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TITLE: Working with Scientists as 'Specialist Audience' for Arts that Address Climate Change: Weather Engines at Onassis, Athens 2022.

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ABSTRACT

This paper explores the proposition that experience of art can contribute to scientific discourse on climate issues, especially at the convergence of physical and social sciences. Drawing from an experiment conducted during the Weather Engines exhibition in Athens (2022), it highlights how specialist audiences, notably scientists, engage with contemporary art in their specialist area. The study reveals that scientists discovered novel insights within artworks, and propose innovative interpretations of the work. A distinctive metaphorical structure played a crucial role in shaping scientists' perceptions, fostering fresh perspectives and uncovering layers of meaning 'general audiences' would not perceive.

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TEXT

Today's "artistic research"[1] [2] practices result in uniquely complex artworks that specialist audiences from outside the arts may be well equipped to understand. In this paper we present findings from a specialist audience experiment involving social and physical scientists during the *Weather Engines* exhibition in Athens, which took up issues of the climate crisis [3]. This approach aims to present an example for innovative art-science discussion, with artworks serving as case studies and generators of new research vectors for science.

*Weather Engine*s, was a part of Studiotopia, a "European initiative that seeks to inspire transdisciplinary innovation in addressing the ecological implications of the Anthropocene"

[4]. Art-science initiatives like Studiotopia offer up artistic research insights analogous to scientific methods. This proposition is particularly relevant to issues like climate change, where sciences fall short in driving behavioural change. This paper explores the potential for specialists in various fields to benefit from art practitioners' perspectives. The Weather Engines specialist audience experiment adopted a "distributed critique" approach[5], involving scientists in interpreting transdisciplinary artworks. By selecting relevant themes and artworks, four specialists from diverse scientific backgrounds were invited to visit the exhibition, interview artists, and provide written responses. The scientists visited the exhibition, developed their thoughts in pairs consisting of one social and one physical scientist, and also had the opportunity to meet and discuss the work with the artists. The scientists' insights during this process, along our own commentary, form the core of this paper.

Addressing the climate crisis, *Weather Engines* some artworks made in collaboration with scientists, or featuring research from the sciences [6]. This dynamic is increasingly common: method and knowledge from sciences are routinely drawn on by contemporary artists to inform their practices [7]. Scientists in this case, are invited to undertake the role advisor, providing information for the development of artistic projects. Rarely, though, do artistic methods inform subsequent scientific research. A certain imbalance thus prevails between these two spheres: in the vast majority of activities surrounding art-science programmes, there is very little documentation of scientists' responses, and no dedicated platforms where science practitioners can learn about the implications of art for their discipline, despite the evidently relevant insights being produced in that field. A result of this one-sided relationship is that art is framed as a public-relations exercise for the sciences; with artists subordinated to "representing" complex ideas in compelling ways. This is surely valuable, but it is a rather old-fashioned notion of what art does – and leads to some ethical challenges for disciplines which might otherwise seek to be critical of its institutions and contexts. As we show in this paper artistic practices can help scientists challenge the mediums and assumptions of their practice.

We focus on the act of criticism as an intellectual engagement in the knowledge embodied in specific art works. Specialists from diverse scientific backgrounds (and various levels of experience with contemporary art) were invited to visit the exhibition. The scientists developed their critical responses in pairs consisting of one social and one physical scientist. Their insights, along our own commentary, form the core of this paper. We look at four works from the *Weather Engines* exhibition, showing how the commentary provided by art critics differs from the observations made by the science specialists. We show scientists' engagement in the arts can be original and incisive, and that the act of engaging in interpretation offers new perspectives for scientists: bridging social and physical sciences, and offering ways of concretely revisiting how and why science is done.

SECTION A: WEATHER ENGINES

Weather Engines was a major exhibition with a two-day symposium that highlighted the pertinence of the Athens as a location for exploring the complex of the climate crisis: heat

waves in Greece have increased in duration and frequency recently, outstripping the ‘average’ temperature distortions that are commonly used to describe global warming, exacerbating human and cultural crises in the region. Physical exhibitions do provide occasions to think translocally in this way, concretising links between local instances and global issues: a factor that was not lost on our participants.

The show took place in two distinct locations in Athens. The first was the exhibition hall of Onassis Stegi, where artist films, sculptures, and audio-visual installations were presented. Visitors clustered in a relatively dark space among waves of semi-translucent curtains hung from floor to ceiling; as though cloaked in mist, they could lie on stone-coloured beanbags or hover at thresholds of scarcely delineated ‘zones’ cutting the space into ambiguous shapes like continents or tectonic plates. This design created smaller spaces for each work. Figures could be seen moving between and behind the curtains, their silhouettes lit up by large projections or screens showing scenes of localised environmental and media conditions: among them the ice sheets of Susan Schuppli’s “Cold Cases”, fog caught by Felipe Castelblanco in the jungle valleys of the Putumayo river, a computer generated graphics video by Design Earth depicting the possible effects of geoengineering, and internet and pop ephemera overlaid on urban semiotics by Kent Chan pointing to the exoticization of the tropics. Among those cosmologically diverse imaginings of the planet in video form, were works made from materials not as common for the contemporary art world: the large compressed cylinders of pollen grain looking like they had been extracted from the earth, by Benera & Estefan [Fig.1], a living sculpture made of different species of mushrooms by Matthias Fritsch, an entirely white globe by Manifest Data Lab covered in waves of spikes for the levels of carbon emissions converging on the western northern part of the world like a materialised scream [Fig.2]. The whole poetically evoked a combination of lab and mausoleum.

Proxy Climates, 2019–εν εξελίξει - ANCA_BANERA&ARNOLD_ESTEFAN © Stelios Tzetzias

Fig2_Carbon Topologies, 2022- MANIFEST_DATA_LAB © Stelios Tzetzias 0374

The second location was the hill tops that are home to the National Observatory of Athens, offering breath-taking views to the Acropolis and the sprawling modern city that has grown up in its shadow. Here, *Weather Engines* made use of the premises of the observatory for art installations that built thematic associations with that place. The gardens were used for sculptural, sonic and performance works created for the location: Families puzzled over a bird box that wobbled as it broadcast meteorological data in morse-code beak-taps by sound artist Coti K [Fig3.]. Crowds gathered for poetry and performance works, including an attempt to channel the transmission of an overhead satellite using a metallic wearable antennae, performed by Afroditi Psarra and Audrey Briot. This 'peripheral progamme' was part art exhibition, part discursive and performative about how science meets myth, as both crumble into new arrangements in the Anthropocene age.

Click Ensemble, 2022 - COTI_K © Stelios Tzetzias

The proposition of *Weather Engines* was somewhat essayistic, inviting transdisciplinary interpretations. As one reviewer surmised of the show's message: "'weather observation' has agency, as local observations accumulate, build, relate and form networks of understanding ... Bodies and weather are, after all, already innately entangled; and always imprinting on one another"[8]. Another reviewer concluded that "the Earth is reconfiguring itself in new data-driven geographies and preparing for a new phase. [And humans] will not necessarily be part of it."[9] These are pertinent ideas perhaps unconventional in nature in comparison to those ideas traditionally considered in art's domain [10].

Today, the arts community is well prepared to understand interdisciplinary claims made by artists. Indeed an entire set of concepts exists for reframing the art in relation to the formerly separate areas of engineering and science: grouped using the term “posthumanities” [10]. Posthumanities discourse says that arts is no longer best understood as a ‘humanities’ discipline, partly because of the prevalence of software and other technical approaches, and also in the context of an age where boundaries between humans and their environment, and humans and their tools, are breaking down. Contemporaneously, thinkers have observed that “the human” no longer maintains a privileged position among other actors in the network[11] or material agents[12] on the earth.

In the sciences though, there remains a strong sense that artistic ‘research’ is not sufficiently rigorous to be called such; and that arts value resides primarily in its role in communicating pre-existing ideas, albeit in innovative ways. In addition, the idea of the “entanglement” of observation and observed phenomena that writers such as Jane Bennet [13] have made commonplace in arts, is more commonly understood as a problem to be overcome in the sciences. Hanna Star Rogers, more recently, has argued that it is a matter of context when it comes to art and/or science to “affect the kind of attention that people, objects, and ideas elicit from readers, viewers, and thinkers ”[14]. Rogers argues for interpreting art through the lens of STS and acknowledging the commonalities of art and science, as well as their interaction throughout their respective histories [15].

Weather Engines aimed to be an exemplary ‘posthuman’ exhibition by putting oceans, forests and the different living organisms that form the weather and grant life, to the foreground as its protagonists. The participants we invited were, however, less likely to be encultured in posthumanities discourse, or STS. The comments made by these participants therefore allowed distinctive and non-dogmatic lines of enquiry. They described how the exhibition defamiliarized their everyday encounter with laboratory equipment or deep space imagery, for example. Crucially, they also highlighted ways that the artworks might influence their own conceptualisation of science as a practice.

SECTION B: MATTERLURGY “DATA DIALOGUES” / “HYDROMANCY”

The first works participants chose to look at were by the duo Matterlurgy: a 4K film called “Hydromancy”, and an accompanying digital print [Fig.4]. The word “hydromancy” refers to a method of divination by means of water. Matterlurgy use it to poetically evoke how ocean sensing today offers ways of gaining information and knowledge. Matterlurgy’s video was one of several in the *Weather Engines* show that touched on mystical aspects of our encounters with earth’s materialities.

Matterhurgy (Helena Hunter & Mark Peter Wright)- HYDROMANCY 2021 © Stelios Tzetzias

Art critics were keen to engage in the notion of the ocean and ocean sensing apparatus as non-human protagonists. For example Jamie Sutcliffe for Art Monthly describes the work as “ecologically grounded psychedelic cinema”[16], impling that the ocean has a character, mood, and behavioural characteristics, and this favours “a humbler relationship with the sea and its role in our future.” He also links Matterlurgy’s work to a wider field of practices that use oceans as nodes for studying industrial modernity by developing historical research through science fiction (for example Rivers Solomon’s work on the middle-passage[17]).

The scientists participating in our experiment instead focused on the immediacy of the tools and technologies in the video. For biological oceanographer Olga Ioanna Kalatzi from University of the Aegean, the poetic use of data visualisation and lab equipment was particularly noteworthy: “I was mesmerised by the data visualization, as well as by the hypnotic lab stirrer that looked like a tornado (seen from a side angle). An everyday laboratory object that can change the ‘weather’ in its own micro-environment (the beaker) … I will never look at a lab stirrer the same way again”. Sociologist Celine Germond-Duret from Lancaster University did see a kind of posthuman perspective, but from a more material standpoint than the critic: “the equipment, tools, labs, etc. were the subjects of the work; not the people... I also had an impression of contrast between something very powerful (a big

blue space, the sound of the waves, the mesmerising voice of the Hydromancer, etc.) and the very small things being analysed in the lab under a microscope."

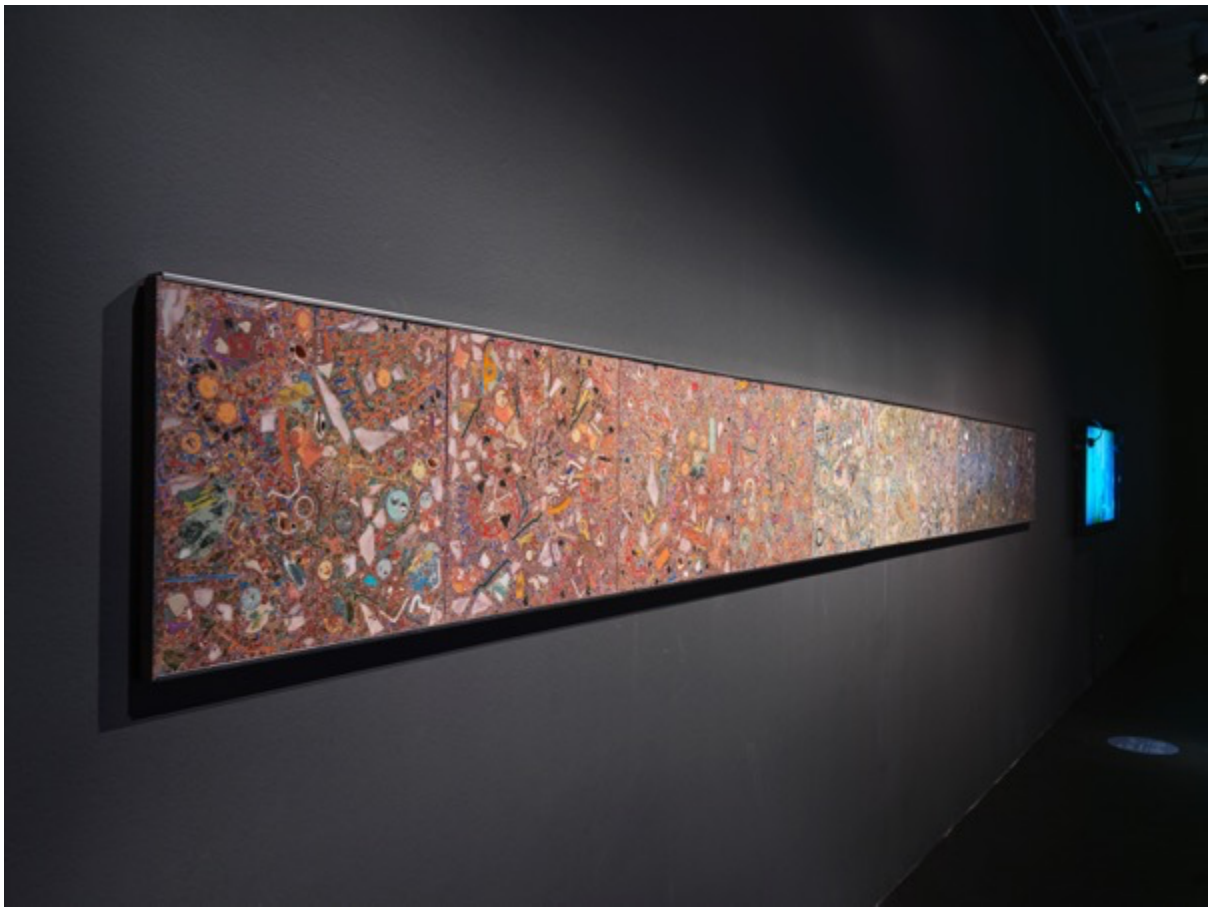
The idea that the science beaker is a "micro-environment", Germond-Duret's comments about scale and the "powerful" agency of the ocean also, suggest something important about how metaphors work for specialist audiences. Metaphorical systems play a crucial role in bridging conceptual gaps, between art and science, or between sciences. The metaphorical framing of data visualization and lab instruments in the artworks highlighted for the scientists the complex ways that measurements, measuring, and the phenomena that are measured relate. Considerations of scale underscore how metaphors expand the interpretative landscape, suggesting that scientists, though well equipped to appreciate a dynamic between macroscopic and microscopic relations at play in the artworks, have their own views evolved through aesthetic iteration. This is not simply through the addition of the 'human' emotional quantity of art to scientists' 'objective' knowledge, but rather, as Roger's suggests through transforming the nature of reflections: in this case a dialogue across scale between human and climatological phenomena.

Whereas the art critic emphasised 'speculation' projecting a fictional aspect on the work, the scientists read the work as a quite immanent "investigation of investigation" provoking questions about the utility of science practices in the ocean. As Kalatzi puts it: "the projects made me more aware of how data is perceived and used. Does more knowledge lead to less damage to the environment?" Germond-Duret, commented also commented on her own practice of public communication: "This exchange has made me reflect on what type of message is, and should be, conveyed to the general public; should a message be suggested or told; what raises awareness; what impacts on behaviour change." Kalazi said "The artists described their work as sensory ethnography, letting data speak, letting spaces speak, which made me think more about the production, use and perception of data that scientists create." In fact, both of our specialist audience participants drew attention to the term "sensory ethnography", from the Matterlurgy conversation. What this highlights for us, is the appreciation by the scientists of the camera and microphone, as apparatuses involved in meaning production akin to the way lab and sensor alike make data. We can infer that art could have broader potential for science: raising questions, for example, about methods or bridging the gap between different types of investigation. Kalatzi and Germond-Duret together discussed complex mesh linking lab and society-based research, and the different impacts of their research on environment and society. Their omments suggest that art can help scientists 'see afresh' the methods that their practices have made commonplace, but also how the 'definite' 'told' messaging of science can be counter-productive in climate contexts.

SECTION C: HYPERCOMF – "MARINE CAVES" / "BENTHIC TERRAZZO"

The second work that these tparticipants discussed were "Benthic Terrazzo" and "Marines Caves" by the Hypercomf duo [Fig 5]. "Benthic Terazzo" is a series of floor tiles, introduced as prototypes of a custom technique based on the traditional Venetian terrazzo, with oceanic pollutants, plastic objects, microplastics, nets, and ropes are used to replace the concrete and sand mixture usually employed in terrazzo fabrication. "Marine Caves" is a video

documentation explaining the theory and practice of benthic terrazzo in the context of deep ocean environments.



Benthic Terrazzo, 2022 - HYPERCOMF © Stelios Tzetzias

Critic Regine Debatty explained her interest in the work: “The technique adopted by the artists is scalable and ensures that anyone can give a second life to the notoriously hard to recycle marine plastics”[18]. Debatty also developed a more extended implication of the work: “By inviting the subject of the ocean inside our terrestrial homes, the project blurs the borders between sea caves and human terrestrial dwellings.”

In this case, the participants of our experiment concurred, in part. Germond-Duret observed: “there seemed to be recurring references to the land/sea connection … the caves used to be inhabited; they were home; the beach is the limit between two worlds; there are new habitants now; ‘the sea used to be land and the land used to be sea’.” However, the aesthetic accomplishment described as a ‘second life’ for those materials by Debatty was considered more darkly by the scientists. Kalatzi said “the benthic terrazzo was a stark reminder of the persistence of the material in the environment ... beautiful, but at the same time terrifying.” Germond-Duret agreed, describing “the dichotomy beauty/ecological tragedy” observing “a ‘new materiality’ as a ‘new normality’.” We are interested to note that these encounters with art by contemporary scientists resonate with an historical art concern (the Romantic notion of the sublime). Equally of interest is the way the scientists emphasised the emotional potential

of this work more than the critic: perhaps because they grasp, better than Debatty, how unlikely it should be for plastic to be found in the deep sea locations depicted?

Both the art reviewer and the scientists note how the notions of home and ecosystem related throughout Hypercomf's work, demonstrating how human and more than human words are interconnected. The art reviewer pays special attention to the technique, the materials and the methodology, in fact (perhaps optimistically) thinking of the terrazzo production as model art practice that visitors might replicate in their own homes. The scientists emphasise the focus on the long endurance of plastic and its becoming part of the living environment, and how this difficult to grasp timescale is made emotionally resonant through a combination of video narration and object presentation. They both noted that the work was clearly a collaborative effort with scientists. Though with our own experiment we are interested in them remaining in the role of the critic, this seems to point to what Rogers argues with regard to STS, suggesting that where art and science should be more symmetrically approached and acknowledged. In fact, Germond-Duret specifically has reported since our experiment, that they have integrated a technique akin to Hypercomf's terrazzo into their teaching materials for social science students – the work embodying a distinctive "deep time" approach to the built environment that is otherwise hard to grasp. The agreement was this project exemplifies the power of art to foster interdisciplinary dialogue, and for the scientists, the value of the work was how it made tangible some of the predicted new materialities of climate catastrophe, making concrete (or plastic) an abstract connection between their home life and the subject of their science.

SECTION D: DAISY GINSBERG'S "THE WILDING OF MARS"

Daisy Ginsberg's artwork, "Wilding of Mars" challenges conventional notions of terraforming and colonization depicted in space science fiction. Instead of envisioning Mars as a new frontier for human settlement, Ginsberg invites us to consider what would happen if an entirely different species, namely plants, inhabited the planet. This is presented through a multi-channel video installation showing plant species growing, blooming, and transforming the Martian landscape.

Ginsberg's work also prioritizes a non-human perspective. As the art critic Maithri aptly articulates [19], the work allows viewers to witness the unchecked growth and "colonization" of Mars by plants, creating a sense of voyeuristic intrusion. Viewers are perhaps invited to question whether leaving the planet solely to plants might be considered "unnatural" and encourages a re-evaluation of our priorities on Earth.

Bron Szerszynski, a professor of sociology at Lancaster University with a keen interest in the terraforming concept, identifies the phenomena depicted in Ginsberg's work as a "soft" form of terraforming where ecosystems are introduced and allowed to develop autonomously. However, he asked while watching the video: can we regard this as a violent imposition of alien biology onto a planet that lacks its own, or a gift of life to that planet? In conversation Szerskynski said that "Wilding of Mars" resonated with him because it extends the discussion of value and meaning a more-than-human world as a virtual-material experiment. This

perspective on the inquiry underscores the misleading simplicity implied in delineating the discipline of “social” science in the Anthropocene, challenging the environmental humanities' prevailing focus on a “living Earth”. Can we value a lifeless planet on its own terms, recognizing the inherent value in nonorganic matter following its own creative course?

Fiori-Anastasia Metallinou, an astrophysicist at National Observatory of Athens, was impressed by how the artwork animated the exhibition space in her workplace. Her specialization knowledge of the atmosphere of Mars added a unique dimension to her own interpretation of Ginsberg's work: as with the lab equipment in the “Hydromancy” film, the art installation played a role here in defamiliarizing tools the scientists had ceased to see as aesthetic objects. Metallinou was also keen to extrapolate from the experiment posed in “Wilding of Mars”, to other planets, and to think about the previous eras of our own planets’ “wilding”.

Unlike the general audience view supposedly ventriloquised by art critics, Szerskynski and Metallinou drew on specialised knowledge to enrich the work's semiotic and critical complexity: namely the dynamic between the human act of occupying the hill-top with viewing apparatus, and the imagined imposition of alien life on a planet the telescope is notionally pointed at. The research of both Szerszynski and Metallinou on Mars led to discussions about how atmospheric conditions are themselves emanated by the human world. Strategies like terraforming, they said, follow a logic of creating the optimal conditions needed for *humans to live*, whereas the non-living surface itself is overlooked. Conversely for astrophysics, there is only non-living surface. Mars, thus, seen through the eyes of the art and the scientists, becomes a strange mirror-world in which astrophysicists can look back at the earth, to discuss the problematics of geoengineering.

SECTION E: ABELARDO GIL-FOURNIER AND JUSSI PARIKKA'S "SEED IMAGE GROUND"

"Speed, Image, Ground" is a two-channel video by Abelardo Gil-Fournier and Jussi Parikka. It explores seed bombing as a starting point for discussing environmental restoration, connecting Earth's surfaces, images, and data. This narrative weaves together climate issues and human efforts to restore the Earth, using cinematography, documentation, and advertising fragments [Fig6]. Like Ginsberg's work, it thinks through images of growth. Capturing various growth phases through seed bombing, the video explores image surfaces on living surfaces. Media theorist Sean Cubitt coined the term "eco-aesthetic"[20] to underscore the entanglement of media and environment, for example comparing digital images and green plant surfaces. Cubit’s work suggests that "Speed, Image, Ground" functions by rearticulating how concepts converge between agriculture and military applications. This, in turn, prompts us to question how images produced in agriculture *on land*, or media surfaces *imaging the land,* are formed. The video invites viewers to contemplate the complex interplay of imagery, ecology, and technology – but perhaps some viewers have more capacity to appreciate this than others?

Seed, Image, Ground 2020 - ABELARDO_GIL-FOURNIER&JUSSI_PARIKKA © Stelios Tzetzias

Szerszynski expanded on the creators' intentions. He focused on the dynamic movements within the artwork, especially the planes, drones, and seed bombs in flight, unveiling insights into their relationships with the environment and the planet: "[Seed Image Ground] links military and civilian technologies, plant growth, and photography, critically examining the transformation of Earth's surface into data." This observation underscores the artwork's multifaceted nature, encouraging a more comprehensive exploration of our connection with Earth and technology. Metallinou, an astrophysicist, further extended this idea by connecting the technical approach of "Seed Image Ground" to Ginsberg's work. She suggested that the concept of "panspermia,"[21] was evoked for her: the name for the theory of distribution of life across the universe through comets and space debris. Comets acting as "seed bombs" on a galactic scale, makes a conceptual link between the works she studied. This unconventional interpretation of an Earth-centric artwork once again highlighted artworks' ability to access metaphorical systems and modes of thought distinct from a general audience's expectations.

CONCLUSION

In the world of art and criticism, Patricia Bickers [22] suggests that concern should arise when there is a consensus: true criticism thrives on robust and substantive disagreement rather than a singular judgement of value. The interplay of diverse perspectives enriches the discourse surrounding art, leading to deeper understandings and appreciations. This experimental endeavour at the intersection of art and science highlights two key messages that resonate throughout our journey. First, it underscores the immense potential for fruitful collaboration between these distinct realms, challenging any perceived hierarchies and

allowing for reciprocal relationships that enrich both art and science. Second, it reaffirms the power of art to provoke unique perspectives and insights within scientists themselves, deepening their appreciation for the communicative capacity of art in addressing critical issues.

Szerszynski initially harboured reservations about the notion that experts could contribute something inherently different from non-experts to art criticism. His background in environmental sociology, which emphasised the knowledge held by laypeople and questioned the limits of accredited expert knowledge, led him to ponder the implications of creating an implied epistemic hierarchy between experts and lay audiences. However, as the experiment unfolded, Szerszynski began to appreciate the power of expertise in dialogue. He recognised that interactions at the level of particular specialisms enriched the interpretation of artworks. This realisation of course echoes the common practice of curators facilitating discussions between exhibiting artists and specialists to deepen the public's engagement with art – but our experiment shifted attention away from scientific knowns towards the knowledge contained in art works, aiming to address the latter through the former and not vice versa.

Collectively, these insights hint at potential for innovative collaborations that allow the knowledge within art exhibitions to be unpacked, and new aspects that scientists can offer on art. The scientists evidently a perception of art as illustration, and began using artworks as *discursive space* to combine ideas anew. Although there was a variation in how familiar the invited scientists were to art previously, with Szerzsynski having been involved in curatorial collaborations, and Kalatzi conversely arriving with limited experience of contemporary art, we nevertheless could tell from their responses that artists' views on scientific topics shed light on different aspects of the participants' worldview, particularly the notion of scientific research *as practice*. There is suggestion here that *new platforms* encouraging scientists to share views on art could be fruitful. These platforms would, for example foster a deeper understanding of the complex interplay between humans, the environment, and technology for scientists themselves.

Looking ahead to the future of art-science collaborations, several key insights emerged from this experiment:

1. The potential for a reciprocal relationship between art and science, in particular with an acknowledgment of contemporary art's capacity to provide insight to the scientific community on questions of method and perspective.

2. Scientists discovered opportunities for discourse and collaboration across diverse expertise areas, in particular between physical and social science using the artworks as a discursive space.

3. There is a potential for innovative discursive *platforms*, through which specialist audiences can unpacking the knowledge within art exhibitions, benefiting both scientists and broader audiences.

4. Recognition of the distinct role metaphors play for scientists during art experiences, resulting in unique ideas and perspectives. Scientists' embodied knowledge meant that multiple connotations and interpretations were unfolded from artists' organisation of materials, contexts and concepts.

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