available at: www.ipsos.com/en/two-thirds-citizens-around-world-agree-climate-change-serious-crisis-coronavirus)
- Happer C and Philo G 2016 New approaches to understanding the role of the news media in the formation of public attitudes and behaviours on climate change *Eur. J. Commun.* **31** 136–51
- Hawken P 2017 *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming* (New York: Penguin Books)
- Hawkins H and Kanngieser A 2017 Artful climate change communication: overcoming abstractions, insensibilities, and distances *WIREs Clim. Change* **8** e472
- Hornsey M J and Fielding K S 2020 Understanding (and reducing) inaction on climate change *Soc. Issues Policy Rev.* **14** 3–35
- Hornsey M J, Harris E A, Bain P G and Fielding K S 2016 Meta-analyses of the determinants and outcomes of belief in climate change *Nat. Clim. Change* **6** 622–6
- Howell R A 2014 Investigating the long-term impacts of climate change communications on individuals' attitudes and behavior *Environ. Behav.* **46** 70–101
- Johns-Putra A 2016 Climate change in literature and literary studies: from cli-fi, climate change theater and ecopoetry to ecocriticism and climate change criticism: climate change in literature and literary studies *Wiley Interdiscip. Rev. Clim. Change* **7** 266–82
- Johnson I 2020 'Solarpunk' & the pedagogical value of Utopia *J. Sustain. Educ.* (available at: www.susted.com/wordpress/content/solarpunk-the-pedagogical-value-of-utopia_2020_05/)
- Kincaid D L 2002 Drama, emotion, and cultural convergence *Commun. Theory* **12** 136–52
- Kollmuss A and Agyeman J 2002 Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **8** 239–60
- Lapierre R T 1934 Attitudes vs actions *Soc. Forces* **13** 230–7
- Lauren N, Fielding K S, Smith L and Louis W R 2016 You did, so you can and you will: self-efficacy as a mediator of spillover from easy to more difficult pro-environmental behaviour *J. Environ. Psychol.* **48** 191–9
- Leiserowitz A, Ballew M, Rosenthal S and Semaan J 2020 *Climate Change and the American Diet* (New Haven, CT: Yale University and Earth Day Network)
- Leiserowitz A, Maibach E, Rosenthal S, Kotcher J, Bergquist P, Gustafson A, Ballew M and Goldberg M 2019 *Climate Activism: Beliefs, Attitudes, and Behaviors* (New Haven, CT: Yale University and George Mason University) November 2019
- Lutkenhaus R O, Bouman M P A, Wang H and Singhal A 2020 Using markers for digital engagement with the audience of main kuch bhi kar sakti hoon season 3 a transmedia entertainment education initiative for sanitation, family planning, and gender equality in India (available at: www.dropbox.com/s/0lzm3p1jn5tlwsi/Exec%20Sum_MKBKSH3_CMH_FinalReport_Dig%20Track.PDF?dl=0)
- Lutkenhaus R O, Jansz J and Bouman M P A 2020 Toward spreadable entertainment-education: leveraging social influence in online networks *Health Promot. Int.* **35** 1241–1250
- Maibach E 2019 Increasing public awareness and facilitating behavior change: Two guiding heuristics. George Mason University Center for Climate Change Communication Report (<https://www.climatechangecommunication.org/wp-content/uploads/2018/06/Maibach-Two-heuristics-September-2015-revised.pdf>)
- Maibach E 2020 Supporting communities of practice as a strategy to accelerate uptake of environmental science for climate action: TV weathercasters as a case study (<https://doi.org/10.2139/ssrn.3702498>)
- Marcinkowski T and Reid A 2019 Reviews of research on the attitude-behavior relationship and their implications for future environmental education research *Environ. Educ. Res.* **25** 459–71
- Marsh D R, Schroeder D G, Dearden K A, Sternin J and Sternin M 2004 The power of positive deviance *BMJ* **329** 1177–9
- Mckibben B 2005 What the warming world needs now is art, sweet art *Grist* (available at: <https://grist.org/article/mckibben-imagine/>)
- Moser S C 2016 Reflections on climate change communication research and practice in the second decade of the 21st century: what more is there to say?: Climate change communication research and practice *Wiley Interdiscip. Rev. Clim. Change* **7** 345–69
- Moyer-Gusé E 2008 Toward a theory of entertainment persuasion: explaining the persuasive effects of entertainment-education messages *Commun. Theory* **18** 407–25
- Munson Z W 2008 *The Making of Pro-life Activists: How Social Movement Mobilization Works* (Chicago, IL: University of Chicago Press)
- Nariman H N 1993 *Soap Operas for Social Change: Toward a Methodology for Entertainment-education Television* (Westport, Conn: Praeger)
- Nesta 2008 Selling sustainability: seven lessons from advertising and marketing to sell low-carbon living National Endowment for Science, Technology and the Arts (available at: https://media.nesta.org.uk/documents/selling_sustainability.pdf)
- NRDC 2020 Rewrite the future NRDC (available at: www.nrdc.org/RewriteTheFuture)
- Nurmis J 2016 Visual climate change art 2005–2015: discourse and practice: visual climate change art 2005–2015 *Wiley Interdiscip. Rev. Clim. Change* **7** 501–16
- Overland I and Sovacool B K 2020 The misallocation of climate research funding *Energy Res. Soc. Sci.* **62** 101349
- Painter J 2013 *Climate Change in the Media: Reporting Risk and Uncertainty* (London: I.B. Tauris & Co)
- Painter J, Erviti M C, Fletcher R, Howarth C, Kristiansen S, Leon B, Ouakrat A, Russell A and Schaefer M 2017 *Something Old, Something New: Digital Media and the Coverage of Climate Change* (Oxford: Reuters Institute for the Study of Journalism)
- Pearce W, Brown B, Nerlich B and Koteyko N 2015 Communicating climate change: conduits, content, and consensus: communicating climate change *Wiley Interdiscip. Rev. Clim. Change* **6** 613–26
- Perkel 2020 Behind the Johns Hopkins University coronavirus dashboard *Nat. Index* (available at: www.natureindex.com/news-blog/behind-johns-hopkins-university-coronavirus-dashboard)
- Petty R E and Wegener D T 1998 Attitude change: multiple roles for persuasion variables *The Handbook of Social Psychology* (New York: McGraw-Hill) pp 323–90
- Poortinga W, Whitmarsh L and Suffolk C 2013 The introduction of a single-use carrier bag change in Wales: attitude change and behavioural spillover effects *J. Environ. Psychol.* **36** 240–7
- Schneider-Mayerson M, Gustafson A, Leiserowitz A, Goldberg M H, Rosenthal S A and Ballew M 2020 Environmental literature as persuasion: an experimental test of the effects of reading climate fiction *Environ. Commun.* **1**–16

- Seethaler S, Evans J H, Gere C and Rajagopalan R M 2019 Science, values, and science communication: competencies for pushing beyond the deficit model *Sci. Commun.* **41** 378–88
- Singhal A and Dura L 2009 *Protecting Children from Exploitation and Trafficking: Using the Positive Deviance Approach in Uganda and Indonesia* (Washington, DC: Save the Children)
- Singhal A and Dura L 2017 Positive deviance: a non-normative approach to health and risk messaging *Oxford Research Encyclopedia of Communication* (Oxford: Oxford University Press) (<https://oxfordre.com/communication/view/10.1093/acrefore/9780190228613.001.0001/acrefore-9780190228613-e-248>)
- Singhal A and Rogers E M 2002 A theoretical agenda for entertainment education *Commun. Theory* **12** 117–35
- Singhal A and Rogers E M 2011 *Entertainment-education: A Communication Strategy for Social Change* (London: Routledge)
- Singhal A, Wang H and Rogers E M 2013 *The Rising Tide of Entertainment–Education in Communication Campaigns Public communication campaigns* (SAGE) Rice R E and Atkin C K ed 4th edn (<https://doi.org/10.4135/9781544308449.n22>)
- Springett J 2018 Solar punk—a reference guide *Medium* (available at: <https://medium.com/solarpunks/solarpunk-a-reference-guide-8bcf18871965>)
- Stajkovic A D and Luthans F 1998 Self-efficacy and work-related performance: a meta-analysis *Psychol. Bull.* **124** 240–61
- Tavris C and Aronson E 2020 *Mistakes were Made (But Not by Me): Why We Justify Foolish Beliefs, Bad Decisions, and Hurtful Acts* 3rd edn (Boston, MA: Houghton Mifflin Harcourt)
- UCLA Skoll 2019 The state of SIE report—mapping the landscape of social impact entertainment *State SIE Rep.* (available at: www.thestateofsie.com/)
- van der Linden S 2017 *Oxford Research Encyclopedia of Climate Science* (Oxford : Oxford University Press) Determinants and Measurement of Climate Change Risk Perception, Worry, and Concern (<https://doi.org/10.1093/acrefore/9780190228620.013.318>)
- Vaughter P 2016 Climate change education: from critical thinking to critical action (UNU-IAS) (available at: www.unclearn.org/sites/default/files/unuias_pb_4.pdf)
- Wallace-Wells D 2019 Opinion | time to panic N. Y. *Times* (available at: www.nytimes.com/2019/02/16/opinion/sunday/fear-panic-climate-change-warming.html)
- Wenger E 1998 *Communities of Practice: Learning, Meaning, and Identity* (Cambridge: Cambridge University Press)
- Witte K 1992 Putting the fear back into fear appeals: the extended parallel process model *Commun. Monogr.* **59** 329–49
- Witte K and Allen M 2000 A meta-analysis of fear appeals: implications for effective public health campaigns *Health Educ. Behav.* **27** 591–615
- World Bank 2015 World Development Report 2015: Mind, Society, and Behavior (<https://doi.org/10.1596/978-1-4648-0342-0>)