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The culture of science communication in rural and regional Australia: the role of awe and wonder

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Abstract

Experiences of awe and wonder are vital to science and innovation. In this practice insight we explore how these emotions shape the culture of science communication. In doing so, we examine how exclusively nature- and place-based experiences for awe and wonder are often features of resource-limited settings. We then describe strategies for awe- and wonder-centred science communication beyond reliance on nature or the power of place by detailing a successful hybrid resourcing model in a rural Australian science centre. We finish by describing the role of science communicators in engaging potential collaborators to enable science communication in resource-limited settings.

Keywords

Public engagement with science and technology; Science centres and museums; Science education

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Introduction

Every STEM (Science, Technology, Engineering, Mathematics) professional will remember their first encounter with something that elicited awe and wonder: the size and might of dinosaurs, the elegance of a mathematical equation, the immensity of the universe and our relative insignificance - the list goes on.

Psychology categorises awe and wonder as emotions, and they are crucial for instilling a lifelong interest in STEM [De Cruz, 2020]. L'Ecuyer [2014, p. 6] suggests that *wonder* "is the centre of all motivation and action in the child" and De Cruz [2020, p. 159] defines *awe* as "the feeling of experiencing something vast that is beyond our grasp or understanding and that we have a desire to accommodate". Awe, according to Keltner and Haidt [2003], therefore consists of two complementary elements — vastness and accommodation. Vastness relates to scale, it is often associated with physical size but can also relate to "time, complexity and power" [Cuzzolino, 2021, p. 683]. Accommodation on the other hand refers to the experience of encountering information beyond and often inconsistent with an individual's epistemic grasp, such that it demands a

remoulding of one's worldview or frame of reference [Cuzzolino, 2021]. Other definitions of awe also draw connections with connectedness, spirituality, existential awareness and humility [Cuzzolino, 2021; Piaget & Inhelder, 1969; Sinai, Johnson, Farahmand, Farahmand & Cody, 2019] Additionally, we define *wonder* as a related emotion that instils admiration and inspires curiosity. Both emotions work toward a curiosity for, and give impetus to, exploring the stimulus to uncover 'truth'. Such experiences shape science communication culture [Silva Luna, 2021] and, during childhood, act as an important gateway to STEM-based careers later in life [Valdesolo, Shtulman & Baron, 2017; Bianchi, 2014; Rowen, 2006].

The purpose of this practice insight is to explore the culture of science communication in rural and regional Australia, defined here as localities with populations under 80,000 people. We begin by exploring the role of awe and wonder in shaping the culture of science communication, examining both classical and constructivist notions of awe in particular. We then discuss what appears to be the prevalent culture of informal science communication in rural and regional Australia, one that we argue largely draws on awe- and wonder-inspiring stimuli grounded in proximate natural environments and STEM-based tourist attractions. We then argue that a shift in this culture of science communication from a predominantly place- and nature-based culture to one that engages the public in STEM through varied stimuli can be facilitated through a hybrid strength-based resourcing model in science communication. In particular we discuss the role of science communicators in this hybrid resourcing model, drawing on our own experience in rural and regional Australia. We end by considering the role of awe and wonder in advancing society as a vehicle for engaging disparate stakeholders in supporting science communication in rural and regional areas. Whilst describing the culture of science communication in rural and regional areas in Australia and elsewhere is an endeavour that requires more empirical research, this practice insight hopes to serve as a foundation for such work.

Awe and wonder in shaping a culture of science communication

To understand the role of awe and wonder in developing a culture of science communication in rural and regional Australia, we will briefly examine conceptions of awe and wonder, the role of culture in shaping ideas about these conceptions and the development of a culture of science communication.

The recent literature on both emotions considers awe in far greater detail than it does wonder. We therefore mostly consider the former in this section, but recognise that wonder is often awakened by awe, playing an important role in the evolution of science communication culture [Paulson, 2021].

Luna and Bering [2020] describe in detail the role of awe in science communication. They first examine and contrast two conceptions of awe in the communication of science; one that is classical and another that is constructionist. This follows similar discussions in the broader academic discourse on emotion. Hoemann, Xu and Barrett [2019], for example, present a parallel dichotomy in the debate on emotional development in general — is it innate or constructed?

The classical conception of awe holds that this emotion is innate, regardless of cultural or social context, and a universally consistent response to awe-eliciting stimuli. This classical view, which Luna and Bering [2020] consider the

predominant conception of awe in science communication, finds expression in the form of media and other content intentionally positioned to elicit a particular type of awe. One that is associated with "vastly large objects" [Luna & Bering, 2020, p. 3] such as space, embellished by stylistic choices in science communication. This view of awe, they argue, has shaped the prevailing culture of science communication and given rise to the idea that awe simply elicits this innate, universally human response but does not shape its manifestations. It is difficult to ignore the extent to which this prevailing culture of science communication draws, very intentionally, on concepts and images of expansiveness and largeness in both physical size and across time — dinosaurs, space, the oceans, "wonders of the world", and so on are all employed in the elicitation of awe. And while awe is certainly associated with vastness, its other aspects unrelated to physical size are often marginalised. Even science communication and experiences which deal with physically small subject matter, such as insects, tend to do so in the context of physical vastness, such as large congregations of butterflies or glow worms [Lemelin, Boileau & Russell, 2019].

Luna and Bering [2020] challenge this idea of awe as an innate attribute independent of cultural context. They particularly cite developmental psychology literature which argues that emotional expressions are learnt and progressively acquired from an individual's environment and culture [Hoemann et al., 2019]. "Emotion terms such as 'awe' are not natural kinds but rather folk categories, learned over the course of a person's lifetime of repeated use of that category in their particular culture." [Luna & Bering, 2020, p. 5]. As such the authors make a case for what they term a constructionist view of awe illustrating their point with examples, however many of these are centred on science communication in the context of Western culture. For example, Luna and Bering [2020] discuss the role that documentaries play in creating an association between mountains and awe, suggesting that such an association may be only four centuries old. But in making this conclusion, the authors draw only on European examples, neglecting to examine the strong association between mountains and awe in a myriad of other cultures and traditions, including Islam (The Qur'an Al-Hashr 59:21), Persian culture [Karbasi, al-Islam, Shabani & Norouz, 2020] Judaism (Amos 4:13) ["King James Bible", 2022], The Baha'i Faith [Bahá'u'lláh, 1991], Daoist and Chinese philosophy [McIntire, n.d.; Ham & Scheidegger, 2018], Māori culture [Dennis, 2017] and many others [Sinai et al., 2019].

Given these considerations, we conclude that there is a dynamic relationship between culture, awe, wonder and a *culture of science communication* but that this interaction requires more exploration including sources outside of Western contexts. How can we reasonably discuss the universality of an emotion if the discourse marginalizes so many perspectives? To proceed, we feel it necessary to outline our current but evolving and impermanent understanding of the aforementioned interaction between emotions and the development of a culture of science communication. We accept that emotions are felt in response to particular stimuli, in the context of awe these are related to vastness and accommodation [Keltner & Haidt, 2003]. In the context of wonder, these stimuli inspire curiosity. While we propose that both emotions are universally felt as part of the human experience, we acknowledge that 1) the limitations of language limit our exploration and understanding, 2) that both emotions have broad and contested definitions and 3) the response to these stimuli — exhibited through indicators

such as specific facial expressions and verbal/vocal responses — are to some extent constructed through culturally learnt behaviour. As such, a culture of science communication, where awe and wonder are prevalent features, seems to be sustained and developed through the learnt expressions and curated communications of innate emotions, and thus looks different in varied settings.

While it is not within the scope of this practice insight to further explore these interactions, this classical-constructivist debate merits further exploration and would, in addition to adopting a more global view, do well to further consider the limitation of language in describing emotion [Gmuer, Guth, Runte & Siegrist, 2015; Shablack, Becker & Lindquist, 2020].

Additionally, while a global culture of science communication seems to exist, there also appear to be strata of more localised subcultures [Luna & Bering, 2020]. In discussing the culture of science communication in rural and regional Australia, we are in fact exploring a subculture of science communication within the Australian and Western contexts, themselves subcultures of a global, albeit disjointed, culture of science communication [Orthia, Hikuroa, Nabavi, Rochberg & DeVos, 2021].

The culture of science communication in rural and regional Australia

Populations in rural and regional Australia, defined here as areas outside of Australian cities and large towns with populations over 80,000, experience disparities with urban communities across many areas, including educational performance and resource accessibility. Research demonstrates a disparity between the performance of school students in Australia's rural and regional areas and that of their urban peers [Aldous, 2008; Fraser, Beswick & Crowley, 2019]. Rural and regional school students are also beset by a number of other barriers to their education. Factors such as the capacity to attract and retain staff, the limited availability of specialist staff, a reduced capacity to raise funds, resource pressures arising from smaller class sizes, and the ramifications this has on curriculum availability and program breadth all contribute to educational disadvantage in regional and rural schools [Lamb, Glover & Walstab, 2014]. Hossain and Robinson [2012] discuss that robust STEM education is best delivered by teachers who are well-equipped, well-trained, well-supported and well-prepared. Cuzzolino [2019] conducted interviews with professional scientists and found that authentic experiences that elicit awe are "hard to manufacture". The financial and logistical burden of arranging such experiences is only exacerbated in rural and regional settings.

These disparities likely extend to informal science education and communication experiences, such as out-of-school programs like science clubs, museum and science centre visits, and citizen science projects, but research on such disparities in the Australian context is limited. Dawson [2014] discusses the role that advantage plays in accessing informal science education across the OECD, describing rural communities as less likely to have access to these opportunities [Dawson, 2014]. This reinforces the science education challenge faced by rural and regional children but also sheds light on other accessibility and inclusion barriers, including for ethnic minority communities and low-income families [Dawson, 2018; Humm, Schrögel & Leßmöllmann, 2020]. Therefore, the accumulating drivers of exclusion from science communication and education that exist in urban settings are only

exacerbated for such communities in rural and regional areas [Dawson, 2014, 2018; Humm et al., 2020].

Given this relative scarcity of science communication resources and opportunities in much of rural and regional Australia, experiences in these regions tend to draw on other sources, particularly those which lean heavily on experiences of awe and wonder of the natural world (Table 1). While these nature-based resources are used to fill the above-mentioned gaps, they carve out only a narrow culture of science communication confined to experiences related to nature. This in turn limits the range and depth of awe and wonder experiences in rural and regional Australia's culture of science communication. Where the museums and science centres of Australia's cities and large regional towns supply an array of stimuli, such a rich diversity does not seem to exist in rural and regional Australia (Table 1). While we acknowledge the role that online resources and media play in communicating science across space, we are here considering the role physical assets like science centres, museums, guided walks, national parks, and botanical gardens play, acknowledging their capacity for supporting science communication [Camou-Guerrero, Sánchez, Ruiz-Mallén, Estrada-Torres & Gómez, 2020; Watkins, Miller-Rushing & Nelson, 2018]. In metropolitan Australia, science centres and museums operate with a variety of resources, exhibits, temporary exhibitions, and variously qualified staff. These cities contain places of natural beauty such as national parks as well as specialized infrastructure like observatories which also serve science communication purposes and exist in combination with one another. In much of rural and regional Australia, science communication experiences rely predominantly on nature- and place-based experiences [New South Wales National Parks and Wildlife Service, n.d.; Australian National University, n.d.; Australian Capital Territory Government, n.d.]. Even where museums or centres exist in rural and regional Australia, they largely draw on local content, related to proximate natural, geological, archaeological, or paleontological assets. What follows is the development of a culture of science communication which excludes non-local experiences and has the potential to create a perception of inaccessibility of science beyond local resources. A key knowledge gap exists here: what is the nature of accessibility to informal science education by location across Australia (and other settings)?

While not an exhaustive list, Table 1 demonstrates the degree to which museums and science centres in Australian rural and small regional towns (here defined as localities with populations less than 50,000 in 2018) draw predominantly on the power of place principle. The below are mostly science centres and natural history museums but we have also included other similar facilities which actively facilitate STEM communication, are open to the public, and operate for most of the year, and are not exclusively used by schools (such as state government-run outdoor and environmental education centres used for school camps). There appears to be no comprehensive list of such museums and science centres across regional and rural Australia and we suggest that greater documentation of these is required in order to properly understand the culture of science communication in rural and regional Australia.

Table 1. Science Centres and Museums in Selected Rural and Small Regional Towns in Australia: this table outlines a selection of science centres, museums and other science communication infrastructure across rural and small regional towns in Australia (defined here as places with populations under 50,000). The table details the town size, the name of the relevant centre/museum/etc. and provides binary (Yes/No) characterization with regards to being place/nature based.

Town	**Population (2018 estimate, Australian Bureau of Statistics unless otherwise stated)**	**Physical Science Communication Infrastructure**	**Place- or Nature-based[1]**
Albany, Western Australia	34,205	Museum of the Great Southern	No
Alice Springs, Northern Territory	26,534	Alice Springs Reptile Centre	Yes
		Museum of Central Australia	Yes
		Megafauna Central	Yes
		Central Australian Aviation Museum	Yes
Armidale, New South Wales	24,504	University of New England, Natural History Museum	No
Bathurst, New South Wales	36,801	The Australian Fossil and Mineral Museum	No
Blackwater, Queensland	4,749[2]	Blackwater International Coal Centre	Yes
Canowindra, New South Wales	2,258[2]	The Age of Fishes Museum	Yes
Charleville, Queensland	3,335[2]	Cosmos Centre	No
Coober Pedy, South Australia	1,762[2]	Umoona Opal Mine and Museum	Yes
Echuca - Moama	21,242	TwistED Science	No
Emerald, Queensland	14,119	Outback Exploratorium (Central Highlands Science Centre)	No
Eromanga, Queensland	119[2]	Eromanga Natural History Museum	Yes
Geraldton, Western Australia	37,648	Museum of Geraldton	Yes
Hamilton, Victoria	9,974[2]	Hamilton Pastoral Museum	Yes
Mt Isa, Queensland	18,588	Riversleigh Fossil Discovery Centre	Yes
		Hard Times Mine	Yes
Port MacDonnell, South Australia	847[2]	Port MacDonnell & District Maritime Museum	Yes
Tatura, Victoria	4,669[2]	Tatura Irrigation and Wartime Camps Museum	Yes
Whyalla, South Australia	21,742	Whyalla Maritime Museum	Yes
Winton, Queensland	875[2]	Australian Age of Dinosaurs	Yes

[1]Exists based on proximal natural resources (such as local native animals or plants, ecological niches, or paleontological sites), unique local geology or unique local archaeology. Therefore, these centres must be located where they are located and would be misplaced elsewhere. This information is based on the website of the museum/centre unless otherwise specified.
[2]2016 Australian Bureau of Statistics Census

Awe and wonder in rural and regional Australia beyond place- and nature-based stimuli

Regional and rural Australia is well known for natural assets and experiences, where power of place features in not only science communication, but tourism [Briedenhann & Wickens, 2004; Dragouni, Filis & Antonakakis, 2013; Summers, Cavaye & Woolcock, 2019], film and television [Olsberg SPI, 2016], and Australia's soft power diplomacy [Lemahieu, 2022]. These assets are important for experiences of awe and wonder, yet we argue that the culture of science communication in rural and regional Australia is largely confined to these assets because of financial and human resource constraints limiting diversity. In order to broaden the sources that sustain this culture and to draw on a variety of awe- and wonder-eliciting stimuli as is the case for populations in the country's large urban centres, additional resources must be deployed. Such an evolution in rural and regional Australia's culture of science communication can enhance access to informal and formal STEM education opportunities and contribute to a narrowing of the rural-urban disparities described above. Below we describe one effort to give shape to such a culture of diversified but still awe- and wonder-centred science communication in rural and regional Australia through a multi-stakeholder and hybrid resourcing model.

Achieving a hybrid resourcing model for awe-centred science communication in rural and regional Australia

To say that residents of rural and regional Australia, particularly children, should expect to be bereft of a diversity of science communication options, perpetuates notions of disadvantage, maintaining the status quo. Instead, we argue that the culture of science communication in rural and regional Australia can still be sustained by awe and wonder but that, despite resource constraints, sources can extend beyond place- and nature-based. Rural and regional Australia has a strong tradition of multi-stakeholder collaboration as a means of combining resources for a shared goal [Coyne, 2020; Sinai, 2021] and the same can be true for science communication endeavours. Indeed, here we describe a successful model of multi-stakeholder collaboration for a hybrid resourcing model to develop science communication in outer regional Australia which, while utilising the power of place, is not dependant on its location to achieve its goals. We also discuss how science communicators play an active role in generating co-investment for science communication.

The Central Highlands Science Centre (CHSC), now trading as the Outback Exploratorium, is a not-for-profit science centre and museum, established in 1995 in Capella, Central Queensland, Australia. While its name suggests an association with Australia's arid and semi-arid Outback, the science centre's programs and exhibitions are largely independent of this association and the name reflects efforts to capture the driving tourist market. The CHSC is now based in the small rural town of Emerald, Queensland (population 14,119 [Australian Bureau of Statistics, 2019]) and receives no ongoing government funding. It is managed by a volunteer management board and operated by paid and volunteer staff.

Since its inception, the CHSC's capacity to deliver programs has ebbed and flowed, a pattern of fluctuation that has been subject to a patchwork of funding arrangements and volunteer availability. However, the past six years have seen a stabilisation in the centre's capacity to deliver programs, thanks to the model described below.

Philanthropy and corporate sponsorship

Philanthropic organisations and locally-engaged corporations have provided financial support to the CHSC. This support allows the centre to maintain core staff and access medium-term facilities to house a museum/discovery centre, an activities/programs space, a shop, staff offices, amenities, and storerooms. While this pillar of the CHSC's model has been financially sustained by philanthropists and corporations, the centre's science communicators have championed the centre's work and purpose. In doing so, they have conveyed both the breadth and impact of the centre's informal science education initiatives to these stakeholders and sought to demonstrate shared values and aspirations for community development. For example, one philanthropic donor's aim is to support rural, regional, and remote communities in Queensland to build capacity, vibrancy, connectedness, resilience, and sustainability. Their altruistic goal of facilitating equal opportunity for rural communities closely aligns with the CHSC vision.

Income streams

The CHSC draws on a number of income-generating streams including informal science education programs, entry fees to the museum, hosting school excursions and incursions, venue hire and a gift shop with both a physical and online presence.

The Science Squad program is the centre's flagship science education program. It is nationally recognised as the longest continuously operating out-of-school informal science education program in Australia. This program engages 6–12-year-old children in interactive experiences, drawing on proximate natural assets like botanical gardens and farms but largely employs in-house programs on a variety of STEM themes, often independent of the centre's location. For the past 27 years the Science Squad program has been run by either paid or volunteer science communicators. The Science Squad Coach (facilitator) is supported by paid and volunteer staff who also facilitate a pre-primary school program "Curiosity Club", for children aged two to five in a wonder-centred program aimed at familiarising participants with STEM principles. School holiday programs and excursions to CHSC by school groups are also developed and facilitated by CHSC science communicators. In this way, the hybrid resourcing model allows for diverse science engagement experiences that do not exclusively depend on nature- and place-based assets. This creates a culture of science communication which, while still being awe- and wonder-based, is animated by the science communicator and place-independent programs.

Science Squad is partly self-funded through a user-pays model and partly through philanthropic support for operational costs such as wages with the shortfall financed by retail shop sales. This shop sells an array of mostly STEM education goods and locally-sourced handmade gifts, and together with the discovery museum, seeks to raise funds through purchases and visits from the local community as well as the drive tourism market. The renaming of the CHSC to trade as the Outback Exploratorium was initiated in part to capitalise on this tourism market, largely based on the awe and power of place dynamic described earlier. Here, tourists travel through Emerald to visit a range of nature and natural history tourism sites in "Outback" Queensland and the Northern Territory.

Community involvement and volunteers

Volunteers, parents of participants and other community members play an important role in the CHSC, including through promotional activities, in-kind material and services, networking, facilitation assistance, and service on the management board. Orthia et al. [2021] describe the merits of meaningful community engagement in science communication in the Australian context. Community engagement, as these authors and the CHSC's experience has shown, contributes to the sustainability of CHSC and is a core pillar of the hybrid resourcing model. In our experience, volunteerism and community engagement also serves to enhance inclusivity and diversity, making this a distinct aspect of the centre's culture, this has led to a diverse community of science communicators and supporters. This diversity bolsters the centre's intellectual resources by providing a range of perspectives which expand opportunities and mitigate risks. From this point of view, community engagement both enhances the centre's accessibility and serves the hybrid resourcing model by harnessing opportunity and risk mitigation dividends.

Government grants

While not being government funded, the CHSC has drawn on non-recurrent government grants for support. These have included funding for one-off activities such as building improvements, facility leases, funding for materials and program funding.

Collaboration and in-kind support

The CHSC collaborates with individuals, community groups and institutions to deliver programs and special events. These include universities, artists, government bodies and businesses. Resourcing from these collaborations takes many forms including in-kind support, funding to run off-site programs and special events serving to grow science engagement, promote CHSC's activities and engage the centre in research projects whilst presenting capacity building opportunities for the centre's science communicators.

Fundraising

While not a major source of funding, occasional fundraising activities have served two important functions. These initiatives have raised material means for the centre's operations and activities, but they have also provided opportunities for promotion and ad hoc science engagement in the community. A recent example of a community focussed fundraising activity was a Pub Trivia event held in Emerald during National Science Week.

Fiscal responsibility

Underlying the centre's management of limited financial resources is a culture of financial responsibility built on both existing mathematical, technical, and professional expertise of volunteers and staff, and a strong sense of purpose to ensure the centre's effective contribution to the community. Operationally, the centre employs a part-time qualified bookkeeper and engages the services of an accounting firm for all financial reporting and audits.

The role of science communicators in advocating for investment in experiences of awe and wonder in resource-constrained settings

In seeking to work with a diverse body of stakeholders to enhance resourcing of science education in rural and regional Australia, science communicators and others in this space must be mindful of the priorities of potential co-investors. Opportunities to demonstrate shared goals are, in our experience, a crucial element of collaborative endeavours. In this regard, we end our discussion by describing some of the economic and policy aspirations of potential co-investors such as governments, businesses, civil society organisations, and community groups.

Economic performance

A common priority of both governments and businesses is economic growth and skills development in local, national, or international contexts. While this is not the only, or even the most important, benefit of science communication endeavours, science communicators would benefit from articulating the benefits of STEM education to the economic (and social) priorities of governments and business [Buffett & Eimicke, 2018; Dillon et al., 2021; Peng, Liao & Lu, 2019].

STEM education has become increasingly recognized as important for workforce development [PwC (PricewaterhouseCoopers) (PwC), 2015], particularly in economies seeking to enhance technical capacity in the labour market [Feller, 2011]. Governments and industry recognize that challenges of the twenty-first century demand both a highly skilled STEM workforce and a STEM-literate society capable of understanding and appreciating science and technology. Experiences of awe and wonder play critical roles in this regard. For example, when it was announced in 2015, Australia's National Innovation and Science Agenda was launched on the back of a realization that the country "is in its 25th year of economic growth but faces new challenges as the mining investment boom comes to an end" [Australian Government — Department of Industry, Science and Resources, 2015, p. 2]. As part of that strategy, Australia's federal government announced measures to channel awe and wonder into a strategy for developing the future STEM workforce by "engaging pre-schoolers with fun experiments, inquiry and play-based learning apps focussed on STEM concepts" and "backing science in our communities, with events such as National Science Week, that inspire STEM curiosity and knowledge in young people" [Australian Government — Department of Industry, Science and Resources, 2015, p. 13].

While policymakers, governments and industries around the world seek to increase STEM participation at the secondary and tertiary education levels, with a view to shaping the workforce, we recommend that they should also increasingly examine sources of awe and wonder in STEM for primary and pre-primary

school-aged children. As Singh, Granville and Dika [2002] suggest, attitudes and motivations towards secondary school education are likely to be established in earlier years. However, we caution that undue attention on a child's potential career path could stifle experiences which inspire awe and wonder. Instead, we have every confidence that an emphasis on rich STEM experiences which evoke both emotions should form the basis for early childhood STEM education and will inevitably inspire the future workforce.

STEM- literacy for cohesive societies

Beyond individual career aspirations, the importance of STEM-literacy and skills, extends beyond a need for workforce development. Governments, communities, civil society, religious organisations, and other institutions appear to be increasingly concerned with the need to achieve and/or sustain social cohesion [Pepper, Powell & Bouma, 2019; Piff, Dietze, Feinberg, Stancato & Keltner, 2015; Dandy & Pe-Pua, 2015; Office of External Affairs, 2021; Australian Government — Department of Home Affairs, n.d.].

As the COVID-19 pandemic has demonstrated, a lack of both general STEM knowledge and respect for scientific institutions and processes erodes public health messaging [Albrecht et al., 2022], risks exacerbating the effects of this crisis [Barua, Barua, Aktar, Kabir & Li, 2020] and erodes social cohesion [Dayrit & Mendoza, 2020]. In such a climate, the burden of mitigating the harmful ramifications of conspiracy theories, fake news and misinformation often falls on science communicators who, in many cases, may need to convey their messages to individuals and communities unfamiliar with the scientific process and even suspicious of its proponents [Van Bavel et al., 2020; Rogayan Jr. & Dantic, 2021]. What these science communication challenges illustrate is the difficulty of conveying STEM principles to non-expert audiences [Van Bavel et al., 2020]. Greater resourcing of science communication endeavours may work to mitigate such risks.

Conclusion

Awe and wonder play important roles in shaping a culture of science communication, regardless of the setting. While awe is associated with ideas of vastness and accommodation, we have outlined here how this conception of awe is often narrowly associated with physically large, natural expanses. Drawing on the work of others, particularly Silva Luna and Bering (2020), we have examined the challenges with the development of a prevalent culture of science communication which largely associates awe with this idea of physical vastness. We have discussed how nature- and place-based science communication has shaped this culture in rural and regional Australia, largely owing to resource constraints that limit broader experiences of awe and wonder in science communication. Finally, we presented a multi-stakeholder hybrid resourcing model for overcoming such constraints in rural and regional Australia. We ended by exploring how science communicators can facilitate multi-stakeholder engagement in community-based science communication. We hope that by offering this model and by identifying a number of knowledge gaps, we can contribute to efforts in other resource limited settings to expand awe- and wonder-based science communication.

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Conflict of interest

Saba Sinai and Lisa Caffery are volunteer board members of the Central Highlands Science Centre (trading as Outback Exploratorium).

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