

Emotional Power and Communicating about Climate Change: Engaging Urban People with Bushfire

Madeleine Antonellos
School of Computing and Information
Systems
The University of Melbourne
Parkville, Victoria, Australia
Faculty of Science and Technology
Charles Darwin University
Darwin, Northern Territory, Australia
antonellos.mk@gmail.com

Nicola J Bidwell
Faculty of Science and Technology
Charles Darwin University
Darwin, Northern Territory, Australia
Department of Information Systems
Rhodes University
Makhanda, South Africa
nic.bidwell@gmail.com

Sarah Webber
School of Computing and Information
Systems
The University of Melbourne
Parkville, Victoria, Australia
s.webber@unimelb.edu.au

Abstract

Amidst escalating global concern about the intensification of bushfire (wildfire), we investigate how interactive, data-driven articles shape people's engagement with this expanding environmental crisis. We build on critical discourse that positions climate informatics products as sociopolitical actors, as well as research on polarisation in environmental communication, through an empirical study of bushfire news coverage and its reception by urban Australians. We conducted semi-structured interviews with 7 fire science experts and 12 city-dwellers, who engaged with three interactive news articles. Our analysis highlights the challenges of navigating uncertainty, polarised and shifting discourse, and the emotional burden of bushfire communication. We show that engagement is shaped by a dynamic interplay between affective and cognitive sense-making, which can both motivate and inhibit attention. Participants expressed a desire for actionable, place-relevant information, yet often encountered barriers in interpreting complex or ambiguous visualisations. Based on these findings, we identify design opportunities for interactive articles that (1) respond to audiences' existing exposure to environmental discourse, (2) scaffold engagement with uncertainty, (3) connect audiences with distant people and places, and (4) support pathways to collective action.

CCS Concepts

• **Human-centered computing** → **Empirical studies in collaborative and social computing.**

Keywords

bushfire, science communication, environmental informatics, interactive articles

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1 Introduction

The intensity and scale of wildfires (or bushfires) have captured global attention through emotionally charged imagery, data-rich reporting, and politically oriented tweets [76]. News coverage of the escalating impacts of such fire events combine photos of blackened landscapes, estimates of billions of animals killed and expansive maps of affected regions, from Hawai'i to Greece and beyond. Data-driven reporting and visualisations have become tightly woven into communicating about fire science and 'informating' [31] fire events; however, their role in public engagement and sense-making about bushfire is under-examined.

In this paper, we extend HCI's interest in relationships between media production, environmental crises, societal inequities and polarisations. We focus on interactions between urban dwellers and interactive articles about bushfires in Australia. Comprising most of the population, people living in Australia's dense metropolitan and peri-urban areas and are often framed as distant from bushfire risk. This obscures their entanglement in bushfire's economic, social and cultural impacts, including decisions about an uncertain future, which can contribute to collective responses.

Visualisations of megafires powerfully communicate about climate change. Amongst the many ways that HCI has explored communicating about climate change [51, 56], prior work refers to how data and representations, produced in managing and documenting environmental events, shape the possibilities for acting in the world, obscure uncertainty, and amplify inequities between subjects of risk [79]. Interactive articles are an example of efforts to enable the public to explore data sets in ways that meet their interests, and have been studied in domains such as public health and climate change [28, 68], alongside interest in practices of 'data journalism' [55, 75]. Other work in HCI focuses on relations between design, ethics and care for particular places and ecosystems (e.g. [14]), often co-authored with [5] or inspired by [38, 59] First Nations people. However, to date, little work has explored how emotional and cognitive aspects entwine in interacting with data-driven communications about climate change or how the effective design of interactive science communications may be a foundation for productive public discourse on complex topics [18, 43].



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To understand design issues in communicating about contested science topics in climate change, we analyse three interactive articles about Australia's Black Summer fires. We conducted interviews with experts to examine communication intentions, and with urban dwellers to examine their reception. We ask: 1) how different types of interactive elements elicit engagement and might foster collective involvement; and, 2) how urban dwellers, who bring varied questions and motivations, navigate the information. Our contributions are fourfold. Firstly, we contribute an empirically grounded account of the complex, dynamic and affectively charged space of bushfire science communication. Secondly, we illuminate how emotional responses and cognitive sense-making combine in shaping engagement. Thirdly, we offer implications for interactive articles that support connection, comprehension, and action. Finally, we illustrate how studies of polarisation and politicisation of online climate discourse (e.g. [76]) and 'informing crisis' [31, 79] can inspire communication design.

2 Background: Bushfire and Communities in Australia

Long understood as part of Australia's natural ecology, bushfires occur across the vast continent, although their season varies with the climate zones and weather patterns. The peak fire season in the south, November to March, is driven by summer heat and dry vegetation, especially in forested areas of New South Wales (NSW), Victoria (VIC), South Australia (SA), Tasmania (TAS), the south of Queensland (QLD) and Western Australia (WA). Across the Northern Territory (NT), northern QLD and WA, vast savanna fires occur from May to October after the wet season ends. Periodically, there are more extreme bushfire seasons. For instance, in 1939 (the "Black Friday" fires), 1983 (the "Ash Wednesday" fires), 2009 ("Black Saturday"), 2019/2020 (the "Black Summer" fires) and, between 2023 and 2026, extensive burning in the north and southeast of the continent. Climate change has increased the rate and impact of severe bushfire seasons [23]. Australia is now drier and has more heatwaves, more frequent cyclones and heavier rains which increase fuel loads between fires [15, 72]. Fires have also elevated both carbon dioxide release and the loss of flora [29, 97].

The spectre of species extinction, irrevocable loss of beloved landscapes, as well as degraded air quality and water systems challenge Australians' expectations about fire cycles and their impacts on human lifestyles. The public outpouring of grief [65] shows how extreme bushfires incur emotional tolls. Community participation is recognised nationally and internationally as vital for effective action in the face of changing bushfire regimes [66, 87], and bushfire disasters can precipitate a desire for collective responses. However, in bushfire preparation and recovery, "community" is conceptualised in various ways [26], and the content and reach of information exclude many people from spheres of responsibility. For instance, national media rarely report on northern fires, despite dire consequences for the health of First Nations people, or about how First Nations' land management practices have long contributed to fire resilience [8, 80]. While policymakers seek to engage different publics in bushfire decision-making and resilience [32], practices emphasise engaging with the rural dwellers who are most directly affected by fire risk [20]. Thus, urban and peri-urban

dwellers may feel disconnected despite the anticipated future impacts of fire on peri-urban and wildland-urban interface areas [48, 52, 85]. This disconnect performs in both rural-city divides and the inequities of the environmental crisis. Importantly, it affects the agency of different communities by creating uneven conditions for their action and response to fire risk.

3 Related Work

We frame our research in prior work about science communication, crisis informatics, and designing in an era of environmental and political crisis, as well as in HCI, Computer-Supported Cooperative Work (CSCW), and Science and Technology Studies (STS). This provides a critical lens on the role of technologies in shaping societal and political constructions of bushfire in Australia, the types of response that are possible, and inclusions and divisions in conversations. Growing attention to bushfires' mental health impacts [35] extend insights about how the psychological effects of the global environmental crisis shape engaging with climate issues [1, 3, 13]. Thus, we draw on literature in psychological and social sciences, and media studies, about emotional responses to climate change and bushfire to inform our analysis of engagement in bushfire-related media, and the effective design of interactive articles.

3.1 Climate change, emotions and engagement in media

While 'good' science communication may convey 'accurate facts' it often does not engage people [21]. Thus, HCI studies of effective online science communication describe the ways researchers and enthusiasts adopt authentic, casual and personal approaches in social media and blogs to engage diverse audiences with complex topics [34, 95]. However, many researchers who maintain social media profiles and websites tied to their professional persona will often use these platforms far less often to engage with emotionally or politically charged topics, because of the potential for miscommunication, backlash or even harassment [25, 34, 93]. Indeed, while emotional involvement with data about climate protection can contribute to political and cultural shifts [42, 60], representations of climate change that promote fear can be perceived as exaggerated [53] or manipulative [64] and can lead to denial [44].

New terms have been coined to describe different "eco-emotions" and earth-related, or "psychoterratic", syndromes. 'Eco-anxiety' describes fears related to the uncertain environment [89]; 'ecoparalysis' refers to inaction when confronting the sheer scale and complexity of the problems and the dilemmas that arise with solutions [3]; and 'eco-burnout' denotes feeling overwhelmed by repeated exposure to disturbing environmental information. People's strategies to cope, emotionally, can include acquiescing, withdrawing, averting attention and avoiding information [83], but they also include focusing on doing something about problems and gaining emotional support, such as a sense of belonging in a community engaged in eco-friendly action or activism [13].

Some HCI researchers advocate for fostering involvement in climate mitigation, adaptation and protection responses by focusing on people's sense of meaning and fulfilment, care for the more-than-human world and happier visions of the future [51, 56]. Studies in climate communication show that deepening knowledge requires

offering people a sense of realistic hope and actionable attitudes [60] that link to their everyday cares, emotions and concerns [54, 64, 73, 74]. Engagement in stories, on social media, can combat eco-anxiety, elicit pro-environmental behaviours and enable eco-emotions to influence public conversation [13, 37, 39, 54, 76]. Thus, drawing on Webster et al.'s, [92] summary about how to communicate about climate change during a pandemic, Ferreira et al. [27] highlight several key shifts for HCI in climate projects, including a focus on the real world rather than abstract ideas, stories rather than statistics or graphs, and accounting for specific audiences' values and political views.

Emotional impacts are integral to how climate change communications act as instruments of power. Soden and Palen [79] draw on Fortun's [31] critique of the unified, authoritative and conclusive statements about environmental problems and remedies which risk communication experts presented to reassure people and avoid panic. They explain that practices of 'informing' events, such as floods and earthquakes, reinforce inequalities and determine who receives assistance and who will live with risk [79]. Fortun [31] argued for enabling different publics to actively make connections both amongst competing and uncertain information and with people in similar and different locales. Yet, different groups have different vulnerabilities to the emotional impacts of climate change [1, 13]. For instance, young people are more likely to fear societal inaction, while scientists who study climate change can incur social penalties [13, 40, 41].

3.2 Bushfires, media and polarisations in Australia

Work in HCI, around the world, has contributed various designs to help prepare affected residents and firefighters in dealing with the immediate threat of a bushfire (e.g. [86]). HCI studies also show that knowledge and data about fire are fragmented across various stakeholders, and that there are wide-ranging concerns about how biases in information affect decision-making [57].

In Australia, most studies of communication about fire events and bushfire preparedness focus on rural residents. These studies show that rural communication practices are deeply embedded in local contexts: residents tend to rely on information conveyed through key local places, newspapers, social networks, and the 'bush telegraph' (word of mouth), which they consider more timely and trustworthy than external or centralised sources [20]. Such communication entwines with everyday practices that rehearse senses of belonging and mutual reliance, helping residents reconcile the risks of living in potentially dangerous settings with feeling safe and secure [52]. As a result, local collective narratives about fire events and preparedness become imbued with meanings of environmental continuity, resilience [9, 52], and ontological security; or a sense that the world, one's life, and identity are stable and predictable [6, 52]. These communication dynamics differentiate rural residents from urban populations. Rural communities often emphasise their separateness and remain cautious of information perceived to originate from 'outsiders' [20, 69, 70]. Yet, while local distinctiveness is salient to the design of early-warning bushfire systems [61], rural populations are also diverse and changing. They include people with varying experiences and knowledge of fire [2],

and their social cohesion can be differently affected by fire events [30]. Further, both preparedness and local economies are influenced by tourists' exposure to bushfire information [20].

The response of Australia's wider, predominantly city-dwelling, public to bushfire is shaped by traditional media, such as newspapers and television, which often contribute to tropes, misunderstandings, and controversy. The visual spectacle of bushfires and grim imagery of exhausted firefighters, traumatised citizens, burnt animals, and the ashes of homes [12] can quadruple the number of photos in newspapers [96] and extend the duration of coverage [58]. Intense emotional content in fire stories has prompted critique that traditional media promotes clichés and myths, portrays people as helpless victims, and creates scapegoats [45]. At the same time, media saturation by modern technology [96] has increased awareness of First Nations fire practices. For instance, radio and TV [11] have featured expert practitioners involved in re-establishing and documenting cultural burns on their ancestral lands, after disruption by colonial pastoralism and forced removal [8, 80].

Media coverage and interactions between traditional and modern media have prompted vigorous debate on both Indigenous fire practices and the causes and reduction of fire [12, 58]. The potency of these interactions reached new heights during the 2019-20 "Black Summer" fires, when two polarised communities emerged on *Twitter* (now known as *X*). Along with sadness expressed across social media, opposing narratives attributed the bushfires to arson or to climate change [91, 94]. A newspaper report about the role of bots in this Twitter exchange [82] expanded the reach of the debate and, although fewer bots were actually involved than first reported, traditional media reshaped the dynamics of the discussion [90]. Yet, while traditional media succeeded in amplifying the debate, it has failed to promote meaningful engagement with fire science and its complexities [4]; and researchers are calling for further studies of 'the relationships and tensions between content creators and journalists in Australia' [88].

In the context of information fragmentation and polarising media interactions, we investigate how bushfire media can better engage more Australians, who are largely urban dwellers. We do not propose that city dwellers should make decisions on behalf of rural people, who are directly affected by fire. Rather, we envision that being better informed about bushfire and fire ecology will enable all Australians to participate in an extended community of mutual care, communal action and shared responsibility.

4 Study Design

4.1 Data gathering

First, we sought to understand scientists' and science communicators' perspectives on public understanding of bushfire and the environment. We interviewed seven Australian subject matter experts, with research specialisms in fire ecology, wildlife ecology, fire impacts on water systems, community bushfire recovery, and science communication. Two authors conducted semi-structured interviews via Zoom, or in person, following a documented protocol. We asked about what the Australian public should know about bushfire and why; perceived levels of understanding and misconceptions; sources of public knowledge and the role of formal education, media and other institutions; important audiences and

how they should be addressed, and suggestions for better science communication in this domain.

Next, we investigated how existing media about bushfires is received, whether it supports meaningful engagement with bushfire issues, and contributes to response and mitigation. We conducted semi-structured interviews with 12 members of the Australian public via Zoom. First, we explored participants’ initial responses and experiences of fire, and perceptions of communities and landscapes affected by fire. Then we asked about their interests in, or questions about, the topic of fire, and whether they could imagine themselves participating in consultation and decision-making on fire-related issues. We asked about the role of city dwellers in responding to fire, the types of knowledge or information they would need, and what they would ask if they had access to an expert on the topic.

To learn about participants’ choices of media about fire, we showed six recent headlines from the Australian Broadcasting Corporation’s (ABC) online news site. As national broadcaster, the ABC is widely accepted as a trusted source of information on bushfire. We searched for articles published within the previous two weeks (July 2023) containing the term “bushfire” or “fire”, and reviewed the first 30 articles. We identified six recurring topics: impacts on communities; firefighters’ preparations; impacts on flora and fauna; links to global warming; innovation and technology; and government response. We selected one article to represent each topic and presented all six to participants. We asked whether they would be interested in reading about any of the topics listed, and why; if they would usually engage or avoid the topic; and what their preferred media sources and types of media they would be most likely to interact with.

Participants also engaged with three interactive articles (IA 1, IA 2, IA3 [19, 36, 67]) using a think-aloud protocol. Through a series of Google searches conducted in 2022-2023, we identified three long-form articles about the 2019-20 bushfires, published by reputable sources, that use interactive features in slightly different ways. Two authors analysed the three articles to identify the types of interactive components they contain (Section 5.2). We distributed participants across the three interactive articles (IA 1–3) to ensure exposure to different interaction styles and content emphases. Each participant engaged with at least one article, which provided comparative insights across articles while maintaining deep engagement with each interaction. Participants spent 10-45 minutes reading the assigned interactive articles, and we used Zoom screen sharing to gain insights into what they were looking at and how they were responding. In instances where participants experienced usability or accessibility issues (P7, P9), we curtailed exploration of the article and invited them to engage with a second article. Finally, participants completed a short demographic survey and the New Environmental Paradigm (NEP), an internationally used instrument to measure ecocentric orientation [24]. An ‘NEP score’ [24] was provided for each participant, quantifying their environmental orientation from 1 (low) to 5 (high) (Table 2).

4.2 Participant recruitment

We identified subject matter experts (labelled E1-E7 in Table 1) through our existing networks in Australia and by searching a

university’s staff pages for specialists on the topics of fire ecology, wildlife conservation, fire science, and science communication. Drawing from the university’s collective expertise in fire science and social sciences in fire recovery, we asked key informants for suggestions as to the areas of research relevant to our inquiry, to expand our search for experts, and asked each expert participant to suggest other people or disciplinary areas that we should speak to.

ID	Field	Role
E1	Ecology	Senior Academic
E2	Fire Ecology	Early Career Academic
E3	Fire Ecology, Fire Risk	Early Career Academic
E4	Fire Ecology, Fire Risk Modelling	Mid-Career Academic
E5	Social Work in Post-Disaster Settings	Senior Academic
E6	Forest and Fire Hydrology, Climate Change	Senior Academic
E7	Wildlife Ecology and Conservation	Senior Academic

Table 1: Subject Matter Experts Who Participated in the Study

We recruited members of the Australian public (designated P1-P12 in Table 2) via *Prolific*, a commercial recruitment service. We applied demographic filters to recruit a sample of residents of Australia’s major cities that was gender-balanced and represented varied incomes, educational backgrounds, occupations and political affiliation (Table 2).

4.3 Data Analysis

We analysed our interview data using reflexive thematic analysis as outlined by Terry & Hayfield [84]. We systematically coded the interview data from subject matter experts and members of the public separately and developed themes. We read the interview transcripts repeatedly to familiarise ourselves with the data and to note initial ideas, then open-coded the entire dataset and organised the relevant data into meaningful groups. We then collated these codes into potential themes and assessed them against the dataset to determine whether they formed a coherent pattern. Subsequently, we defined, named and refined the themes. We present them in the following section.

5 Bushfire Science Communication and Interactive Articles

This section first summarises subject matter experts’ perspectives on the challenges and approaches of science communication related to bushfire, and then provides a description of the interactive elements included in the three articles (IA1, IA2, IA3) studied in this project [19, 36, 67].

5.1 Subject Matter Experts’ Perspectives on Bushfire Science Communication

Our interviews with experts revealed both the complexity of fire-related science and the challenges of communicating it effectively to the public. Many experts were actively engaged in science communication, producing content for public and government audiences. They emphasised empowering the broader community in environmental conversations, by foregrounding agency over “*fear-mongering*” or sensationalism. and avoiding ‘deficit models’ of science communication (E1, E3). As E1 explained, “*I think we know*

ID	Gender	Residential area	Political affiliation	NEP Score	IA*
P1	Male	Inner capital city	Independent	4.60	IA1
P2	Female	Suburbs of capital city	Labor	4.00	IA1
P3	Male	Suburbs of capital city	Greens	3.47	IA3
P4	Female	Regional city	Greens	4.00	IA1
P5	Female	Suburbs of capital city	Labor	3.27	IA1
P6	Male	Suburbs of capital city	Liberals	3.87	IA2
P7	Female	Regional city	Nationals	2.73	IA1
P8	Male	Suburbs of capital city	Greens	3.87	IA1
P9	Female	Regional city	Independent	3.33	IA3
P10	Male	Regional city	Greens	3.67	IA2
P11	Male	Suburbs of capital city	Greens	3.87	IA3
P12	Male	Suburbs of capital city	Labour	3.00	IA1

Table 2: Members of the Public who Participated in the Study

that just making people frightened doesn't help because you need people to have a sense of agency" adding that assuming those without a scientific background cannot "understand complexity" does them "a real disservice". Experts also referred spontaneously to the importance of incorporating, or at least better understanding, First Nations knowledge about fire management (E1, E2, E3, E5, E7). Furthermore, experts described their work as emotionally demanding. Several reflected on sadness and dismay encountered when engaging deeply in research about fire, biodiversity loss, and climate change (E1, E3, E4, E5, E7).

Experts consistently described fire ecology as complex, evolving, and context-dependent, noting that generalisations are difficult: "fire ecology is not rocket science; it's much harder than that" (E7). They explained that responses to fire must vary across ecosystems due to specific interactions between vegetation, landscape, and weather. For example, controlled burning is not universally appropriate: "It's not just a clear-cut issue of 'we need to reduce risk by burning'. It's where do we need to do that, and how do we need to do that? [...] things like Alpine Ash have a really long life-cycle, and if they're burnt too frequently, they'll die [...] some of that nuance is probably missed" (E3). Climate change adds layers of uncertainty by altering fire seasons and weather patterns, making fire behaviour less predictable. These evolving and nuanced aspects of fire science closely intertwine with broader issues of biodiversity and climate change, further complicating clear communication.

Interviews indicated a growing trend toward community involvement in bushfire management decisions, such as determining controlled burn locations. Visualisation tools are seen as central to making trade-offs legible to non-expert audiences: "Instead of saying 'we could do some thinning and reduce the basal area of the forest by 38%' they're gonna go, 'What are you talking about?'. But if you then show them a before and after simulation, they'll go, 'Oh no, I get it now'" (E6). However, experts also identified tensions between scientific knowledge, institutional practices, and public expectations. Some ecologists suggested that current practices disproportionately emphasise protecting human assets over ecological values: "the biodiversity, and wildlife, and ecosystems, often take a serious back-seat when you look at reporting about the impact of fire, and also how we should respond" (E7).

Experts identified multiple, overlapping challenges in communicating bushfire science effectively. Key difficulties related to conveying nuance in public discourse, and navigating the contested politics of climate change. Participants stressed authenticity and avoiding stereotypes when engaging diverse audiences, but also highlighted the difficulty of defining a clear and consistent message. Unlike vaccine communication, which has a clear behavioural goal, bushfire messaging lacks a single actionable aim: "with vaccinations, you've got a really clear goal [...] With bushfires, what's the message?" (E1). Experts viewed social media ambivalently: as E3 noted, "those platforms can be both a bad thing and a good thing"; a source of misinformation but also a channel through which scientists can directly correct misconceptions. Mass media presents a distinct challenge, with some outlets reducing the complexity of fire science and reinforcing polarised narratives: "these things get oversimplified [...] and that can translate into these black and white standpoints where it's like, 'You must burn!' or 'You shouldn't burn!'" (E3) – including claims that arson is a leading cause of severe bushfires; that environmentalists or Greens politicians are responsible for limiting fuel reduction burns; and that scientific explanations overstate the role of climate change. These narratives can undermine public understanding and complicate efforts to communicate evidence-based perspectives.

Despite these challenges, some experts expressed optimism that audiences are capable of engaging with greater complexity and uncertainty. As E4 noted, "COVID has shown us that we can probably handle a bit of complexity [...] I think it's worth trying to communicate some of the nuance." Accordingly, they advocated for building scientific literacy around fire ecology, and for creating more inclusive forms of communication that acknowledge uncertainty, incorporate diverse knowledge systems, and support meaningful public engagement.

5.2 Interactive Elements across Bushfire Articles

International news and research outlets published a range of media to communicate the socio-cultural, environmental and economic effects of the 2019–20 Australian bushfires. Many chose the format of interactive articles, which combine narratives and interpretations, data visualisations, maps, interactive graphics and hypertext

to allow active engagement and personalised exploration of information, which can potentially aid learning about complex topics [43]. Next, we summarise key interactive elements in the articles presented to participants (IA1–3), while drawing inferences based on established findings in the scientific literature. The insights gathered about the following interactive elements act as hypotheses to be tested when working with participants. Participants selected their choice of article based on headline and first impressions of its aesthetic features (Table 2). These articles can be explored firsthand:

- (1) **IA1.** Interactive Article from *The Conversation*: <https://bushfires2020.netlify.app> [19]
- (2) **IA2.** The NASA ArcGIS Storymap: <https://asdc.larc.nasa.gov/outreach-material/studying-the-2019-2020-australian-bushfires-using-nasa-data-storymap> [67]
- (3) **IA3.** Interactive Article from the *ABC*: <https://www.abc.net.au/news/2020-02-19/australia-bushfires-how-heat-and-drought-created-a-tinderbox/11976134> [36]

5.2.1 Maps. Across the analysed articles, maps were not presented as a uniform visual device but as distinct interaction paradigms. These can be broadly categorised as zoomable dashboards, layered maps, and scroll-driven (long-scroll) visualisations. While each approach enables exploration of bushfire data, they differ significantly in how they structure user agency, support interpretation, and evoke emotional engagement. Zoomable dashboards, as seen in IA2's *Global Active Fires and Hotspots Dashboard* (Fig. 1), prioritise user-directed exploration, allowing readers to pan, zoom and click on individual hotspots to retrieve localised data [67]. The dashboard presents live data and a clickable map. In contrast, the layered maps in IA2 (Fig. 2) structure interaction through selective visibility, enabling users to toggle between datasets such as population density, ecological loss, and fire extent of the 2019-20 bushfires [67]. Finally, scroll-driven maps from IA1 (Fig. 3) [19] and IA3 (Fig. 4) [36] constrain interaction into a linear narrative, where additional layers or spatial shifts are revealed progressively through scrolling rather than direct user manipulation. While zoomable interfaces emphasise spatial granularity and real-time data access, layered maps foreground comparison across datasets, and scroll-driven designs embed maps within a guided storytelling sequence.

These interaction paradigms also differ in their 'interpretability' [62]. Zoomable dashboards (Fig. 1), while data-rich, often require prior knowledge to interpret variables such as fire intensity or thermal activity, which could potentially be overwhelming to non-expert audiences. Layered maps (Fig. 2) improve interpretability by segmenting information into discrete, user-selectable layers; however, they rely on the user to actively construct meaning by toggling between views. In contrast, scroll-driven visualisations (Fig. 3 and Fig. 4) may reduce cognitive load by sequencing information, guiding the reader through curated comparisons (e.g., fire extent followed by habitat loss in Fig. 3), but at the cost of limiting exploratory depth. The 'emotional affordances' [17, 22] of the map types also diverge. Zoomable dashboards (Fig. 1) tend to privilege analytical engagement over affective response; their interface resembles a scientific tool, which may distance users from the lived reality of the bushfire disaster. Layered maps (Fig. 2) introduce some

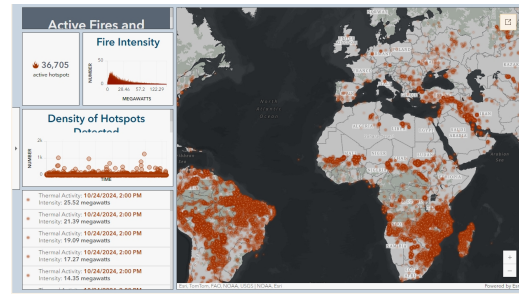


Figure 1: Interactive Map (Featured Datasets) in IA 2 [67]: Screen capture of NASA *Global Active Fires and Hotspots Dashboard* [67].

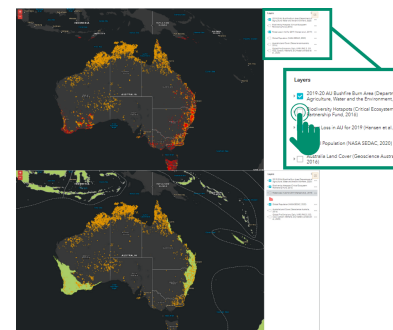


Figure 2: Interactive Maps (Layered) from IA2 [67]: Map reveals additional layers of information upon user selection via checkbox.



Figure 3: Long-Scroll (Layered) from IA1 [19]. Map reveals additional layers of information upon scroll-through.

emotional resonance by enabling users to juxtapose human and ecological impacts (for example, population density against forest loss), but this connection remains largely inferential. In contrast, scroll-driven maps (Fig. 3 and Fig. 4) are more clearly affective: by combining dramatic imagery, controlled pacing, and sequential revelation of damage (e.g., fire extent followed by threatened species loss in Fig. 3), they construct a narrative arc that can heighten emotional engagement. As a result, emotional engagement appears to emerge not from the mere presence of data but from how the type

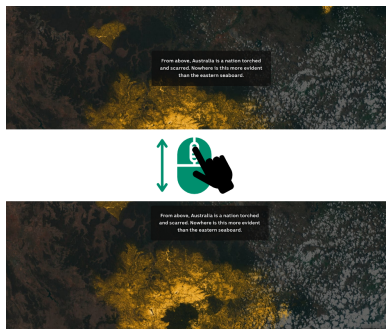


Figure 4: Long-Scroll (Pan) from IA3 [36]:
Scroll-able image that pans across a map to visualise fire damage.

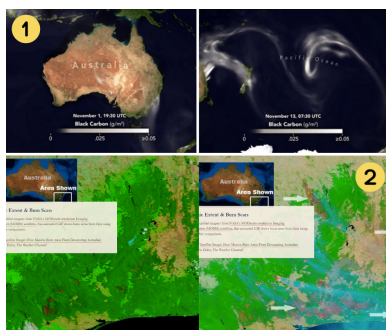


Figure 5: Timelapse videos and animations from IA2 [67]:
1. *NASA Animates World Path of Smoke*
2. *Geographic Extent & Burn Scars*

of interaction constrains or guides the reader's encounter with that data.

Taken together, these results suggest a trade-off between explorability, interpretability and emotional engagement: interfaces that maximise user control (e.g. zoomable dashboards) risk reduced accessibility and affect, while more constrained, narrative-driven designs (e.g. scroll-based maps) enhance comprehension and emotional impact but limit exploratory agency.

5.2.2 Temporal Visualisations. The selected articles communicate temporal change through two primary paradigms: timelapse animations and timeseries-based interactions. While both aim to represent the progression of the 2019-20 bushfires over time, they differ in how they structure user control, support interpretation, and evoke emotional responses. Timelapse visualisations, such as the animated GIFs and videos featured in IA2 [67], present temporal change as a continuous, automated sequence. These include looping animations of smoke dispersion and burn scar expansion, where time is compressed and rendered as fluid motion (Fig. 5). In contrast, timeseries visualisations, such as scroll-driven image sequences in IA2 (Fig. 6) [67] and IA3 (Fig. 7) [36], or timeslider maps in IA2 (Fig. 8) [67], separate time into discrete steps. In scroll-based formats, users progress through key temporal moments (e.g., pre-fire, peak fire, and recovery) (Fig. 6), while timeslider interfaces allow users

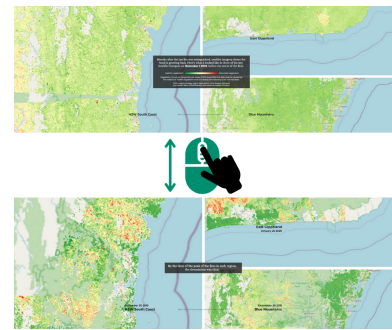


Figure 6: Long-Scroll (Timeseries) from IA2 [67]:
Scrollable three-panel visualisation showing how fire intensity changes over time.

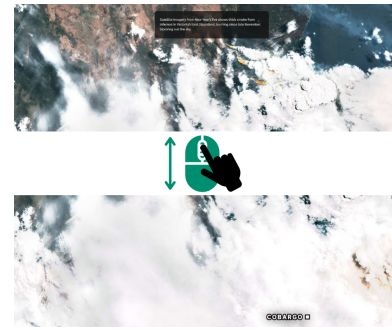


Figure 7: Long-Scroll (Pan) from IA3 [36]:
Scrollable visualisation of smoke across a map.

to manually select specific points along a timeline (Fig. 8). This distinction reflects differing interaction models: timelapse visualisations prioritise passive viewing and continuity, whereas timeseries interfaces introduce varying degrees of user control, enabling both guided and exploratory engagement with temporal data.

These temporal paradigms also differ in their 'interpretability' [62]. First, Timelapse animations can effectively convey overall trends and movement - such as the global spread of smoke in Fig. 5 - but may obscure specific temporal markers or make it difficult for users to extract precise information about when changes occur. The continuous nature of motion can therefore favour visual impact over analytical clarity. In contrast, timeseries visualisations (Fig. 6) improve interpretability by segmenting time into discrete, comparable states. Scroll-driven sequences (Fig. 7), in particular, guide users through curated temporal milestones, reducing cognitive load and supporting clearer comparisons between before, during and after states of the bushfires. Similarly, timeslider maps (Fig. 8) offer granularity in the controls, allowing users to interrogate specific dates and revisit time points of interest. However, this increased control can also introduce complexity, as users must actively navigate and interpret multiple layers of temporal and spatial data.

The 'emotional affordances' [46, 81] of these temporal visualisations are closely tied to how they represent scale and progression over time. Timelapse animations tend to produce a strong immediate impact by representing large-scale phenomena, such as the

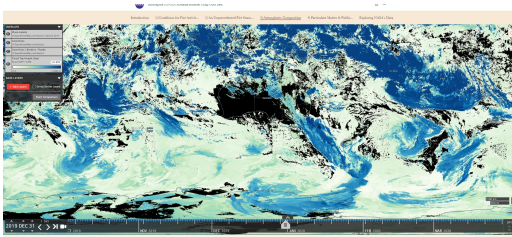


Figure 8: Timeslider Map:
NASA Worldview Cloud Map in IA2 [67]:
Interactive, scrollable cloud visualisation adjustable by time period.

movement of smoke across continents (Fig. 5), in a compressed timeframe. This acceleration of time can amplify the perceived magnitude of the disaster, making gradual processes appear sudden and overwhelming. Timeseries visualisations (Fig. 6), by contrast, often build emotional engagement more gradually. Scroll-driven sequences that reveal degradation or fire spread step-by-step allow users to witness transformation over time, reinforcing a sense of loss and progression. In particular, transitions from healthy vegetation to burned landscapes, or from pre-fire to post-fire conditions (Fig. 6), can make the impacts of the bushfires more tangible and legible. However, emotionally impactful engagement appears to depend not only on the presence of temporal data, but on how interaction structures the user's encounter with change. Guided sequences that emphasise key moments and contrasts tend to produce clearer and more affectively resonant narratives, whereas highly interactive systems may prioritise exploration at the expense of emotional coherence.

Taking these factors into consideration, timelapse visualisations emphasise continuity and scale but may reduce interpretability, while timeseries approaches, particularly scroll-driven formats, enhance clarity and narrative impact, albeit with reduced temporal fluidity. Interfaces that balance these elements play a critical role in shaping how urban audiences understand and emotionally engage with complex environmental crises.

5.2.3 Multimedia and Narratives. Multimedia elements - including embedded videos, linked stories, and panel-based navigation - extend beyond information delivery to structure how users engage with human and ecological dimensions of the bushfire crisis. These elements differ not only in format but in how they frame the disaster and evoke emotional responses. The articles employ a range of multimedia formats to guide users toward supplementary content. Panel-based interfaces, such as the side-by-side species stories featured in IA1 ([19] (Fig. 9), offer curated entry points into related narratives, allowing users to select specific topics of interest. In IA2 [67], and IA3 [36], hyperlinked text extends the users' personalised reading journeys by connecting them to external articles, reports and first-hand accounts, which open in separate browser tabs (Fig. 10 and Fig 11). These formats align in the degree of user agency they afford, with both panels and hyperlinks requiring active selection and enabling navigation across multiple narrative threads.

A key distinction across these multimedia elements emerges from how they frame the impacts of bushfires. Linked articles

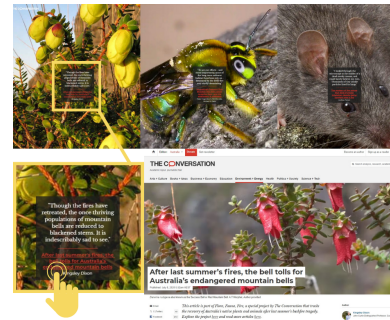


Figure 9: Personalised Reading Journey (Panels) from IA1 [19]:
Interactive graphics with embedded hyperlinks to relevant article.



Figure 10: Personalised Reading Journey (Links) from IA2 [67]:
Screenshot of article text featuring embedded hyperlinks.

and embedded stories frequently foreground human experiences, such as the loss of homes or community-level impacts, making the disaster relatable through personal narratives (Fig. 10). In contrast, panel-based features that highlight specific animal and plant species emphasise an ecological framing, drawing attention to biodiversity loss and environmental damage (Fig. 9). This separation of human and ecological narratives suggests that different media formats are used to compartmentalise aspects of the crisis. While hyperlinks often direct users to human-centred stories, panels and visual previews tend to foreground non-human subjects, such as threatened species, through imagery and curated excerpts.

These different framings are closely tied to variations in emotional engagement. Human-centred narratives accessed through hyperlinks (Fig. 10 and Fig. 11) tend to evoke empathy through specificity and relatability, particularly when they describe individual or community loss. However, emotional engagement may be fragmented by requiring users to leave the primary article content and access the stories through embedded hyperlinks. In contrast, ecological narratives presented through panels and visual previews often rely on imagery and summarised content to generate affective responses. Close-up images of animals and plants, combined with evocative quotations, can create immediate emotional resonance, even in the absence of detailed storytelling (Fig. 9). Overall, emotional impact appears to depend not only on content, but on how it



Figure 11: Personalised Reading Journey (Links) from IA3 [36]:
Screenshot of article text featuring embedded hyperlinks.

is structured by multimedia elements. Integrated, visually driven elements (e.g., panels in Fig. 9) provide immediate but potentially shallow emotional cues, whereas linked narratives offer deeper engagement at the cost of continuity (Fig. 11).

These results highlight a tension between narrative depth, framing, and emotional engagement. Multimedia elements that foreground human stories tend to support empathy through detail and relatability, while those emphasising ecological impacts rely more on visual and symbolic representation. The design of these elements - whether embedded, selectable, or externally linked - plays a critical role in shaping how users encounter and emotionally process different dimensions of the bushfire crisis.

5.2.4 Interactivity and Navigation. Interactive features - such as 3D models and navigable directories - in each of the selected articles, are designed to support deeper exploration of bushfire data. However, these elements also reveal tensions between enabling user exploration and introducing points of friction or frustration, particularly where key affordances are limited or absent [50]. Interactive elements such as the *MISR Plume Height 3D model* (Fig. 12) in IA2 [67] and the *Directory of 119 threatened species* (Fig 13) from IA1 [19] offer users opportunities to actively explore complex datasets. The 3D model (Fig. 12) allows users to manipulate spatial perspective through panning and rotation, supporting engagement with the vertical scale of smoke plumes. Similarly, the Directory (Fig. 13) enables hierarchical navigation, allowing users to drill down from broad taxonomic categories to individual species-level impacts.

However, this exploratory potential is not always fully realised. In the case of the 3D model (Fig. 12), interaction is limited to basic navigation (e.g. panning and changing orientation), with limited guidance on how to interpret the visualised data. As a result, users may engage with the interaction at a surface level without developing a clear understanding of plume height or its significance. Likewise, while the Directory structure (Fig. 13) supports browsing, the need to click through multiple layers to access meaningful information can introduce friction, particularly when users are uncertain about what they are looking for.

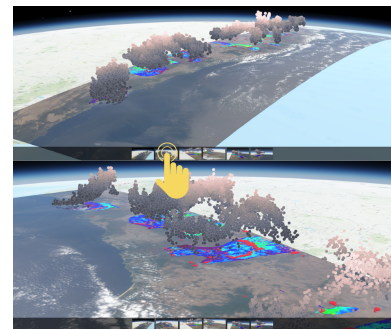


Figure 12: Interactive 3D Model: MISR Plume Height from IA2 [67]:
User can adjust viewpoint via frame selection.

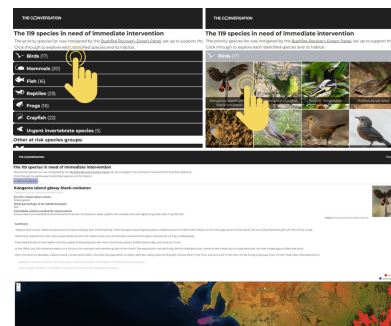


Figure 13: Directory (of 119 species) in IA1 [19]:
User can select animals to view by species/habitat and read about interventions.

These challenges are closely linked to the absence or limitation of key interaction 'affordances' [33, 50]. In the 3D model (Fig. 12), the lack of visible legends, scale indicators or explanatory overlays makes it difficult to interpret the meaning of visual elements such as plume height or spatial distribution. The interface affords movement, but not necessarily understanding. Similarly, the Directory (Fig. 13) provides navigational affordances (e.g., clickable categories and images) but offers limited support for orientation or comparison across species. The absence of features such as search functions, filtering tools or persistent context (e.g. summaries) can make navigation feel fragmented. Users may struggle to maintain a sense of where they are within the dataset or how individual pieces of information relate to the broader ecological impact.

Collectively, the interactive features across the selected articles highlight a key design consideration - interactive systems must balance the provision of exploratory freedom with sufficient scaffolding to support user understanding. Without clear affordances - such as legends, guidance, or navigational support - users may be able to explore data, but not effectively interpret or connect with it. These interfaces afford interaction, but not necessarily understanding.

6 Findings

We first describe participants' orientations and connections to bushfire issues, and their interests and preferences relating to news media on the topic of bushfire media. Then we describe participants' responses to the varied interactive elements included in the three articles IA1-3.

6.1 Participants' existing connections to bushfire issues

All participants resided in the inner or outer suburbs of state capitals and regional Australian cities. Although initially indicating that they were not directly affected by bushfires, most participants also described experiences of personal or professional impacts of fire events. For example: P1 and P3 grew up in rural areas and were closely connected to fire-affected regions through family or friends; P9 and P11 were impacted by fire whilst on holidays; P1 and P5 accounted for fire risk in their housing decisions, either deciding against building in the bush or relocating from a rural to an urban area; P2 and P12 lived in suburbs adjacent to bushland and close to national parks; and P7 and P9 lived in cities that were heavily impacted by smoke during the 2019-20 fires. P2, P6 and P8 also had professional experience with organisations that assist bushfire-affected communities. That participants tended to view bushfires as events that happen to "others" in rural communities, fire had already effected their lives, suggests coping mechanisms may involve emotional distance. Australians' relationships with bushfires are shaped by early memories, national history, and cultural awareness that fire is a constant presence. Participants described intense memories, such as threats to family homes (P1), media images of trapped tourists and fears for friends (P3), and experiences of friends unable to evacuate during the 2009 fires (P6). Fire issues influence worldview and lifestyle choices for some (P1, P5, P11). P1 commented that similarity in event names, like "Black Saturday" and "Black Summer," adds to this sense of blurred, repeated experiences and weariness.

6.2 Bushfire topics of interest

Responses to the six news headlines indicated participants' primary concerns, questions and orientations regarding bushfire. They were most likely to give attention to Australian news and sometimes miss overseas fires because of local concerns (P2) or being "*not really relevant*" (P7), unless it related to a place they had a personal connection to (P1). Two participants (P7, P12) were not particularly interested in the topic of bushfire and rarely chose to engage with related media. Several participants preferred stories that might help them in preparing for fire, at national as well as community and individual levels, pointing to future solutions rather than "*doom and gloom*" items. There was interest in headlines on technology-related solutions and Indigenous fire management approaches. On the other hand, some expressed desires for more knowledge, even if the topic is challenging and hard to grapple with. For example, P4 stated that they wanted to know "*just how bad things are going to get*" in the future: "*not only will we live, but will we have a home and have resources and will it be liveable?*". Yet even participants who were willing to engage with difficult topics indicated they would sometimes instead seek positive news items.

6.3 Emotional responses to bushfire media

Media about bushfires evoked a wide spectrum of emotions for our participants. They mentioned feelings of sadness and concern about people who had died or lost loved ones (P3, P4), the plight of fire-affected communities (P3, P5, P6), the extent of devastated bushland (P11), animals and native species that were badly impacted (P2, P6, P8, P9), and devastation of particular holiday spots (P1, P6). Several participants expressed deep concern or fear regarding the future impacts of worsening fire (P3, P5, P11). Strong emotions were also attached to the weight and complexity of the problem, including fatigue at the inevitability of fire threat (P1), the challenges of reconciling societal and personal trade-offs (P1, P8), and frustration or anger at governments' lack of action on climate change (P5, P11) and reports of insufficient funding for fire preparedness (P3).

For several of our participants, frustration was associated with their conception of bushfire as a vexed and politicised topic that makes some people wary to engage at times. Participants referred to "*people blaming each other*" (P3), "*a shouting match*" (P1) and calling others "*ignorant*" (P2). This topic intertwines with other environmental controversies, for example, P7 said they were unlikely to engage with bushfire topics because they are "*in the middle with global warming*", and P1 lamented "*everyone jumping into blaming climate change*". P5 felt, on the other hand, that "*the greenies*" had too much sway and believed they had prevented backburning despite First Nations' calls for more burning. Notably, several participants raised the problem of polarisation when asked how Australians might become more involved in bushfire issues.

6.4 Australians' ongoing relationship with fire

Participants engaging with the interactive articles expressed a strong interest in understanding how Australia can better prepare for and respond to bushfires. They indicated that they would have liked more information about future fire severity and how landscapes and species had been recovering since the fires. Comments on changes in fire management practices, alongside a desire to see greater adoption of Indigenous fire knowledge, reflect concerns over lost strategies for preparedness, management and mitigation. Many participants (P1, P2, P3, P4, P5, P8, P9) sought actionable information on how they could personally contribute, from helping wildlife (P2, P5, P8, P9) to influencing policy (P1) and monitoring fire risks (P3). However, participants also felt insufficiently informed about fire management and adaptation strategies, and said the media articles did little to strengthen their ability to contribute. As P1 explained, "*...by the end of it, I'm not really sure what I'm supposed to do*". Taken as a whole, this indicates a preference for fire-related information that empowers proactive engagement and preparedness, as part of their sense that fire is something that Australians will always need to grapple with.

6.5 Participant responses to *The Conversation* article (IA1)

In this section, we describe participants' responses to *The Conversation's* article on Flora, Fauna and Fire, and to its particular interactive elements. Generally, readers found the topic interesting and the article highly engaging, informative and easy to navigate and digest. However, a lack of in-page navigation and apparently

deliberately slow scrolling was frustrating for P12. In addition, opportunities were missed to allow readers to explore how fires had impacted places they were familiar with. For example, photos of well-known sites would have helped participants who were unfamiliar with the named locations.

6.5.1 Long-Scroll (Layers). Participants found the layer map to be a good introduction to the article's focus on fires' extensive impacts on wildlife. For example, P8 said it was a *"quick way to get the concept and understand what the topic of this article is going to be about"* and estimated that the fire had dramatically reduced the habit range of Australia's wildlife species. The map engendered interest in knowing more about what had happened and especially how the fire impacted specific, familiar places, such as areas around capital cities. This was true even for P12, who exhibited a low level of engagement with the topic overall, but expressed a desire to zoom in to look at specific locations. While the map shows the extent of fires, it did not elicit emotional responses or a sense of connection with the issues; or as P8 indicated, *"we're just looking at data"*. Further, some usability problems affected the interpretation of the map's key messages; for example, P12 mistook the blue shading for smoke-affected areas.

6.5.2 Long-Scroll (Timeseries). Participants were interested in map-based representations of changes to vegetation and the timeseries images could be quite affecting. P8, for instance, saw how a familiar location was impacted: *"Yeah, so all that pale, pale brown up in the top right, East Gippsland. That's sad"* (P8). Indeed, the map's colour coding had emotional impact, and given the colour legend was not sufficiently visible suggests that the readers interpreted the maps as though viewing satellite imagery, and had trouble interpreting the significance of the red colour coding. Again, a primary interest for P12 was to view impacts on places he had visited; however, this representation did not provide sufficient material for him to compare with his own memories, and interaction difficulties inhibited comparison since readers must scroll up and down several times to spot and understand the changes from one image to another, and repeat this for each locations shown side by side.

6.5.3 Personalised reading journey (Panels). Offering several stories, the personal reading journey panels responded to varied interests in native wildlife. P8 and P9 were drawn to the article on bees, which they related to broader environmental issues affecting pollinators, and to learning about fire's effects on fish and rivers. The intent to engage readers through compelling narratives of conservation scientists was effective for some participants. For instance, P9, was impressed by the protagonist's dedication to saving stocky galaxia, while fire's impacts on bee conservation affected P8: *"I think just seeing how devastating that they've lost all of the artificial nests is pretty upsetting to the crews"*. However a lack of clarity about whose point of view the narratives expressed limited participants' connections with these stories and ability to contextualise and relate them to collective actions to help wildlife. For example, P9 concluded that volunteers (not scientists) were doing the work and recalled how they had once aspired to assist a wildlife rescue organisation, while P12 questioned the taxpayer costs of conservation efforts. In fact, the array of articles conveyed the extensive impact of bushfires, even to those with less interest, like P12, who noted

the broader damage. However, again, usability issues contributed to participants not realising that text could be clicked to access full stories or misinterpreting connections between items presented side-by-side.

6.5.4 Directory (of 119 species). The directory effectively conveyed the extent of affected species. Some participants wanted to know more about the recovery of affected populations and the efficacy of conservation measures described. They reflected further on how they might get involved. At first P8, who had studied zoology, thought that they would be unable to assist, but then pondered *"if there's a way to assist with volunteering on certain projects that would track the numbers [...] there might be some apps out there [...] anyone can do it. So yeah, if I could do something like that, that'd be awesome"*. P9 and P12 looked for species they had encountered in person, and P8 wanted to know more about reptiles because *"they're just cool and I like to look at them"*. This suggests the value to personalised avenues that connect with the overarching issue by presenting information about lesser-known species, as well as iconic native mammals. Participants who were interested in the content thought the directory was well organised and well presented, and did not seem cognitive overloaded by the many species included. However, a participant who was less interested in the topic was less sure how to navigate and digest the information and was highly frustrated that clicking the 'Back' button returned to the start of the article.

6.6 Participant responses to NASA ArcGIS Storymap (IA2)

Participants' responses to the NASA article varied according to their interests and attitudes to environmental issues. The content selection and the use of technical terms put-off P7, a university-educated participant with dyslexia who had little interest in bushfire science. They said, *"if I came across an article like this, I would just stop reading it because it's full of jargon"* (P7). P7 suggested that greater attention should be given to human-interest topics such as air quality and health impacts, and called for improved readability. The article also left key questions unanswered — such as how bushfires start and spread, and how to protect populated areas — reflecting broader gaps in its coverage of scientific, environmental, and human impact topics. In contrast, the article's restrained emotional tone was appreciated by some participants. As P10 noted, *"It did well, I think, to not go into the emotional aspect of it [...] it can be a bit overwhelming having to look through and go through all these emotional stories"* (P10). The article's varied visual designs and interaction mechanisms were not raised as a concern; however, restricted access to previously public datasets via *Storymaps* affected usability, highlighting the challenge of integrating data from multiple sources.

6.6.1 Timelapse videos and animations. Reactions to the article varied with participants' orientations to climate change issues and interest in relevant science. P10 indicated that the key message of the video, *Heat Wave Breaks Records in Australia*, is that the situation is dire and *"if there's a time for action, that it's now"*. P7, who said they were *"in the middle"* on climate change issues, also readily understood that the essential message was *"global warming"*. Yet the animation and/or accompanying text were unclear to participants

regardless of their orientations, which impeded learning. P7 said *"I don't really know what I'm looking at [in the video], to be honest, other than I assume it's temperature in this one. But the rest of it [...] As a layperson, I can't interpret it.... I didn't really learn much at all because the bits that I understood I already knew and the rest of it I just didn't understand"* (P7). P10 said the accompanying text *"kind of loses me a little bit in the second paragraph when it starts to get a bit jargony"*, and noted an absence of introductory explanations *"if you have prior knowledge on global warming then 1.1° is a big difference. But for people that maybe don't know too much about it, that might not seem too crazy"* (P10).

6.6.2 Other videos and animations. Animated visualisations in GIF format generally helped participants' understanding. However, jargon, acronyms and scientific terms were challenging or frustrating and some legends were missing, to explain colour codes, which made interpretation more difficult. For instance, discussing the graphics, P10 said: *"I don't really know what a troposphere is"*. Participants found the video controls more helpful than automated looping, which didn't signal the start and end of the sequence, because they can play a video when they are ready.

6.6.3 Interactive Maps (Featured Datasets). Participants were far more interested in the *Australian Air Quality Map*, than the *Global Active Fires and Hotspots* dashboard, which suggests a preference for visualisations that focused on fire impacts on populations and protection measures. Participants tended to zoom in on familiar areas, including their hometowns, and also explored sites where air quality indicators were especially poor; often pondering what factors impacted different sites. P7 thought the data and accompanying information about air quality and human health seemed *"buried"* towards the end of the article.

6.6.4 Interactive Map (Layered Datasets). Participants were only moderately interested in the information presented in the interactive map of Australia. Until prompted to explore further, the map did not elicit any avenues of inquiry or new knowledge, even for P10, who was generally interested in the topic. Readers must manually add layers before the map displays anything meaningful, which took trial and error, and guessing the meaning of some layers. This hampered use and particularly frustrated a participant with little enthusiasm for the topic (P7).

6.6.5 Timeslider Maps. The timeslider maps of *Worldview Clouds and Fire Counts* can effectively display the progression of events over time. However, for the *Cloud Map*, participants were unsure what message this element intended to convey; or, as P10 expressed: *"I don't really know what I'm looking at [...] What's it saying?"*. Moreover, unfortunately, the dataset previously published for the *Fire Counts Map* became unavailable during testing and thus was not usable by many participants.

6.6.6 Interactive 3D Model. Participants were only moderately interested in the 3D model of smoke plume height and were unsure what they were supposed to learn from it. While relatively easy to navigate and explore, using the thumbnail images and their mouse to pan and change orientation, participants found it difficult to identify the geographic location of the model as the smoke *"bubbles"* often obscured the name labels of places.

6.6.7 Personalised reading journey (Links). Participants did not follow the many links in the article to information about datasets, satellite sensors, NASA activities and additional resources. P10 commented that, if exploring it alone, *"there's a couple of those [links] that I could see myself definitely looking into"*; primarily to better understand the data and how it should be interpreted. The navigation menu let participants skip between one section and another, track progress through their journey, and compare items by jumping between them. P7 noted, however, that the menu items were too long, complicated, and included unfamiliar words such as *"particulate"*.

6.7 Participant responses to the ABC article (IA3)

Some participants commended the overall design of the ABC article. For instance, P11 and P9 found it visually compelling and effective in conveying geographic scale. However, although participants mentioned the human impacts of fire, and places of personal significance, place-based anchoring was missing; especially for those unfamiliar with specific towns that were affected. Places named on the map and in the text were also not always coherent. Furthermore, participants noted the absence of future-focused information, and that the article didn't address key questions; such as those expressed by P11: *"What are we doing? What's the next steps? How do we mitigate some of these problems?"*. Thus, this piece did not inspire a proactive approach to addressing or mitigating issues. It also seemed to provoke some frustration, about societal inaction and governmental policy, in participants who already felt informed about the interwoven issues of environmental change and bushfire impacts.

6.7.1 Long-Scroll (Pan). Participants gained a stronger understanding of the fires' geographic extent by scrolling from north to south on a map of much of Australia's Eastern coast, as emphasised by two of the three participants who read this article (P9, P11). P11 described: *"You hear a billion animals are lost and you're like, 'Oh, that sounds like a lot', but it doesn't really mean anything. And 'this many acres'? I'm not even 100% sure how big an acre is in my head, because I don't work in acres. But when you see it on the map and just see this big area [...] it makes it a lot more obvious and it makes it a lot more visually interesting"*. However, a lack of a visible legend limited understanding of the colour coding and whether the maps showed satellite imagery, in particular, because yellow was used to show fire-affected areas. The ability to scroll suggested it might be possible to pan to a specific location on the map, and P9 noted that they would have liked to view their hometown.

Certainly, place names were vital to understanding the geographic area that participants scrolled across. P9 said they would have liked to see more of the places named in the accompanying text marked on the map: *"You know, town names that are standing out like Mallacoota and places like that"*. P11 said, *"you've got a good idea of where they are on the map, maybe you've been there before"* (P11). Whilst this might have increased understanding for some; for others, naming several towns and areas reduced the narrative's overall impact. P7 described this element as *"just an account"*, noting that there were *"no pictures of the actual town or how it was and before. So like, I can't imagine the town. I'd never been there. I know"*

nothing about it". On the other hand, while acknowledging that *"some people just need a human connection"*, P11 commented about the critical nature of images in *"weaving an emotional story, through it might potentially turn some readers off because they're just like, 'I can't handle this today'"*. This points to the importance of photographs, for some readers at least, to anchor and make meaning of text and map-based narratives.

6.7.2 Long-Scroll (Timeseries). These timeseries maps, which use satellite imagery and map-based visualisations to show how fires unfolded, also depict the scale of destruction through the expansion of burned areas and smoke-affected areas over time. The time progression view was especially effective for a participant who had dyslexia (P7), who commented that *"it's good to see the lightning strikes [...] where the fires had been [...] the smoke [...] the burnt landscape"*. One instance showed the emergence of a large burned area, close to Sydney, which prompted an emotionally affecting size comparison for P11: *"That's so much bushland. That's upsetting. Now you've got me. But it's just about the scale of it. You know this is avoidable [...] Having visited Sydney, I've got a good idea of what the scale of Sydney is. And just comparatively... This is on this year, I guess"*. Their response also indicates that the emotional impact partly originates in a prior understanding of the worsening problem and that barriers to action are largely political.

6.7.3 Personalised reading journey (Links). Only one participant expressed interest in following links embedded in the article. P11 volunteered that they would like to click through to learn about concepts such as *"this polyvortex thing"*, and the expertise a scientist cited. P7, in contrast, commented in frustration about: the lack of user control in navigating the article; wanting more visibility about how much of the article they had left to read; and, the ability to skip between sections.

7 DISCUSSION

7.1 Interplay of Affective and Cognitive Engagement

Our findings reveal a complex and multifaceted interplay of affective and cognitive engagement in bushfire media. For some people, emotional responses are immediate and intense, evoking stories of destruction and feelings of sadness, fear, and empathy. Such emotions can impede processing information about the changing environment, steer attention to some details at the expense of others [13, 16, 42], and prompt information avoidance [83] or psychological distancing [21]. We identified information avoidance when lay participants said they would not choose to engage with a certain topic if they thought it too gloomy or distressing, and identified psychological distancing when they conceived bushfires as remote or irrelevant to their personal lives for the purpose of reducing the emotional impact of news. These strategies simultaneously provide ontological security [6] and emotional regulation, and limit engagement with important information.

Science communicators and HCI researchers recognise the need to balance emotive content, which can engage public attention in serious environmental issues, with positivity and the possibility of taking positive action [42, 51, 56, 60, 64]. Our findings highlight two additional emotional dimensions pertinent to bushfire media.

First, the complexity and uncertainty inherent in fire science can prompt feelings of overwhelm and disengagement; so care must be taken to ensure stories are comprehensible. Second, a milieu of fierce debates about controlled burning and polarisation on broader environmental issues amplifies emotions or repels people. Together, these impede subject matter experts' effective communication of emerging science, with its inherent nuance, complexity and uncertainty. As a result, a deep sense of frustration clouds interpretations of media by some members of the public, while others become disinclined to engage with certain issues altogether.

7.2 Lifelong Engagement with Bushfire Narratives

People engage with bushfire narratives over a prolonged time, which integrates deep and evolving relationships with fire. Although often reported as distinct events, bushfires are studied and experienced within a longitudinal narrative that intertwines with concurrent environmental, social, cultural and political phenomena. Our findings illustrate how public thinking about bushfire in Australia is situated in a set of cultural framings that are constructed in social memory, political discourse, mainstream media, and social media [69, 94]. Prior encounters with bushfire discourse shaped people's willingness to engage with different aspects of fire. For example, lay participants explicitly shied away from narratives that they expected to involve "finger-pointing", polarised disagreement, overwhelmingly negative stories, or overly complex scientific explanations. We also detect, in the answers that people seek in fire-related media, the effects of past frustration with politicians and persisting concerns about how authorities will cope with worsening fire regimes.

People aim to construct a sense of continuity in understanding bushfires and seek to know how the specifics of an event connect to prior events and portend for the future. Participants' desires for updates on recovery and regrowth from past fires, and learning about fire predictions and implications for future response strategies reflect notions that bushfire is an ongoing, repeated and cyclical phenomenon. Subject matter experts and some lay people have strong convictions that a continuing narrative must reflect the provisional, cumulative and evolving nature of scientific knowledge. This stance recognises that knowledge is being revised by contemporary advances in fire science, a new appreciation for Indigenous fire management, and emerging insights about interactions between climate change and bushfire. However, this evolving knowledge creates additional uncertainty for the public, particularly when it intersects with messaging that challenges established 'facts' within broader social narratives of fire. Thus, guidance about delivering simple, clear public communication on fire [71] is complicated by approaches designed to support public engagement and empowerment [31] by reflecting scientific nuance and uncertainty [77].

7.3 Urban Populations and Bushfire Media

Mainstream media narratives often reinforce the trope that urban populations are removed from the immediate dangers of bushfires, overlooking the many significant connections urban communities have with fire events. In doing so, media miss vital opportunities to engage urban audiences in discourse on bushfire management.

More broadly, as Soden & Palen suggest [79], media could play a greater role in addressing environmental crisis by reconfiguring relationships between urban and rural spaces, and between decision-makers and knowledge holders.

Bushfires are not merely remote news items for urban dwellers. They directly and indirectly impact personal and family decisions around where to live, whether to purchase a second property, when and where to holiday, and concerns about the safety of friends and family. Urban dwellers also hold emotional and historical ties to specific places, ecosystems and species affected by bushfires, including urban peripheries, childhood homes, holiday destinations, and wildlife from places they formerly lived. Beyond the personal, their concerns extend to financial and regulatory issues - insurance premiums, food prices, urban planning and rural land management - all of which are shaped by bushfire risk and policy. Their lives and livelihoods are further affected by decisions about emergency services funding, government expenditure, and personal autonomy.

By failing to speak to urban dwellers' many connections with bushfire, the media misses a chance to foster greater civic involvement. Bushfires can prompt broader reflection on Australian living patterns - including trade-offs in choosing where to live - and on the interrelationships between fire and environmentally relevant practices, such as land clearing, forestry, urban growth and agriculture. While it is right that the voices of rural dwellers, who are most directly impacted by fire and its aftermath, lead these discussions, media coverage should also highlight the myriad ways that bushfire dynamics entwine with urban lives. Encouraging urban populations to actively participate in conversations about bushfire management and its challenges is vital if all Australians are to share collective responsibility for addressing a critical issue that affects the entire nation.

7.4 Design Considerations for Interactive Bushfire Media

7.4.1 *Emotion as a Mechanism of Connection.* Our study shows that emotional engagement is central to how interactive bushfire articles function. For urban audiences who do not reside in fire-prone areas, emotion is a key mechanism for establishing relevance, enabling understanding, and supporting ongoing engagement. Balancing emotional and cognitive elements in bushfire media is vital for effective communication. Interactive, bricolaged media and long-form articles offer particular opportunities to design for this balance. Designers can carefully orchestrate the presence of alternative narrative arcs to support audiences in managing their cognitive and emotional demands. Design must extend beyond information presentation towards crafting educative and emotionally engaging interactive spaces. A thoughtful approach to designing narrative arcs will offer multiple structured pathways that guide users through a journey that is informative but also works productively with emotions. This requires integrating real-world stories and multimedia content that resonate emotively, visualisations that convey scale and gravity, relevant information that empowers, and calls-to-action that promote user agency and involvement. Designers should be mindful that their intended audience is not merely rational information foragers, but socially embodied agents who

proactively seek emotionally desirable user experiences [63], media gratifications [47], and technologies to manage their affective responses to everyday challenges [78].

7.4.2 *Interactive Media as Affective Socio-Technical Systems.* We conceptualise interactive news articles as affective, socio-technical systems, where design elements (interaction, visuals, narrative) and reader actions (scrolling, clicking, exploring) work together to produce emotionally situated experiences. This extends HCI perspectives on informing by integrating feeling and meaning-making into coordination and data-use. Interactive media offers designers innovative opportunities to balance three interconnected objectives related to emotional engagement: (1) using emotive content that conveys the seriousness of bushfire issues without creating overwhelm; (2) representing the inherent complexity and uncertainty of science without precipitating anxiety or confusion that leads people to seek simpler, inaccurate explanations; and (3) offering meaningful points of connection that allow audiences to be actively and collectively involved in addressing fire, despite the enormity of the problem. Insights from prior studies of climate change communication [27, 60, 92] can be applied to the challenge of designing bushfire media, by situating design within ongoing environmental narratives that inspire feelings of care and responsibility towards distant places, people and wildlife. Emotional design can also improve data-driven decision-making to support social and ecological connections. For instance, participants in a study of automated conditional donations to crisis events [7] felt an immediacy and deep connection to affected people and planetary dynamics when they received notifications triggered by geological or meteorological changes. The study found that the timing of the information people receive, which differs from that produced by aggregating data about multiple people's interactions in so-called 'personalised moments', represents opportunities to consider engagement arcs that integrate remotely sensed scientific data [7].

7.4.3 *Implications for Science Communications.* Our findings suggest that effective communication of climate-related hazards should move beyond information transmission, consider how design shapes emotional experience, and leverage interactivity to foster connection without sensationalism. Importantly, this is not about amplifying fear, but about supporting meaningful engagement, particularly for audiences who may otherwise feel detached. We observe important opportunities for bushfire media to involve urban populations by enabling them to investigate impacts on specific localities to which they are connected, and identifying practical actions they can take. Our evidence of broad interest in fire science, the future of fire in Australia, and the ecological interconnections between landscapes and fire-affected species suggests a need for more nuanced and accessible information about these topics. Given that bushfire knowledge is already characterised by uncertainty and debate, there is significant scope to increase the level of explanation and transparency, making clear the links between what is known or predicted, decisions that must be made, and the potential ecological and societal implications that others also suggest [77]. We find that people are very interested in helping bushfire-affected wildlife, habitats and communities, which suggests there is ample opportunity to provide more entry points to actively involve them.

7.4.4 Implications for Design. Designers of interactive articles should consider how interactivity positions the reader (e.g., observer, participant, witness), how pacing and sequencing shape emotional trajectories, and how data visualisation can communicate both scale and feeling. There is a significant opportunity for interactive media to demonstrate communitarian ways of managing fire and caring for ecosystems that promote interconnectedness and collective action, and align with Light et al.'s [51] call for tools that support “care, wonder and fulfilment”. Bricolaged interactive media could include, for instance, video created by First Nations communities in specific ecosystems and narratives generated by conservation and wildlife volunteers. Such examples can illustrate care for Country, oriented by relations between landscape, flora and fauna, geography and fire observed over millennia [8], and collective involvement in caring for landscapes impacted by fire [10, 49]. Such an approach has the potential for media spaces to support urban Australians in joining other communities in contributing to bushfire management, adaptation and environmental stewardship. Indeed, interactive media spaces that demonstrate communitarian ways to care for ecosystems can offer the social support needed to cope with eco-anxiety [13], address young people's frustration at adults' inaction [37] and rise to calls to design for communal action and mutual care in a time of existential crisis [51]. Bringing together narratives and data from diverse ecosystems might create an information space which, as Fortun [31] argues, enables people to explore information, connect with other communities and leverage shared knowledge to take action for the places they care about.

8 Conclusion

We investigated expert perspectives and public reactions to mediated science communication about bushfires in Australia. This revealed a dual challenge in bushfire communication: 1) experts must represent scientific complexity, while carefully navigating the risks of communicating uncertainty; and 2) audiences' interpretations of bushfire information are both emotionally and socially situated, as well as shaped by place-based connections and polarised discourse. We show that engagement is not episodic but ongoing, embedded in people's lived experiences and evolving sociopolitical contexts. Central to this engagement is the dynamic interplay between affective and cognitive sense-making. Ultimately, emotion operates in multiple ways: it motivates attention and individual engagement, underpins collective responsibility and action, and is actively managed by people through their interactions with media and technology.

This paper contributes to HCI and environmental informatics by conceptualising interactive news articles as active participants in socio-technical systems of meaning-making around environmental crises. Extending prior work on informing and politicisation, we demonstrate how interactive, data-driven articles shape engagement with bushfire through both emotional and cognitive processes. In doing so, we contribute to understanding how such systems operate within broader social contexts, including crisis response, mitigation, and human-ecological relations. Our findings indicate opportunities for designing interactive articles that more effectively engage excluded audiences by building on their existing exposure

to environmental discourse and creating spaces where they feel included, capable, and connected to distant places, communities, and ecosystems. Interactive mechanisms, such as alternative narrative arcs, hypertext structures, and user-controlled visualisations, can provide new ways for people to explore the uncertainty and ongoing evolution of science, and its intersections with Indigenous approaches to fire management, while situating bushfire within ongoing ecological and social processes. Together, these interactive mechanisms can present bushfire narratives as historically situated, dynamic and ongoing; and open possibilities for audiences to investigate questions that interest them, such as patterns of recovery, which can support emotional engagement, collective understanding, and pathways to action.

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