

Artist-Scientist Collaborations: Maximising Impact of Climate Research and Increasing Public Engagement

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Scientists are under increasing pressure to communicate their findings effectively to decision-makers and undertake public engagement activities. Research councils require researchers to demonstrate the Pathways to Impact of their funding and within the Research Excellence Framework to demonstrate an “effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia” (Stern 2014, 43). However, scientists are often ill-equipped or may be restricted by resource and capacity to effectively engage in activities that can ensure the broad dissemination and uptake of their findings. Similarly, adoption of the “information deficit approach” where more information is assumed to lead to better understanding, means the evidence-base on climate change can be abundant yet inaccessible and misaligned with the needs of different audiences. Cross-research collaboration and partnerships with artists could enable knowledge exchange and sharing of experiences to facilitate this. Processes through which scientists engage with the arts provide a unique opportunity to engage with different audiences in meaningful ways to enable scientific evidence on climate change to become salient and relevant, providing more potential to inform decision-making and practices. This commentary explores the science-arts relationship through an analysis of three case studies. “The Prediction Machine,” “A Conversation between Trees,” and “Cold Sun.” We discuss insights that can be gained from these art-science collaborations on climate change. In particular, we explore how these collaborations can support scientists to further enhance salience to climate change and co-produce resilient solutions at different scales, to maximise dissemination of research.

Keywords: Science-Arts Collaboration, Climate Change, Communication, Public Engagement

Introduction

Artists offer a unique contribution to engaging the public with complex scientific issues (Ruddock et al. 2016, Arends et al. 2003), from the traditions of performance art (Stiles et al. 1996), interactive art (Wilson 2002) and mixed reality performance (Benford et al. 2011). These provide opportunities for dialogue between scientists, artists and most significantly the public. Artists are increasingly developing strategies to engage the public with complex representations of the scientific process, exploring new ways to communicate and represent the risks and impacts of climate change, through sensory, embodied, personal, human-scale narratives, metaphors and aesthetics in relation to scientific data (Jacobs et al. 2013).

This commentary discusses how art-science collaborations can successfully communicate scientific findings to non-experts. We explore different approaches to art-science co-production and the benefits of combining artistic and scientific processes, informed by a series of case studies. We introduce a framework for knowledge exchange between artists, scientists and the public in support of future artist-scientist collaborations.

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Science Impact: What is Expected of Scientists?

Scientists are under increasing pressure to communicate their findings effectively to decision-makers and undertake public engagement activities. Research Councils in the UK require researchers to demonstrate the impact of their funding and the Research Excellence Framework (which assesses the quality of research in universities) requires they demonstrate the “effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia” (Stern 2014, 43) of their research. However, scientists may feel ill-equipped or restricted by resource and capacity limitations to effectively engage in these activities that can ensure the broad dissemination and uptake of their findings. Similarly, adoption of the “information deficit approach” where more information is assumed to lead to better understanding, means the evidence-base on climate change can be abundant yet inaccessible and misaligned with the needs of different audiences.

Public engagement activities can be perceived by scientists as being time and resource intensive with a divergence away from the publication and income generation foci they undertake to enable them to progress in their careers. Where this has proved particularly fruitful, however, is through cross-research collaboration to maximise dissemination and impact of science (RCUK 2010). Partnerships with artists could further enable knowledge exchange and sharing of experiences. Processes through which scientists engage with the arts provide a unique opportunity to engage with different audiences in meaningful ways to enable scientific evidence on climate change to become salient and relevant, providing more potential to inform decision-making and practices. A larger proportion of researchers in the arts and humanities (i.e., 88%) participate in public engagement activities than those in science, technology, engineering and mathematics (i.e., 78%) (TNS BMRB & PSI 2015). This provides a platform from which engagement activities could be further used to maximise cross-disciplinary collaboration whilst simultaneously enabling a cross-fertilisation of research and engagement practice to self-reflect on the public impact of science generated.

Going Beyond Traditional Approaches to Climate Science Communication

Individuals filter scientific information on climate change based on their cultural and political viewpoints, weighing the risks of climate change alongside potential solutions (Bellamy and Hulme 2011). This has led to an over-reliance on a linear flow of information from scientists to the public, and the assumption that providing information about the issue (e.g., climate change) will be sufficient to lead to a solution to alleviate its impacts (e.g., reduce greenhouse gas emissions (GHG) through behavioral change). This model fails to fully consider the complexities and intricacies of social and cultural elements that affect information acquisition and that knowing more about the science of an issue will not necessarily increase understanding or lead to action (Sarewitz 2004).

Marotzke et al. (2017) suggest that climate research needs to ‘sharpen its view’ in order to remain relevant and ensure informed decisions are made to limit GHG emissions, specifically by addressing three key questions: (i) “where does the carbon go?”, (ii) “how does the weather change the climate?”, and (iii) “how does climate influence the habitability of the Earth and its regions?” (89). In so doing, the climate science community would enable the production of evidence more relevant to address the needs of end users. Trenbeth et al. (2016) suggest a new climate information system is needed as a third pillar to complement adaptation and mitigation to climate change. This system, they argue, would “require establishing relationships among physical, environmental and social impact variables, understanding and coping with uncertainties, regionalizing results and helping users understand the information” (1058) and would involve actors from across academia, the private and public sector, business and investment communities, and the public. While this aligns with Marotzke et al.’s assertion that “many of the societal demands for climate information cannot currently be robustly met because of the lack of basic understanding” (2017, 91), this climate information system, and Marotzke’s argument fail to acknowledge the role of the arts in filling these knowledge gaps.

Combining innovative mechanisms can enable a deeper engagement and facilitate mechanisms for constructive dialogue on climate change. Research suggests that processes and tools such as narratives, storytelling, and co-production can help with this and, demonstrate particular innovation by enabling a better understanding of the needs of different audiences and tailoring engagement and communication approaches to better align with these. Howarth (2017) highlights how narratives on climate change or stories that “enable the framing of complex and challenging societal issues such as climate change, in a way that aligns and resonates with the values receiving these stories and makes climate change more tangible,” (4) can enable more experiential engagement with the issue. This suggests that narratives around particular themes can help frame a low carbon future (helping to mitigate the impacts of climate change) as positive and desirable. Similarly, work on co-production of knowledge where multiple

stakeholders and users are incorporated in the research design process from the outset, enables a better alignment of communication tools with end user needs (Howarth et al. 2017). This highlights that key criteria need to be met in order to maximise a fruitful collaboration that can further enhance the impact of climate science communication: being flexible, iterative, inclusive, trusting, transparent, and incorporating non-academic evidence bases.

Role of Art-Science Collaborations

There has been a long history of bringing together science and art, at times blurring the lines between the differing processes, motivations, and intentions of these disciplines (Ede, 2005). Recent contemporary art-science practices have resulted in the production of a great diversity of artworks, residencies, programmes and activities (see CERN, British Antarctic Survey, Wellcome Trust, Arts Catalyst, Cape Farewell, Tipping Point). Within the context of these collaborative art practices, artists shift beyond an instrumental and illustrative role, engaging in a wide variety of approaches to collaboration with scientists. These approaches have been defined by Jacobs et al. (2015) as falling into five different categories:

1. Illustrating science through direct representations of scientific processes;
2. Artists “re-enacting” scientific process through performative and artistic strategies;
3. Interweaving scientific and artistic processes by juxtaposing data alongside experiential, felt, sensory, aesthetic and personalised interpretations;
4. Using scientific data as a new material—without interrogating the scientific-ness of the data; and
5. Creating critiques that might reject scientific processes completely.

These collaborations interweave scientific and artistic processes that can provoke emotional responses to scientific data, specifically enabling non-experts to engage with the scientific process meaningfully, co-produce meaningful responses, and engage in complex dialogues (Hohl 2012; Polli 2011; Malina 2009). In the context of art-science collaborations that focus on issues of climate change Giannachi suggests we need to create opportunities for analysis and debate, requiring narratives that engage us emotionally in order to bring into play our rational, cognitive and intuitive processes (Giannachi 2012). This has also been seen to occur through “spectacular environmentalisms” (Goodman et al. 2016) such as in the film industry (Branston 2016). Yet in this instance, contemporary artists are increasingly embodying and embedding climate data within socially engaged, interactive, visual and performative artworks, resulting in more sensory, tangible and visceral representations that bring the scientific data “alive.” This has been shown to provoke personalised, emotional responses to the data that in turn encourage a greater “embodied” understanding of the science (Polli 2011; Bureaud 2011; Malina 2009). These works move away from the ‘information deficit approach’ that tends to rely on static visualisations, and visual narratives with simplistic messages, towards dynamic and performative experiences of scientific data, combining multiple interpretations and datasets with subjective experience and metaphor that support engagement with issues of complexity, uncertainty and risk (Jacobs et al. 2016).

Successful Arts-Science Collaboration

We discuss three arts-science collaborations: *A Conversation between Trees* (2011), *The Prediction Machine* (ongoing), and *Cold Sun* (2014) that took place across the UK, each led by the same key artists. In parallel, ethnographic studies of these collaborations took place to investigate the processes employed in the making of the works and how they encouraged the public to engage with issues of climate change through an interplay between rational thinking, cognition and emotional, subjective experience.

A Conversation between Trees is a touring artwork that captures and visualises local environmental data from forest regions in the UK and Brazil, juxtaposed with global CO₂ data, resulting in a series of exhibitions, an interactive mobile phone experience, and public workshops. It embeds scientific data (temperature, relative humidity, decibels, light and CO₂) captured in forests in Brazil and the UK into live dynamic, abstract visualisations of the data projected on either side of a gallery. A machine in the centre of the gallery, scorches circular graphs representing the Mauna Loa global CO₂ series onto circular discs of recycled paper, visualising a year’s worth of global CO₂ data per sheet that were then hung from the ceiling. This process explored how the use of metaphor allowed visitors to engage in dialogues about the data, situating local and global reflections of climate change alongside a real world experience of walking through a local forest.

Semi-formal interviews with exhibition visitors revealed how the artwork created opportunities to reflect on how climate and weather data was changing locally and globally, allowing visitors to explore their own interpretations of the data. Visitors were also observed spending up to an hour in the exhibition discussing the data

with each other and were found seeking out the paper discs representing the year of their birth, discussing the increases in the circle sizes and what might have caused particular changes based on their memories. Discussions between the artists and a climate scientist then based at the Hadley Centre, Met Office UK, explored how these narratives might engage the public in a deeper, more human scale reflection on climate data in comparison to how the media, where most members of the public receive information on climate change, requires quick interpretations, high levels of numeracy, and looking beyond attention-grabbing headlines (Boykoff 2011).



Figure 1: *A Conversation between Trees*
Source: Active Ingredient 2011

The Prediction Machine is an exhibited artwork and series of public workshops that combines scientific data and climate models with the public's own observations and experiences of weather to predict the impact of climate change thirty years in the future. The artwork involves two interactive machines, reminiscent of Victorian era fortune-tellers. The first machine juxtaposes weather and climate data, short video clips of people talking about climate change, and finally prints out personalised predictions for a future impacted by climate change written by local people who take part in the workshops. The second machine presents a scientific explanation of the projected data and reveals a graph depicting 100 years of minimum and maximum temperatures; visitors are then invited to reflect on their own "promises, wishes or predictions" for the future. By taking the "predictions" away with them, visitors are able to reflect over a longer period of time on the impact of climate change on their everyday lives. A study of how the public engaged with the work revealed how visitors discussed the artwork with each other (Jacobs et al. 2016), trying to make sense of the predictions and scientific data in comparison to the weather outside, whilst during the workshops a complex dialogue took place between the artists, scientists and public interrogating the data, the nature of predicting weather and climate and scientific climate models. This work explores issues of uncertainty and risk through playful interactions in ways that were often contentious, particularly in reference to combining subjective experience with scientific climate data. Yet interviews with participants revealed that these strategies enabled a deeper level of engagement and reflection than often experienced through more objective, information based communication (Jacobs et al. 2016).



Figure 2: *The Prediction Machine*
Source: Jacobs 2015

Cold Sun is a mobile phone game that illustrates how scientific and real world data can be integrated into a fictional futuristic game world, engaging players with a rhetorical experience of climate and weather, through situated and personalised experiences during game play, played in two modes. Firstly, a character is required to navigate a daytime “existence” mode that is affected by the weather in the real world, e.g., a storm in the real world causes flooding in the game world. Secondly, a dream mode appears at night time, when the character is required to navigate an abstract set of planetary-like spheres, whose attributes are defined by the real world weather, but where the connection between the weather and the game is less clear. The different modes serve to illustrate that weather and climate exist on completely different scales, with the former being a personal view and the latter a world-view. This allows multiple interpretations of data through different modes of play while provoking emotional and personal engagement to explore how climate change challenges will affect our future.

A pilot study of the prototype explored how the game might embed live weather and climate data (Coulton et al. 2014) in order to illustrate the difference between weather and climate. Results indicated that by using live data in this way, *Cold Sun* has the potential to encourage players to consider weather and climate as a differing temporal experience which impacts on their personal actions and the world.

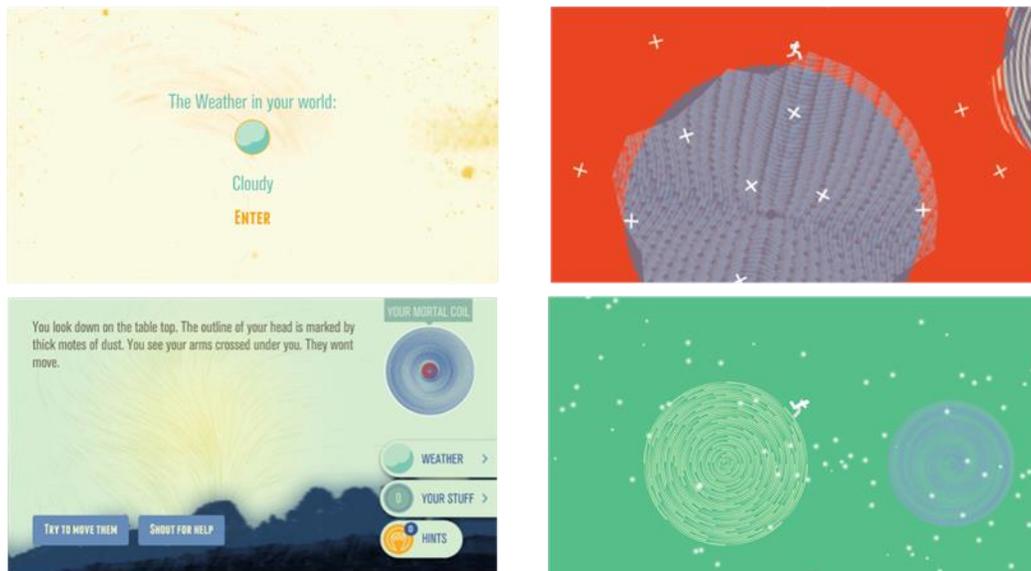


Figure 3: *Cold Sun*
Source: Watkins 2014

The Future Role Of Arts-Science Collaboration: Looking Ahead

Each of these projects involved forms of engagement with the public and processes of collaboration between artists and scientists. *A Conversation between Trees* engaged over 3,000 people, many of who did not normally engage with art or science. The artists re-enacted scientific processes in dialogue with the scientists that were embedded in the artwork, providing opportunities for the public to create their own narratives. A study of the visitors to the exhibition (Jacobs et al. 2013) reported that this experience provided an embodied understanding of the data, bringing it to life in the context of the forests where they were situated.

The Prediction Machine engaged approximately 2,000 mainly non-scientists. The scientists and artist collaborated from the beginning in a complex interweaving of scientific and artistic processes. A study of visitors to the exhibitions and participants in parallel workshops reveals the resulting complex dialogues about uncertainty and risk, in response to the playful nature of the machines (Jacobs et al. 2016).

Finally, *Cold Sun* focused on an interdisciplinary collaboration between climate scientists, artists, and game designers by embedding scientific process within a mobile phone game. The game rhetoric focused on humans’ difficulties relating trends in the weather to climate change. A pilot study (Coulton et al. 2014) showed that the playful capture and tracking of weather, at the player’s own location, had the potential to bring these complex issues to the fore.

These three case studies provide evidence of how art-science collaborations can successfully support meaningful communication of scientific evidence on climate change, knowledge exchange between artists, scientists, and the public. The post-exhibition evaluation demonstrated the impact these works had on their

audiences and in so doing, they draw on insights from beyond artistic processes and add significant value to climate science communication processes, beginning to address how we might co-produce responses to this evidence, whilst informing decision-making around adaptation and mitigation.

Going forward we suggest more ongoing collaborative work is needed between artists and scientists, as well as studies to establish the success of these collaborations to maximise real-world impact of science in this context that enable the public to more effectively connect with climate science and ultimately support decision making processes than can enable mitigation and adaptation to climate change, as supported by the findings from *A Conversation between Trees* and other similar studies (Polli 2011). In order to facilitate this we propose three areas that require deeper consideration:

1. Rapid funding opportunities to support more art-science collaborations.
2. Options to co-produce training tools for scientists and artists to more effectively work together.
3. More effective mechanisms to publish findings from arts-science collaboration to further the impact of these partnerships.

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