Art hacking and Big Science Public engagement

Creative innovation, advanced networked computing, digital audio-visualisation techniques and communications technologies have enabled the rapid acceleration of a third culture in which the boundaries between art, science and society dissolve. (Brockman, J, 1996). Third culture operates as a mutually enriching collaborative site of production that supports generative and experimental art-science (also called art-sci/sci-art) practices. (Muller, Froggett and Bennett, 2020) Disruptive forms of artistic and curatorial practices – referred to here as "art-hack practices" - challenge traditional and hierarchical boundaries between knowledge ecologies, to evolve new, direct ways of working within the unsettled edges between disciplines. What follows is an example of an art-science project that aimed to cultivate a third culture within a technologically advanced, global scientific research initiative with the capacity to revolutionize future healthcare and medicine.

One cell at a time: Bringing together communities, patients, and researchers to build the Human Cell Atlas' (OCAAT) is a national public engagement project delivered as part of the Human Cell Atlas (HCA) during the Covid-19 pandemic (2020 – 2021). This chapter presents the approach taken to reposition artmaking and curatorship as active 'art hacking' agents within OCAAT, to interrogate the assumptions, methods, and goals of the HCA. Four art-science commissions will be introduced: *Ways of doing things* by Anna Macdonald, *Sensory Cellumonials* by Baum & Leahy, *Donate Yourself* by Stacey Pitsillides with body>data>space, and *The Call of the Silent Cell* by boredomresearch. (*One Cell at a Time*, 2021) Projects are participatory in nature, a form of art that 'directly engages the audience in the creative process so that they become participants in the event' (Bishop, 2012, p.18). Each project employed innovative digital technologies (including Augmented Reality, 3D visuals, screen based and interactive performance, 3D simulations, experimental film, immersive meditation, and generative mapping techniques) resulting in the emergence of a hybridized art-science visual culture within the HCA that was created in collaboration with the communities upon whom science at this scale depend.

The computing revolution

Global networked technological infrastructures increasingly facilitate the world's economy and production. While ongoing advancements within networked computing and communications technologies have revolutionised all fields of knowledge. (Dewdney, A and Sluis, K, 2023) Billions of people now have access to a seemingly ubiquitous internet and rapidly developing software, digital audio-visualisation techniques, automation, and electronics. Increasingly frictionless boundaries between our material and digital cultures allow our daily lives to move fluidly between our physical and technical realities as we navigate our post-digital, hybridised and media saturated world. The accelerating technological capacity of large scale or 'big science,' new computational techniques and increasing access to massive repositories of connected open data has led to the development of planetary-scale research projects that aim to impact all of humanity. (UKRI,

2023) Big science draws massive government as well as corporate funding by connecting globally disparate research labs and scientific networks to drive basic and applied scientific innovation. Notable examples include the 'International Geophysical Year' and the 'International Biological Programme,' 'The Human Genome project' and the scientific research initiative at the centre of this chapter, 'The Human Cell Atlas.'

Artists have been exploring the aesthetic possibilities of emerging media and technologies from its earliest inception. However, it was not until after 1989, when scientist Tim Berners Lee gifted the World Wide Web to the world on a royalty-free basis for everyone, forever, that 'networked', 'new media' and the more recent umbrella term, 'digital' art began to gain notable traction. (Gere, 2006) Anzures and Marques recognise that the term 'digital art' does not describe one unified set of aesthetics, (Anzures and Marques, 2022) thus it is difficult to define (Paul, 2015). However, as Tom Corby notes, it is generally understood that this form of practice is a critical artform that is both inclusive and formally complex (Corby, 2006) and takes a critical and reflective approach to the social, political, cultural, and more recently, environmental implications of rapidly evolving technologies. (Quaranta, 2013) (Bridle, 2018) As a field of practice, digital art has primarily developed beyond the reach of traditional institutional and commercial contexts, existing on the Internet, in labs and research facilities, often created by figures who do not see themselves strictly as artists (Rocco, 2024). These critical, interdisciplinary practices prompted a radical expansion of the curatorial role and function (Graham and Cook, 2010) and gave rise to a thriving network of curators, art historians and theorists who continue to track the exponential growth of the art of our time.

Creativity as a catalyst for innovation

The term 'Creative Economy' describes the reframing of creativity as a vital source of innovation and an engine for driving economic growth (Mould, 2020). Investment within this sector ideally leads to innovations that are applicable within industry (e.g. products, services, tools), applied research (e.g. new knowledge, processes) and wider societal challenges (e.g. climate change, health). Within this innovation led context, aesthetic outputs and experimentation emerge at the peripheral edge rather than at the core of interdisciplinary collaborations. Social, and by extension, cultural values that are generated by arts-led practices can go unacknowledged. Their impact is often reduced to a marginal contribution that feeds more central commercial, or research aims.

Notable exceptions to this predominant way of thinking can be traced back to the early 1960's, to industry-led collaborative initiatives such as Experiments in Art and Technology (1966) and PAIR, the Xerox PARC Artist in Residence Programme (1999). Within these complex knowledge ecologies, artists were acknowledged as role models who had an ability to go beyond established boundaries of knowledge and were paired with scientists in joint projects to create new ideas, new ways of thinking, new modes of seeing and new contexts for doing (Harris, 1999). More recently, organisations such as the Open Data Institute's Data as Culture programme, have explicitly aimed to integrate artists working with data into innovation practice. However, the close relationship of these projects to industry has meant that while they are often well received in mainstream press, (particularly in technology focused publications such as WIRED), they have rarely managed to find a 'critical' home within their own field, the Arts. (Krysa, Parikka and Kurenniemi, 2015).

The economic possibilities inherent within the democratisation of D.I.Y. (Do It Yourself) digital fabrication technologies established a globally connected, rhizomatic network of innovation labs and D.I.Y maker spaces that have been specifically designed to support enterprising co-production of innovative new products, ideas, and services on an individual rather than an industrial level. These collaborative, open and inclusive spaces also enabled and ethos of experimentation and risk-taking within multiple cross-disciplinary creative and artistic communities. These developments have led to an unprecedented rise in popularity and understanding of collaborative structures that broker new, direct ways of working between sites of artistic and innovative production.

Straddling disciplines and sectors within innovative contexts for creative production requires artists to link multiple points of contact, often across disciplines, to achieve technologically complex projects, prototypes, and artworks. An experienced curator can serve as a broker between different knowledge ecologies and facilitate a complex navigation of projects with various players across sectors, and mediate differing intents, expectations and working practices. (Bradbury and O'Hara, 2020) The working curatorial framework of OCAAT drew directly from the creative innovation collaborative structures and ethos described above to facilitate a 'third culture' within the HCA.

Third culture and public engagement

The curatorial approach for OCAAT builds upon a developing field known as art-science. The genesis of the art-science 'third culture' is often mapped back to the intense debate surrounding provocations made by C.P. Snow during his seminal Rede lecture entitled '*The Two Cultures and the Scientific Revolution*', delivered in Cambridge in 1959.(Snow, 1958) In this lecture Snow detailed what he perceived as a divide between culture and science and argued that the two fields were separated by 'a gulf of mutual incomprehension' and as such, no longer engaged with each other. Inspired by Snow's call for a more natural relationship between art and science, kinetic artist and astronautical scientist Frank Malina founded Leonardo, a scholarly journal for artists in 1968. The Leonardo art-science network expanded at a fast pace in the 1990s to become a not-for-profit global think tank operating at the nexus of arts, science, and technology.

Increased public scrutiny and advancements in the field of research ethics laid the ground for public engagement to emerge as a policy focus for UK Higher Education in the early 2000s. The field initially developed to address public concern about the conduct of science in relation to the use of human and animal subjects. (National Co-ordinating Centre for Public Engagement, 2023) This policy focus marked a shift within scientific research from developing a public understanding of science, towards engaging directly with communities who participate in or will benefit from emerging areas of research and innovation. (*Select Committee on Science and Technology - Third Report*, 2000)

These early art-science foundations and changing policy landscape helped pave the way for an acceleration of strategic funding and collaborative opportunities facilitated by initiatives such as Wellcome Sci Art (UK), Banff Centre (CAN) and Symbiotica (AUS). These collaborative contexts and projects began exploring the transformative potential of collaborations across the disciplines:

> *"…in which science is understood not as self-sufficient or complete, but as transformed and enhanced through its engagement with art, just as art is transformed and enhanced through engagement with science." (Born and Barry, 2010, p2)*

At the same time, a growing number of art-science galleries opened within Higher Education environments. A good example is the Global Science Gallery Network pioneered by Trinity College Dublin; an international collaboration of universities dedicated to public engagement through interdisciplinary art-science initiatives. Since the first gallery opened in 2008, membership has grown to include venues in Atlanta, Bengaluru, Berlin, Melbourne, Monterrey and most recently in London, as King's College London's flagship public gallery. (*Science Gallery London*, no date)

Less than twenty years later, the National Co-ordinating Centre for Public Engagement (also launched in 2008) acknowledges on their website that 'public engagement' is now a flexible term widely used across multiple disciplines and sectors, including science and policy, local government, arts, and heritage. Engagement is understood to be an open two-way process with the public that helps research institutions improve their accountability, enact their social and civic responsibility, be part of the debate on the social and ethical implications of research and generate mutual benefit. Today, the art-science contexts span far beyond the higher education public engagement. Contemporary third culture has been helpfully described by Muller et al. as a generative site of shared experience that enables

> *"a heterogeneous field of collaborative scientific and aesthetic investigations that is distinguished by its intersection with the public and its capacity to connect audiences and stakeholders to researchers in mutually enhancing ways." (Muller et al. 2020)*

Unsurprisingly, there has been an upsurge of curators whose practices centralize emerging artistic practices that explore the unsettled edges between and beyond disciplines. Notable examples include Ariana Koek, a British curator and writer, best known for initiating and being the founder of Arts at CERN (2009 - 2015), the first officially organized international arts programme by the world's leading particle physics laboratory, Geneva, Switzerland. (Dubber, 2021) and Honor Harger, Director of the ArtScience Museum in Singapore since 2014. Harger stages large-scale, spectacular art exhibitions which explore concepts within science and engineering, such as cosmology, big data, particle physics, natural history, marine biology, and climate change. The third culture collaborative ethos, and the ready availability of an established community of interdisciplinary artists and designers with a technical fluency, skillset and desire to explore aesthetic possibilities inherent within the HCA science through emerging hybrid media and new digital audio-visual technologies laid the ground for the curatorial approach to 'art-hack' the OCAAT public engagement project.

Art Hacking and the Covid-19 Pandemic

'Art hacking' is a term that seeks to describe new modalities of interdisciplinary art and curatorial practices that disrupt traditional and hierarchical boundaries between disciplines and sectors. The term was originally used by the author before the COVID-19 pandemic to describe post digital artistic strategies that emerged in response and parallel to the digital fabrication opportunities afforded by the global D.I.Y Maker Movement. The term highlighted the influence of globally connected innovation lab style contexts that are not created with the arts in mind, but where artists, curators and creative producers continue to find strategies for leveraging them to accomplish creative projects that are hybrid in nature. (Bradbury and O'Hara, 2020)

Since that time, the COVID-19 pandemic spread around the globe with unprecedented consequences for the health of millions of people. Much has been written about the global public panic and shock caused "at all socio-political and economic levels, dramatically disrupting everyday life, global economy, international travel and trade" (Zoumpourlis *et al.*, 2020) The successive government lockdowns (which began at the beginning of the OCAAT public engagement project in March 2020) accelerated an unprecedented move to mass engagement with global networked technological infrastructures and tools. Perceived divisions between work, education and the personal collapsed as the notion of the "hybrid" life was forged in millions of homes. This led to a period of intense development in online content and engagement, while also exacerbating preexisting socio-economic inequalities, particularly in relation to education, technologies, and outdoor space**.** As such, the term art-hacking is employed in relation to OCAAT to draw attention to emerging art-science practices that leverage globally connected and industry funded contexts enabled by big science and a policy drive for innovative public engagement strategies within an increasingly hybridized post digital society.

Performing, Sensing, Speculating and Embodying the Human Cell Atlas

The HCA is made up of a growing international consortium of (currently) 2,000+ researchers from over 83 countries. The multidisciplinary community is made up of biologists, clinicians, technologists, physicists, computational scientists, software engineers, and mathematicians. Together they are using a combination of pioneering single cell genomics and spatial imaging technologies to create an exhaustive guidebook or 'atlas' of trillions of 'normal' human cells. As stated on their website, research outcomes will be used as a basis for both understanding human health and for diagnosing, monitoring, and treating disease and has the potential to revolutionise future healthcare and medicine for the benefit of all of humanity.

In 2019, the UK HCA team, hosted by the Wellcome Sanger Institute alongside a consortia of five UK based institutions – the European Molecular Biology Institute-European Bioinformatics institute, Cambridge; Kings College University of London; University of Newcastle; University of Cambridge; and University of Oxford - were awarded a multi-million pound grant from the Wellcome Trust to deliver the first phase of the HCA scientific research project. The grant focused on three main areas: human development, the skin and inflammatory conditions. As a global community, HCA members need to collect cells from diverse cohorts of people who are willing to undertake projects driven by locally based scientists. As such, engaging with communities and understanding the barriers that stop individuals from donating their tissue and data for research purposes is fundamental to the project's success. A subsequent public engagement grant (OCAAT) was awarded to help bring about a cultural shift towards enhanced and sustained engagement with the HCA with identified communities of interest based in four locations in the UK (Cambridge, London, Newcastle upon Tyne and Oxford). The two questions that framed OCAAT delivery were: "What does it mean to be normal?" and "What influences peoples' value and trust in research involving tissue donation and open access data?"

Many scientific research projects continue to commission artists to aid translation of scientific knowledge through visual communications that help engage new audiences. Indeed, the power of artistic expression was cited by HCA authors in the OCAAT grant application as a way "to establish relationships between the research team and specific audiences." Artists were framed as 'illustrators' and 'visualizers' who would interpret HCA dialogue and data to help communicate the research to its identified audiences. However, from inception, OCAAT's curatorial approach aspired to move beyond a transactional, visual translation of HCA research to aid public understanding. Rather, the curatorial aim was to create a generative third culture collaborative context that would expand the HCA membership to include artists, creatives and communities. The hope was to reposition artmaking as an active disruptive 'art hacking' agent that could develop mutually beneficial points of connection between scientific, creative, and public communities. By drawing upon their specific artistic discipline, artists were supported to critically respond to the HCA's aims, ethics and outcomes on their own aesthetic terms. The cross – pollination of skillsets, expertise, methods and tools seeded shared experiences that would lead to a new hybridized art-science culture within the HCA and generate mutually beneficial outcomes for art, science *and* society.

Four art-science projects commissioned by OCAAT were framed by distinct, yet interconnected lenses: Performing Normality (Cambridge), Sensing Normality (London), Embodying Normality (Newcastle upon Tyne), Speculative Normality (Oxford). Each twelve-month project was participatory in nature and utilized innovative digital technologies to provoke critical, public dialogue about issues directly related to the science. The final artworks were showcased in a virtual exhibition (onecellatatime.org), which launched as we were coming out of the final lockdown of the pandemic, with a weeklong programme of live, virtual and physical events.

Performing Normality: Ways of Doing Things

Figure 1: Still from Collected ways of doing things, part of Ways of doing things by Anna Macdonald, 2021. Part of One Cell at a Time virtual exhibition, part of Human Cell Atlas scientific research project.

The theme 'Performing Normality' aimed to test how an embodied and affective art practice could explore the HCA project. The resulting artworks entitled Ways of doing things by dance and moving image artist Anna Macdonald examines the complex embodied sensation of diverging and returning from notions of normality. Through a combination of dance, moving image and screen-based performance practices the project explores issues of consent, the act of donation, and the significance of pattern within the HCA project. The reflexive and iterative participatory project used everyday movement to explore the concept of normality with HCA members, a group of expert 'receivers', individuals who identify as organ donor recipients, and a group of young caregivers (aged between nine and thirteen) with direct lived experience of giving their time, their attention, and their energy to another. Two central lines of enquiry evolved to inform the project's focus. The theme of matching - as a way of finding patterns and connections, was inspired by scientific methods of creating maps and atlases to visualize information and find patterns of correlations, variations and matches within the vast data sets of cells. The second theme considers why people might (or might not) give tissue for research, and the act of receiving tissue samples for scientific research. The two community groups met regularly in virtual and physical workshops using the body to think through ideas of donation, health, wellness, maintenance, and matching.

The resulting interconnected suite of artworks that make up Ways of doing things include a moving image artwork, a zine and a screen-dance entitled *Collected ways of doing* *things*. This artwork involved fifty screen-based one-to-one interactive performances of hand dances. Each twenty-minute performance catalysed the liveness of the fourth wall through a highly visual, embodied screen-based experience. Every unique hand dance between the professional dancer and audience member explores the lure of searching for patterns of correlations and variations and matches within the vast fields of data we encounter every day. Each recorded performance adds to a growing constellation of other people's gestures, that are uploaded and allocated a number within a simple interactive database, aesthetically informed by the spatial visualisations of cells produced by the HCA researchers. Audiences are invited to click and hold their cursor to rotate the numbers and select up to three recordings which play simultaneously on the screen, creating visual patterns. A voice draws attention to the relationships emerging between the dancers' hands and movements, inviting the viewer to think about the complexity we can hold in our movements, creating time for the eye to attune to difference and connection. By fusing the language and visualization methods of the scientific research with dance led artistic methods, Anna drew connections between the way the body does things at a cellular level and how we perform ways of doing things in everyday life.

Sensing Normality: Sensory Cellumonials

Figure 2: Sensory Cellumonials by Baum & Leahy, 2021. Part of One Cell at a Time virtual exhibition, with the Human Cell Atlas scientific research project.

Sensing Normality aimed to explore how our sensory interactions affect our perceptual experience of normality. *Sensory Cellumonials* by artist duo Baum & Leahy (Amanda Baum and Rose Leahy) invites viewers to dive into the potential of our cellular bodies through an immersive meditation. A community Advisory Panel brought together HCA members and a small number of community members based in Peckham, London who through their work, organise/participate in rituals (ancestral or new, secular, spiritual or religious, personal, or collective). The panel supported the development of a series of virtual public workshops with local community members from Peckham. Drawing from the spirit of the counter-mapping movement, which questions Western-centric ways of mapping the world, workshops combined sensory meditation with speculative mapping and collective imagination techniques. Participants were invited to create their own alternative version of the Human Cell Atlas - their own body map - and share their 'gut reactions' to this research. Open discussions between HCA members, the artists and public participants explored how a 3D imaging of a fully mapped cellular body might become layered with meaning from memories, emotions, and associations of those who experience it. An informal lunchtime session with HCA members informed the development of sensory workshop kits sent by post that encouraged participants to speculate on the legacy of cellular biology in ninety-nine years' time and to think about the long-term impacts and ramifications of cellular biology beyond their own lifetime.

The final artwork takes the form of a fluxing, responsive, kaleidoscopic interactive animation, composed of five portals, that are accessed through each of our five senses. Each portal is made up of an undulating digital landscape of green, yellow, and purple accents, and intricate cellular imagery. The portals unlock sensory and immersive experiences or ‘ceremonies’ that present five future, speculative worlds transformed by our now advanced understanding of cellular biology. Viewers are invited to travel through each of five portals by a shapeshifting ‘Our Living Cellular Kin’ (Olcks) – speculative guardians of the five human senses. These polyvocal beings invite visitors to experience an introspective, sensory journey, each six to eight minutes long. Following this digital encounter, viewers are invited to contribute their reflections in the ‘wishing pool’ – a generative map of public perspectives on cellular biology research, inspired again by the spatial visualisations created for the HCA research. Baum & Leahy honed a mindful, embodied approach that helped open new directions for participants to encounter the science of the HCA, consider the ethical and mental frameworks at play within the HCA and think about the impact of contemporary scientific research on future generations.

Embodying Normality: Donate Yourself

Figure 3: IMMORTAL Augmented Reality (AR) artwork 3/5 by Stacey Pitsillides with body>data>space 2021. Part of One Cell at a Time virtual exhibition, with the Human Cell Atlas scientific research project.

Embodying Normality aimed to critically respond to the ways in which XR (virtual, augmented, hybrid reality and immersive) technologies are disrupting, enhancing, or altering our post digital experience of normality. *Donate Yourself* by designer Stacey Pitsillides, with the multi-disciplinary collective body>data>space, is a site specific, augmented reality (AR) experience and digital artwork that uses sound and 3D visuals to spark debates about our organs, tissue, and body data. The project is centred its engagement on a participatory design strategy (Bannon & Ehn, 2012) to develop the AR experience. This involved the design and delivery of public workshops, postal packs and a series of in-depth (and ethically approved) interviews with HCA members. Collectively, the activities aimed to identify key ‘thematic and visual anchors’ that could be developed into a non-linear narrative exploring themes of value and trust in research involving tissue donation and open access data. (Pitsillides, Boddington and VindiŠ, 2023) Five HCA members - an immunology and cancer biology specialist, a researcher who collects samples and works with human tissue, a Parkinson's clinician and researcher, a data wrangler, and an Emerita professor - were invited to share their personal experiences of working with data and human tissue.

Building upon the outcomes of these interviews, the artist worked with HCA members to collaboratively shape a series of design probes that mirrored the lab-based processes used within the HCA research. Design probes are particularly useful in helping people to breakdown complex and unfamiliar issues into simpler questions that can be answered visually or textually. (Wallace *et al.*, 2013) A public open call invited participants to complete a postal pack and share their views on donating body, tissue, and medical data for research purposes in an online workshop. Anonymised reflections drawn from interviews with HCA members were weaved together with the data collected from the packs and developed into a series of five AR based experiences.

The final *Donate Yourself* artwork was premiered as a twenty-minute webAR walking trail of five locations around the Ouseburn Valley area of Newcastle Upon Tyne. Visitors accessed the digital objects and narrated audio stories by scanning the QR codes with their mobile phones. The QR codes were located on a series of markers strategically located along the route to present further detail of the HCA project to an incidental public audience. The digital objects introduce virtual, visual, and sonic expressions of our organs, cells, and body data. Each one is imposed on the landscape behind, as audio unfolds stories of care, trust, immortality, consent, and futures, exploring the key role our bodies play in scientific discovery. As the artist notes,

> *"The scale, composition and positioning of AR elements – that present larger than life organs, cells bopping on the river and body data dancing in the sky – offered the viewer an artistic gaze on the scientific visualisations, aiming to situate themselves between human and non-human with the voice and sound emphasising an intimacy in the interaction."* (Pitsillides, Boddington, and Vindis 2023)

Each experience on the AR journey explores how we might view our bodies as a collective source of knowledge for humanity, as a material to explore our biological make up, or even as a way of immortalizing ourselves in cells. The sound and 3D visual objects examine diverse perspectives on what donating parts of yourself mean to different people.

Speculative Normality: Call of the Silent Cell

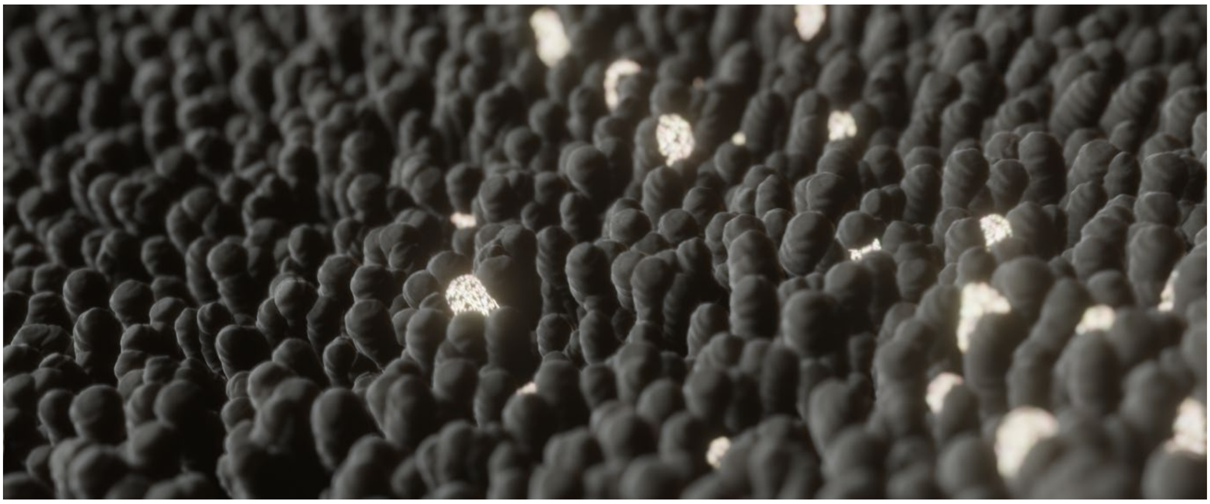

Figure 4: Villi *Sea still image from Call of the Silent Cell film by boredomresearch, 2021. Part of One Cell at a Time virtual exhibition, with the Human Cell Atlas scientific research project.*

Speculative Normality embraced speculative and fictional alternatives that can help us see beyond traditional beliefs, established systems and accepted narratives by showing us different perspectives of how things could be. *Call of t*he Silent Cell by artist duo boredomresearch (Vicky Isley and Paul Smith) is an experimental film of cellular behaviour cantered on the interplay between the gut microbiome, the immune system, and wider concerns regarding the symbiosis of human and environmental health. From early and sustained interactions with HCA members, the artists created interactive software within a game engine, called "Cytokine Storm" to explore an art and science participatory approach to interrogating the rules that govern the behaviour of our immune system. The outcomes of this activity would inform their final artwork. A cytokine storm can occur when something goes wrong and your body releases too many signals. This can cause the immune system to overreact and damage otherwise healthy cells. Within the interactive game, four cell states represented the behaviour of an immune system, healthy cell, damaged or infected cells, activator cells, and killer cells. For a healthy immune response all these interactions need to be balanced.

The artists devised a series of virtual workshops entitled 'The Natural Killer Within' to engage a cohort of Interactive Media & Computer Arts students (sixteen to eighteen years) from at the City of Oxford College. Each student received a postal pack with materials for cell staining and microscopic photography and were invited to replicate simple scientific histology techniques in their own kitchens. Creating and documenting stained samples from plant material to reveal the intricate structure of cells. The students inputted their cell images into Cytokine Storm and were then able to change the balance between these four cell states to see how it affected the overall behaviour of the system. HCA members were invited to attend the final workshop and respond to all the different simulations that the students had created, describing what was happening in the body if we were to see this behaviour on a cellular level.

The final speculative fiction film highlights how the impact humans are having on environmental systems also impacts the complex interactions happening inside of us. The artists explain that the film

> *"…takes us on a journey with an elderly man who wanders through a forest, meditating on the fragility of his body and the environment. A storm arrives, not of breath and air but of cells and their signals, revealing a disturbance in the body, an immune system in overdrive. Emerging from the storm the old man gains a new wisdom that his bodily health is deeply intertwined with the life of the forest."* (*One Cell at a Time*, 2021)

By directly reflecting upon the latest insights revealed by single cell analysis, the work offers audiences the opportunity to briefly enter the magical world of the immune system - as a 'storm' breaks, revealing we are not as separated from nature as we think. The poetic narrative blends scientific enquiry with impressive technical proficiency, blending 3D animation, experimental film and interactive gaming technologies. *Call of the Silent Cell* explore how a scientific understanding of cells can inform our sense of self, both as beings made of cells and as individual parts of a wider ecological system.

Conclusion

OCAAT encouraged the deconstruction of binary art and science perspectives towards enmeshed understandings of the HCA science. The curatorial approach was inspired by creative innovation and third culture contexts and resourced by the global infrastructure of big science. The project's art-science strategy aimed to broker a closer alignment between scientific, cultural and societal concerns by facilitating links between multiple points of contact. Within this generative site of collaboration, a wide range of artistic tools, methods and knowledge were recalibrated and brought on a par with the core multi-disciplinary HCA membership – aided in a large part by the creative application of digital visual technologies that have revolutionized science and wider society. The role of the artist transitioned from illustrating the HCA science to an active and disruptive art-hacking agent whose purpose was to explore the science of HCA critically, materially and on their own terms - in collaboration with, rather than in service to the scientific research.

The four thematic lenses (Performing, Sensory, Speculative, Embodied) offered engaging entry points for diverse communities who might not respond to traditional forms of science communication. Somatic performance fused with the language and scientific data visualization methods enabled screen-based experiences to evolve beyond sites of scientific information. Sensorially immersive animations re-humanized the intricacies we are now discovering within cellular systems through advancements in single cell analysis. Hypnotic polyvocal guardians guide us beyond the excitement of emerging technologies and short-term scientific advancements to consider long-term realities of what it means to deliver research that is transformative in nature. Larger-than-life artistic 3D objects and scientific visualizations mesh with architectural structures and public spaces to explore ways to explore public attitudes towards donation and consider how our bodies can be reimagined as a collective legacy that will benefit future generations. Serious play generates gamified simulations that draw attention to the symbiotic relationship between systems – and how a scientific understanding of cellular behavior can inform our sense of self, both as beings made of cells and as individual parts of a wider ecological system.

Embedding artists as disruptive actors that move between and beyond complex, knowledge ecologies catalysed the development of a hybrid art-science visual culture that placed humans, rather than their tissue and data at the centre of the HCA. The resulting art-science aesthetic investigations, participatory digital artworks and sensory interactive experiences are hybrid in nature, aesthetically driven, scientifically informed and mutually enriched by community input and participation. Big Science operates at a systemic level and harnesses the potential of rapid computational advancements to bridge current thresholds of knowledge, with a view to transform future healthcare and medicine on a planetary scale. It follows that if broader social, political and environmental implications of scientific and technological advancements are not critically and carefully considered, the potential for science to impact society (positively or negatively) scales exponentially. The successful cultivation of a collaborative art-science visual language within the HCA suggests a real possibility for greater mutual comprehension between art, big science and a post Covid, hybridised society. Finally, OCAAT makes a strong case for the role that artmaking can play in enabling a more embedded and expansive role for the public to enact their social responsibility and scrutinise the assumptions, methods, and goals of scientific research on their own terms. Art-science practices can provide alternative contexts and critical creative methods that help to hold technology enabled and industry funded scientific innovation to account, for the benefit of all of humanity, now and for future generations.

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