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Street art as a vehicle for environmental science communication

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Abstract
Street art is visual art in public spaces — public art — created for public visibility. Street art addresses a massive and extremely diverse audience: everyone in a city. Using a case study approach, this article explores: 1) the extent to which science-inspired environmental street art can be considered a vehicle for science communication in less tangible science contexts and institutional settings — on the street — and 2) the strategies that street artists deploy to communicate their environmental messages through large-scale painted murals. This article clarifies how street art can be understood as a means of creative grassroots environmental communication. It shows that, and how, street art can encourage agency in pro-environmentalism and help to develop our relationship with sustainability.

Introduction

Art appeals to the affective domain of learning: it elicits visceral, emotional responses and engages the imagination [Bengtsen, 2018, p. 13]. Being visually stimulating, the arts are (becoming) a favoured medium for communicating science with publics [Schwartz, 2014]. Art inspires action, for example on environmental issues, and deepens engagement [Lesen, Rogan & Blum, 2016; see also Fleerackers, Brown Jarreau & Krolik, 2022]. Research on the power of art in climate change discourses thus highlights its ability to foster agency and inspire hope, responsibility and care to create openness beyond the human world and to raise awareness and creativity for tackling complex environmental problems [Bentz, 2020]. Art also enhances learning through more creative and richer intellectual inquiry in, and for, science and environmental communication projects — which mainly emanate from universities, non-governmental organisations and museums [see e.g. Bentz, 2020; Lesen et al., 2016; Warner, 2022; Zaelzer, 2020]. In contrast, against this background, in this paper we explore:

1. How can the communicative role of art be grasped in less tangible science contexts and institutional settings, especially environmentally-themed, science-inspired street art?

2. What strategies do street artists who want to get people engaged in environmental issues use to get their environmental messages across?

3. How can we grasp street art as a means of creative grassroots environmental communication?

Street art on public buildings, streets and other publicly-accessible spaces and urban environments taps into a massive and extremely diverse audience — everyone in a city — making it a fascinating stage for sharing an artist's messages. For example, within Australia's capital, Canberra, there is a lively and productive street art culture, where many street artists explore environmental themes [Houlcroft & Jürgens, 2023; BOHIE, Jürgens & Thompson, 2022; Power, Jürgens & Thompson, 2022; Byrd, Jürgens & Thompson, 2022; PHIBS & Jürgens, 2022], and, in most cases, create their artwork together with communities; in *and* as a collective conversation about environmental concerns, uncertainties and desires. This turns audiences into collaborators (or makers of art) and is more effective in engaging people with a science topic than models where knowledge is imparted by experts to audiences who supposedly lack scientific literacy [Evans, 2014]. Street art is thus unique in that it is both a producer of public knowledge and a participant within the environmental discourse, as it represents knowledge of environment but also reflects the public's perception of this knowledge.

We argue that because of these qualities, and because street art is "unsanctioned, open and ephemeral" [Bengtsen, 2017], street art is an effective and underappreciated tool for communicating important ecological messages and for raising awareness about our environment. Informed by, and expanding on, a series of ongoing short articles on street art, science and engagement that two of the authors run in an open-access peer-reviewed online journal aimed at a wide, non-academic readership [*w/k — Between Science & Art*], this paper explores the communicative strategies of the science-based and environmentally-focused artwork of Australian street artist BOHIE in three case studies. Building on previous collaborations with BOHIE [see BOHIE et al., 2022; ANU CPAS, 2022], we engage in in-depth analysis to better understand the artist's participatory, community-embracing approach in creating science-related public environmental artworks. We are interested in the street artist's perspective on the messages of her art to better understand the mechanisms of how — and which — environmental issues are communicated through public art.

In what follows, building on Jonsson and Grafström's [2021] use of the comics format as a pedagogy to communicate content/research *and* the research process, we include a street artist in the iterative and integrative process of our research reflection, discussion and writing to gain new insights into our own analytical process — and not just the process of co-creating the text [Jonsson & Grafström, 2021]. We do not intend to talk 'to' or 'about' the street artist, but *with* the artist — with BOHIE — in the spirit of art-encompassing science communication [Davenport & Morton, 2022; Fleerackers et al., 2022]. Since there is little research on the role of street art in, or for, science communication, we understand this article as a pilot piece: we do not attempt to provide categorial 'truths' about the

communicative functions of street art, but rather seek to raise questions about the role of street art for science communication by looking at the achievement of an individual artist in a specific setting. By diving into sufficient detail around one artist, further analytical possibilities are opened up [Silverman, 2017, p. 44].

Objectives: exploring images and insights of science through visual art

"What is known and passed on as *science* is the result of a series of representational practices" [Pauwels, 2006, p. vii], which is why the discourse around science has been called a "multimedia genre" [Lemke, 1998, p. 87]. Within this context, images *of* science and scientists can emerge outside the framework of science altogether and "explore and exploit the mirror images of science or scientists in the collective imagination" [Hüppauf & Weingart, 2007, p. 6]. These cultural approaches to science communication examine what is being made or reinforced through "public storytelling about science" [Davies, Halpern, Horst, Kirby & Lewenstein, 2019, p. 4] and, thus, how society constructs meanings around science. Given the "increasingly prevalent sense that science communication is not external to (popular) culture" [Davies et al., 2019, p. 2], examining representations of science in popular culture — of which street art is one expression — allows us to identify formative cultural meanings that "may be the most important element contributing to public attitudes of science" [Davies et al., 2019, p. 9]. Indeed, popular images of science can "significantly influence public attitudes toward it by shaping, cultivating, or reinforcing these 'cultural meanings' of science" [Kirby, 2017, p. 11]. The process behind these phenomena has been described as "scientific culture and its knowledge becom[ing] incorporated into the common culture" [Bryant, 2003, p. 357]. This is the background against which we examine the meanings and communicative functions expressed in science-inspired environmental street art murals and the extent to which they can be considered vehicles for conveying environmental messages and communicating science (see three key questions, above).

Taking a case study approach, this paper contributes to both current discussions about visual language in science communication and ways of communicating and engaging in dialogue about research [Jonsson & Grafström, 2021; Wiseman, Collver, Worth & Watt, 2021; Igarashi, Mizushima & Yokoyama, 2020; de Hosson et al., 2018; see also Fransberg, Myllylä & Tolonen, 2023] and to the study of the intangible cultural aspects of environmental communication [cf. Burns, O'Connor & Stocklmayer, 2003, p. 191]. In addition, following Collver's and Weitkamp's approach — by including a street artist in our discussion as a primary source and 'partner in research' — this study also further develops the definition of the environmental street art genre by clarifying "its claims to authorial intent" [2018, p. 2]. In so doing, we add new perspectives to the 'cultural stream' of science communication — by highlighting that not only fiction and film, but also visual science narratives in street art reflect ideas about science and "construct perceptions for both the public and scientists in a mutual shaping of science and culture" [Kirby, 2008, p. 44]. Ultimately, this paper follows Löschnigg and Braunecker's call that it is time to explore the aesthetic possibilities of fields *beyond* science to raise awareness of the environment — such as within the arts and humanities, which have long been concerned with the "the circulation and organization of symbolic meaning through culture" to convey information and knowledge in very distinct ways, affecting "emotion, attitude and agency" [2019, pp. 3–4].

Background and research context

Street art is an urban art practice that encompasses a range of techniques and materials. Sprayed, painted, stencilled or printed images are street art manifestations just like light sculptures, knitted and planted works and many other formats. Street art evolved from graffiti as a form of artistic expression, social intervention and protest [Ross, Bengtsen, Lennon, Phillips & Wilson, 2017; see also Florance & Malins, 2022; Bloch, 2018; Cooper & Chalfant, 1984]. However, the actual connection and interrelationships between graffiti and street art are complex and the subject of fierce debate [e.g. Young, 2016, pp. 29, 35; Dew, 2007, pp. 11–23], which also applies to the societal and political role of uncommissioned street art [see e.g. Kuittinen, 2015; Awad & Wagoner, 2017]. For all its diversity, there is a consensus that street art is a multidisciplinary "form of imagery that activates the street using a pictorial vocabulary to transmit its messages" [Waclawek quoted in Sachdev, 2019]. While street art comes in various shades of aesthetic sensibility, confrontation, invasiveness and impermanence, it is largely ephemeral, non-commercial art that is free to experience, "owned and overseen by no one (or, rather, everyone)" [Riggle, 2010, p. 249] and intrinsically linked to a street context. In the words of Nicholas Alden Riggle: "the artistic use of the street must be *internal* to its significance, that is, it must contribute essentially to its meaning" [Riggle, 2010, p. 246].

The messages, goals and motifs of street artists range from beautification to protest. 'Subvertisers' — like the international art collective Brandalism, for example, who subverts advertising in urban spaces by creatively intervening into ad spaces — define themselves as "a revolt against the corporate control of culture and space" [Bengtsen, 2018, p. 48] Other, eco-spirited artists aim "to surprise people in the urban environment with a temporary invasion of natural forms" [Lewis quoted in Kuittinen, 2015, p. 84]. It is important to note, though, that with its growing popularity and the commercialisation of urban creativity [e.g. Young, 2016, p. 189], more and more street art is commissioned [Kuittinen, 2015, p. 13], which challenges curatorial practices and forces museums and galleries to rethink traditional modes of displaying art [Young, 2016, p. 35].

In the research, street art is explored from a range of perspectives, primarily through qualitative methods, including visual ethnography [e.g. Sachdev, 2019; Armstrong, 2005], sociology, geography, art history [Ross et al., 2017; Prendergast et al., 2021] and most recently multisensory embodied practices [Fransberg et al., 2023], and in collaboration with scientists [Constable, Jürgens & Thompson, 2023]. Practitioners-turned-scholars play a vital role in the research [Ross et al., 2017, p. 418]. Across disciplines and academic lenses, researchers seem to agree that street art, by creating unexpected encounters in public spaces, is an effective means of encouraging people to explore (and thus increase their awareness of and engagement with) their surroundings, and that artistic visual communication with an activist agenda can be an effective way of changing viewers' attitudes and behaviours [Bengtsen, 2018; Riggle, 2010]. While important publications — especially by art historian and sociologist Peter Bengtsen [e.g. 2018] — discuss environmental activism, themes and motifs in street art, it has barely been explored from the perspective of science communication.

Methodological and interpretative frameworks

Our study focuses on three selected murals — large-scale graphic artworks depicted on a wall — that use non-abstract visual narratives to convey messages about the environment. These murals (as with street art murals more generally) are created in highly-populated urban spaces where the art can be seen by people easily. The examples were chosen based on four criteria: 1) they were created in the past few years; 2) they are large, detailed and visually stimulating; 3) they explore different environmental themes; 4) they are figurative (not based on abstract/geometrical patterns). In accordance with the qualitative case study approach, the examples were selected to provide "a close-up, detailed or meticulous view of particular units which may constitute [...] cases which are relevant to or appear within the wider universe" [Mason, 1996, p. 92].

To answer our three key questions (see introduction) our study draws from science communication studies, graffiti and street art studies and cultural studies. Building on the artist's description of the murals ('Corpus') and on our informal, project-based conversations with her, we examine the individual components of the murals (including visual techniques and stylistic features) and how they relate to each other to understand the meanings they create, and the context they use to convey an environmental 'story' or message ('Analysis & Interpretation'). To identify the details and their relations (essential to the fabrication of a story in a narrative image) and to make sense of the environmental messages in the selected murals, we use a qualitative approach, drawing from textual analysis (close reading) and studies 'reading the visual' [Schirato & Webb, 2004; Horváth, 2018]. Like Schirato and Webb, but through a science communication lens, we read street art murals as texts — a text "comes to have meaning by virtue of the signs that make it up, the way those signs are arranged or organised in the text and also, importantly, because of its context"; its context is "the environment in which a text occurs, and communication takes place" [p. 8].

Approaching visual cultural artefacts, such as murals, as texts (which themselves make sense through narrative, "or stories that are organised visually" [p. 9]) is a standard procedure in cultural research because "whenever we produce an interpretation of something's meaning — a book, television programme, film, magazine, T-shirt or kilt, piece of furniture or ornament — we treat it as a text" [McKee, 2003]. A close reading of texts involves paying close attention to textual details such as setting and characterisation. "Often, close reading concerns the dichotomy between what the text literally says and what can be inferred" [Rapaport, 2011, p. 4]. Thus, close reading — and 'reading' street art — makes no claims about whether the texts (or our interpretation) are 'accurate' or 'truthful'. This approach follows communication and media scholar Alan McKee: "There isn't a single, 'true' account of any event, but there are limits on what seems reasonable in a given culture at a given time" [2003]. Artworks, artist reflections/statements and artist conversations were given equal weight during the analysis.

Corpus — the artist's voice

BOHIE is a versatile multidisciplinary Australian artist engaging in culturally transformative creative works through large scale, research-inspired public mural works, fine art and commercial design. She collaborates with local and state governments, educational institutions, corporate partners, NGO's and community groups to design public art projects that challenge social constructs, inspire change for greater sustainability and promote human-animal-environment connections

[BOHIE, n.d.; BOHIE et al., 2022]. Creating works that "question our current circumstances and create mindful connections both with the natural world and with each other", BOHIE frequently consults experts and researchers (including environmental scientists) to ensure that her street art is both relevant and appropriate [BOHIE et al., 2022]. The three murals by BOHIE introduced by the artist in this section and discussed/interpreted together in the following are located in Canberra, a city known as a place where artists can freely express their own style [Florance & Malins, 2022], thanks to, for example, 32 legal practice spaces and the support of the Australian Capital Territory (ACT) government through its public street art events and commissioned murals [Jürgens, Petheram & Thompson, 2022].

CASE STUDY 1: Inspire Growth *(2022) — artist's reflection on the mural and its environmental theme*

Figure 1. BOHIE: *Inspire Growth* (2022). Photo: Blake Thompson.

The "INSPIRE GROWTH" mural was created in partnership with the ACT Government sustainability initiative "NoWASTE", so I knew it had to have an environmental activism theme. First, I researched the impact of disposable coffee cups and found on Sustainability Victoria's website that Australians throw out 2.7 million single-use or disposable coffee cups every single day. They said "This adds up to 1 billion coffee cups thrown out every year. It's no surprise that disposable coffee cups are a major contributor to litter on our streets and in our waterways". So a reusable coffee cup had to be in there somewhere.

The mural site is located in a bustling Canberra suburb known for its cafe culture so for design research I spoke to various local business owners about their sustainability practices. It's important to me that the mural directly reflects the local community and empowers the general audience to make more informed choices about sustainability.

One nearby cafe was donating their food waste to community gardens for composting, and the owner and I got chatting about how cool it was that coffee grounds were being used to grow mushrooms for commercial kitchen use. I started researching this and found a scientist from the Canberra-based Commonwealth Scientific and Industrial Research Organisation, Dr. Oliver Mead, who was researching different uses for fungi. He told me that "Fungi have such an important role in our ecosystem. They have a crucial role as decomposers and recyclers. And they make it possible for members of the other kingdoms to be supplied with nutrients and to live. Ultimately, the food chain would not exist without these organisms". Then I read about global research being undertaken into using a specific fungus to clean up oil spills! This inspired the oily coffee liquid seeping out of the keep up.

Mushrooms seemed like the perfect symbol for recycling, and the words "Inspire Growth" act as a double meaning; the fungi research inspired a spiritual growth in me by helping me to consider new ways of doing things, and the action of recycling food waste inspired a physical growth for food production. I added the KeepCup logo while I was painting, which I have adapted to say "Keep Up". This is a little tongue-in-cheek that asks the viewer "What are you doing to inspire growth?"

CASE STUDY 2: In Our Hands (2021) — artist's reflection on the mural and its environmental theme

Figure 2. Faith Kerehona and BOHIE: *In Our Hands* (2021). Photo: Blake Thompson.

"IN OUR HANDS" is a mural painted in collaboration with Faith Kerehona and funded as a placemaking grant by the ACT Government City Renewal Authority. The funds were

released six months after the 2019/2020 Black Summer bushfires ravaged the environment surrounding Canberra and the greater area. Through local community consultation we learnt that many civilians were deeply concerned about broader animal welfare with particular concern for loss of habitat due to the bushfires.

In response to this, we created an artwork featuring a young girl holding/protecting a baby kangaroo whose feet are bandaged up from bushfire burns. She has an echidna holding on to her ankle and Arthropodium minus — lilies — floating around her, which we decided on because we learnt that these natives are quick to bloom from dormant seeds activated by bushfire heat. This worked well as a symbol for strength and regrowth through adversity. We placed the trio floating in cool blue water to calm the scene and hold space for the raging bushfire that glows from the girls' belly/internal space.

The public have been incredibly positive in response to this artwork, both locally and nationwide on social media. There have been many street art bushfire tributes since the fires, and I feel proud that we created something that people have found solace and healing in, and who feel like it speaks on behalf of their care and concern for the impacted wildlife. Even three years on now, it serves as a reminder that we are all still healing from the bushfires.

CASE STUDY 3: You Choose *(2022) — artist's reflection on the mural and its environmental theme*

Figure 3. BOHIE: *You Choose* (2022). Photo: BOHIE.

"YOU CHOOSE" is one artwork spanning two separate ICON water boxes in a brand-new suburb of Canberra (Whitlam). I was commissioned by the ACT Governments' Suburban Land Agency (SLA) to create an artwork that challenged the viewer to consider their relationship with the natural environment surrounding the suburb, which is primarily undeveloped (or yet-to-be-developed Natural Temperate Grassland, Box-Gum Woodland, and the Molonglo River Reserve). SLA put me in touch with the Ranger in Charge of the Molonglo River Reserve, Nic Jario, from the ACT Government Parks and Conservation Service, who helped me narrow down a long list of threatened species who call this local area home. Nic also explained to me about the direct connection between urban stormwater from Whitlam and Molonglo river health, with human debris and soil runoff from Whitlam impacting the natural habitat of these already-threatened species [see BOHIE, 2023, for more detail].

I designed an artwork that proposes two different outcomes. One box features threatened species from the grassland and woodland habitats; the Perunga Grasshopper, Grassland

Earless Dragon, Golden Sun Moth and Hoary Sunray wildflowers surrounded by crushed aluminium cans. In this proposal, the natural elements are pixelated, as if fading from view. On the second waterbox I created an underwater scene featuring threatened and vulnerable species from the Molonglo River Reserve. These too are surrounded by crushed aluminium cans, though in this proposition the cans are pixelated and are 'fading from view'. The end wall holds a message explaining the artwork and the titles of the featured vulnerable species, ending with the question 'Which would you rather disappear?'

The mural site is located next to a children's playground, and while painting I found that the mural artwork attracted the young children's attention quite a bit more than their parents. The children seemed engaged by the message, and interested to learn more. By asking questions I learnt that many of their parents were new to Canberra, recent immigrants to Australia and have English as a second language. I found this to be an interesting demographic, as many first-generation Australians are not familiar with the natural environment here beyond a natural fear of sharks, spiders and snakes. I hope that encouraging them to consider their own impact on a larger ecosystem, beyond their own property boundaries, will help instil a sense of belonging and connection to their new home.

Analysis and interpretation — learning from BOHIE and street art

BOHIE's murals (Figures 1–3) communicate environmental concern and manifest that creativity can alter surfaces and structures that are seemingly fixed and unchangeable [Young, 2016, p. 193]. Her creative environmental interventions in public space transform street furniture and urban walls into "sites of exploration" [Bengtsen, 2018, p. 2].

How can the communicative role of environmentally themed, science-inspired street art be grasped in these less tangible science contexts and institutional settings?

The selected murals are not photographic portrayals of the state of the environment but visual narratives about sustainability (Case Studies 1 and 3) and climate change (Case Study 2) that incite our visual imagination. A visual narrative can be a painting, fresco or film — any medium that requires our visual imagination to bring both visual actions and their settings to life [Horváth, 2018]. Visual imagination is thus an imaginative response to visually presented stories. Our visual imagination makes sense of what makes the narrative within the visual stimulus (e.g. variety, disposition/arrangement, repetition, point of view, effects of light and shadow). Visual imagination has been defined by neuroscientists as embracing associative mental visualisations (including the art of memory), activating the image reservoir in memory and learning through images [Horváth, 2018, p. 145]. Visual as well as written narratives revolving around the environment that activate our imagination can (thus) open up "novel forms of seeing, of understanding interconnections" [Löschnigg & Braunecker, 2019, p. 4]. Creating an immersive "melding of attention, imagery and feelings" [Davies et al., 2019, p. 8], narratives can influence audiences' perceptions of their own worlds [Mathies, 2020; Stroud, 2008] — and provide enjoyment (see BOHIE's comments on the reception of her artworks, above). Enjoyment of science-related content does not require the audiences to fully engage with the science: "enjoyment may be described as a pleasurable experience with science as a form of entertainment or art" [Burns et al., 2003, p. 197]. Indeed, enjoyment "and other affective responses may evoke positive feelings and attitudes that may lead to subsequent, deeper encounters with science" [Burns et al., 2003, p. 197]. Through positive experience

and emotions, we can feel encouraged — or, in BOHIE's words, empowered (see above) — to act on sustainability, which can lead to a powerful and long-lasting change in behaviour [Aronson, 1999]. After all, joy feeds hope and hope is essential for sustained climate action [Osnes, Boykoff & Chandler, 2019].

The environmentally-themed murals by BOHIE point to the social function of art by reflecting (on) the relationship between people and their environment — "a tangible sign of the health of society" [Mosstika quoted in Kuittinen, 2015, p. 131]. The connections explored in the three case studies are not only those between people and nature, but also within the specific Australian context and community, and it is the connection to place that enables "a sense of commitment and responsibility" to develop [Halpenny, 2010, p. 411]. More so, the aesthetic experience of environmental themes can lead to an 'affective arrangement': to the creation of a network of recipients related to each other by a shared aesthetic experience and mutual affection of emotional responses [Slaby & von Scheve, 2019]. But what creative tactics are used exactly, or put differently,

what strategies does a street artist who seeks to engage people with environmental themes use to convey their environmental messages?

BOHIE uses figuration and recognisable images [see Johnston, 2016, p. 180 on the value of using recognisable techniques and visual aesthetics] and kindness in her art "as an ethical model for leadership towards our shared future" [BOHIE et al., 2022]. The artist's many creative tactics also draw on surprise and witty juxtapositions/contrasts. There is a large body of research that explores the power of surprise in street art [e.g. Bengtsen, 2018, p. 2; Young, 2016, p. 135; Riggle, 2010, p. 249]. Surprise provides "a prism through which the everyday environment can be perceived differently", jolting potential viewers out of their daily routing and "creating curiosity and awareness" [Kuittinen, 2015, p. 14]. Surprise, for example in unexpected experiences, arouses interest and promotes knowledge acquisition [Adler, 2008]. Like surprise, witty juxtapositions — and humour more broadly — can be activated as tools to reach diverse publics and enrich informal public environmental communication and engagement [Merzagora, Aguirre, Boniface, Bricout & Martineau, 2022; see also Hee, Jürgens, Fiadotava, Judd & Feldman, 2022; Holliday et al., 2023, focusing on cultural-mediated, image-based forms of environmental communication]. For example, humour in climate messaging deepens perceptions and motivates environmental activism [Skurka, Niederdeppe, Romero-Canyas & Acup, 2018].

While all three case studies aim to encourage pro-environmental behaviour, *Inspire Growth* (Case Study 1) in particular emphasises humour. Reducing food consumption behaviours at a household level to become less wasteful is essential for climate change mitigation and the environment [Dietz, Gardner, Gilligan, Stern & Vandenbergh, 2009; Reisch et al., 2021], and Case Study 1 is an example of action-oriented environmental communication — inviting audiences to commit to reducing their own environmental footprint [De Meyer, Coren, McCaffrey & Slean, 2021]. This is seen as preferable to issue-based communication, which uses "language and overarching narrative [focused] on raising concern among its audiences", leading to hopelessness and a lack of agency [De Meyer et al., 2021, p. 2]. Raising concern about waste is unproductive, with 85% of Australians already feeling guilty about food waste [Baker, Fear & Denniss, 2009]. Rather than

making viewers feel bad about their waste, *Inspire Growth* uses humour and witty juxtapositions to convey its environmental message, helping to overcome the anxiety and apathy that the current issue-based approach to climate storytelling creates [De Meyer et al., 2021, p. 11]. BOHIE's public art embodies environmental meaning-making through emotive visual storytelling. Her murals are not just *in* the public, but *for* the public [Sandlin, O'Malley & Burdick, 2011].

Our case studies also highlight how emotional links to climate change [see Sommer & Klöckner, 2021] can be embedded in hope. The artist uses hope as a strategy "to encourage a sense of connection and belonging" [BOHIE et al., 2022], particularly in the *In Our Hands* mural (Case Study 2). Following the 2019–2020 bushfires in Australia, "one of the worst wildlife disasters in modern history" [van Eeden et al., 2020, p. 5], which resulted in the loss of three billion animals, a "high level of concern about climate change was reported across the whole population [of Australia] regardless of gender, age, or residential location" [Garad, Enticott & Patrick, 2021], leading to symptoms of PTSD, and eco-anxiety — "a chronic fear of environmental doom" [Clayton, Manning, Krygsman & Speiser, 2017, p. 68]. This concern is warranted, as Australia has the highest extinction rates of any other place in the world, equating to 50% of recent mammal extinctions worldwide [Vernes, Elliott & Jackson, 2021; WWF-Australia, n.d.]. Focusing on "strength and regrowth through adversity" (BOHIE, Case Study 2) and "regeneration and hope" [Kerehona, 2020] the mural *In Our Hands* expresses the "grief both artists felt" [ACT Government, 2021] while also celebrating the vital importance and value of wildlife [see BOHIE above and van Eeden, Dickman, Ritchie & Newsome, 2017, on changing public attitudes about the value of wildlife]. Values are concepts or beliefs that people place on end states or behaviours that they desire which are ordered by relative importance [Dietz, 2013]. Hence, values "serve as guiding principles in people's lives" [Brown Jarreau, Altinay & Reynolds, 2017, p. 146]. Value-based communication creates behaviour change by integrating the target audience's values into the message [Dixon, Hmielowski & Ma, 2017]. Placing the values of the public in the hands of the woman acts as a metaphor: the survival of animals is the responsibility of humans — it is *In Our Hands*.

Climate change is "not only a scientific phenomenon, but also a cultural one" [Lehman, Thompson, Davis & Carlson, 2019]. By tapping into "the human enmeshment within the biosphere" [Westling, 2006, p. 45], the selected murals represent and contribute to a "culture-based understanding of science" [Davies et al., 2019, p. 4], but

how can we grasp street art as a means of creative grassroots environmental communication?

BOHIE's murals are promoters of ideas and informal, extra-institutional interpreters of environmental events. While the selected street art works do not communicate scientific facts per se, they do touch on scientific ideas around anthropogenic climate change, its impacts on the (natural) environment and our relationship with sustainability — they are cultural signifiers. In other words, BOHIE's environmental murals offer vital commentary and "signify streetscapes with meanings and intentioned communications", thus providing "an indicator into the nature of the zeitgeist and what we consider as being collectively important" [Hickey, 2010, p. 162]. They indicate that public spaces are educative

arenas and pedagogical locations, and thus means and examples of public pedagogy.

Acknowledging that there is an informal dimension to learning that goes beyond the school as a place of teaching and learning, Sandlin et al. [2011] define public pedagogy across different domains as informal educational sites (which includes popular culture and public spaces); educative spaces with an intrinsic pedagogical force. From this perspective, streets are "implicit pedagogue[s]": the street functions "as both active host of public pedagogies (such as the roadside billboard, or traffic sign) and as a pedagogical force of its own contextualisation" [Hickey, 2006]. The experience of a public pedagogical encounter with an artefact — such as a mural — can leave us with a greater sense of familiarity with the world or a sense of excitement at the "possible emergence of a new pattern" [Sachdev, 2019, p. 282 referring to Austin]. So, the new question arises whether street art, when created in conversation with scientists and researchers — as in BOHIE's artworks — is an expression of grassroots environmental creativity at all, or rather a form of creative public communication that repurposes "public spaces toward educational ends" [Sandlin et al., 2011, p. 349] — as a 'boundary spanning' form of public pedagogy [Safford, Sawyer, Kocher, Hiers & Cross, 2017].

Insights and interpretation — learning *with* BOHIE and street art

We science communication researchers were fascinated by how BOHIE's art is able to make visible what is difficult to put into words, such as the fragility of the environment and the urgency to act, but also broader values and (collective) experiences, while addressing a wide audience with a well-considered integrity, to use her own words [see BOHIE, 2022]. For example, the bandaged kangaroo as an embodiment of the vulnerability of our environment and the juxtaposition of animals and rubbish moved us deeply — as a call for all of us to reflect on what and who should be treated responsibly and how. Working together, we developed a new and sharper understanding of the importance of process; the process of working together and understanding how we understand key terms such "research" and "environment" that we had taken for granted — including the different logics with which we approach our projects and writing. BOHIE's artistic visual strategies, including juxtaposition, wit and hope, as well as her reflections on connection and connectivity (with the environment), encouraged us to think about different ways of doing to help make change. Why not create a research-based street art mural on a university campus? In fact, BOHIE, the artist, has become a colleague in the course of writing this article and developing other science communication research projects [e.g. BOHIE et al., 2022; ANU CPAS, 2022]. In 2023–2024 she is a Visiting Fellow at the Australian National Centre for the Public Awareness of Science at the Australian University (ANU). What started as an informal, project-based discussion at a street art festival and a student project led to this article and is now evolving into official university projects. From BOHIE's perspective, working with researchers in the field of science communication has also revealed new ways of bringing about change, create value and reach new audiences. She now has a broader understanding of the potential that her own voice and personal perspective can have on public space and public discourse through research-driven personal reflections — as opposed to brief-driven commercial commissions.

Conclusion — street art as public communication and public pedagogy

Public art can challenge, question and explore unseen alternatives; it can inspire civic pride, promote social interaction, strengthen the sense of community and contribute to local identity [Schuermans, Loopmans & Vandenabeele, 2012, p. 676]. Research-inspired environmentalist street art can explore cultural meanings of science, as our examples show, by creating common ground with audiences through strategies such as surprise, humour, hope and enjoyment — which is "a highly desirable component of all science communication" [Burns et al., 2003, p. 197] — based on environmental events or themes that can connect to the communities in which the street art was created. As seen in our case studies, by positively reinforcing environmentally friendly behaviours, street art uses this connection to encourage agency in pro-environmentalism and to help evolve our relationship with sustainability.

The small selection of three key examples/case studies may raise the question of how generalisable the results of our analysis are to other street art murals (for example with respect to its reception/enjoyment). Indeed, qualitative research with smaller data collections has been criticised for not being transferrable to other settings [Queirós, Faria & Almeida, 2017] and even for "yielding less societal use-value" because "there is no way of telling what is true and what is false" [Frykholm, 2021, p. 255]. However, as outlined above, it was not the point of our study to explore 'what is true and what is false', not least because generalising qualitative research is not the goal or interest of the method we used [Gheondea-Eladi, 2014; see also Silverman, 2017, p. 264]. Within this context, we explored *meaning production* by analysing limited but rich data and how it can be studied as a process that is contextualised and inextricably linked to broader social and cultural practices [Jensen, 1991, p. 4]. Given that pop culture is where collective understandings of science are created, and that pop cultural products exploring science themes — including street art — are considered a form of public pedagogy [see also Giroux & Pollock, 2010, p. 2], we were interested in discovering "deeper themes" in our material — and thus became "message investigator[s]" [De Castilla, 2017, p. 137].

Further research can explore in more detail the emotions evoked by street art through empirical analysis, the ways in which street art reflects scientific knowledge about environmental communication that other art forms do not and the role of specific expressions of public art — such as graffiti and stencil art — as means of environmental communication whose rebellious nature appeals to audiences in different ways. It is important to note that accessibility and communality are vital parts of the street art practice and that it is not always and only "an unsolicited aesthetic injection" [Riggle, 2010, p. 249]. BOHIE's work, for example, is commissioned and informed by the local context: the same artwork would appeal to a different audience elsewhere and evoke a different interpretation [Riggle, 2010; Lynn & Lea, 2005, p. 218]. The fact that BOHIE's artworks, discussed in this article, were commissioned by the government but are neither an expression of illegal protest (often associated with forms of street art) nor an artistic realisation of infographics (or prescribed material) raises interesting questions about autonomy and agency, as well as ethical obligation in relation to the work's environmental messages, that are worthy of closer consideration and further discussion. The role and cultural dynamics of social media in these contexts — e.g. in furthering public debate about the signification of street art and the 'ownership' of public spaces and the autonomy of artists — also deserve further

research [see Hannerz, 2016], as the virtual life of the artwork gives it additional meaning, audiences and interaction, if not "an alternative history of 'open-access' and 'user-generated content'" [MacDowall in Dew, 2007, p. 1].

As public intervention that challenges its audiences through visual impact and immediacy, "offering light-bulb moments on the street through unexpected experiences" [Kuittinen, 2015, p. 6, see p. 14], street art agitates, educates and facilitates engagement. We can conclude, with its experiential and connective function and informal education dimension, environmentally-themed street art works "are participants as well as producers of a dialogue about knowledge and have an important function within the public discourse" [Pansegrau, 2007, p. 257]. Part of this dialogue can be artists and researchers in the field of science communication, and the dialogue can be transformative for all of them.

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BOHIE is an established Canberra-based artist. She creates murals, art, design, and creative workshopping experiences that explore the value of connection both to each other and to the natural world. She works alongside educational institutions, government agencies, community focus groups and stewards of the natural world to design change-making campaigns for each creative project. Using a research-based methodology to uncover inspiration, her creative works are laden with deeper stories and symbolic meaning. This narrative driven conceptual development injects a unique authenticity and grass-roots integrity into the public arena, which she sees as a conscious challenge to public advertising and superficial societal constructs. In a time of rapid change, extreme instability and a globally recognised feeling of imminent threat, BOHIEs' art provides messages of hope and empowerment to inspire her audience towards a changed future.

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Dr. Rod Lamberts is Deputy Director of the Australian National Centre for the Public Awareness of Science (CPAS) at the Australian National University. His interests lie in the worlds of public intellectualism in science communication and risk perception/communication. He professional science communication practice focusses particularly on podcasting, with regular forays into live radio and writing for non-technical audiences.

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