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Art-Science Collaboration Framework: Play as a concept

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How can an artist-researcher develop a framework by testing play as a concept to advance relationships through art-science collaboration that leads to behavioural change?

Joanne Berry-Frith

Bioimaging experiments are carried out in discrete labs, and artists are rarely granted access. This seemed to be an underused resource for artists, and I asked myself how I could contribute to art-science initiatives in advanced imaging and microscopy labs as an artist-researcher. I responded innovatively to current circumstances in bioimaging by thinking about scientific and artistic interdisciplinary practice in a “playful” way. Established play theories and practises from the material I examined, analysed and then modified influenced my work.

As an artist, my research is situated within a group of artists who investigate complex fields of scientific subject matter and engage in an ongoing process of dialogue that has generated new knowledge in science and art. To supplement the work of these artists, I conducted a case-study review based on three scientific research institutes in the United Kingdom and Sweden. My contribution to knowledge beneficial for the fields of both art and science was to introduce play as a disruptive concept. I developed a four-stage, adaptable framework for working with scientists, which I created while collaborating with experts in the field. Alongside this, my research revealed a desire to collaborate from both cultures and that interaction through the application of this framework allowed for a more flexible approach. We accepted that it was okay if artists and scientists did not achieve the same aims or conclusions. It is also clear from this research that working on socially relevant academic topics has substantially influenced the evolution of my research outputs when it is based on adopting a performative, process-based approach (Kestner, 2013: 1). The research demonstrated how

scientific knowledge was necessary to my practice, serving as a bridge between art and science. The concept of play allowed me to disrupt artistic and scientific methods of analysis, moving focus away from a purist approach. Deploying play as a strategy was key to dismantling silo mentalities and demonstrating how artist-researchers can contribute to scientific investigations, develop new modes of representation, and communicate alternative insights. I discovered that play can be used to transform one's viewpoint.

KEYWORDS: art-science collaboration, advanced imaging and microscopy, play, drawing, moving-image, data montage

RSD TOPIC(S): Cases & Practice, Methods & Methodology

Introduction

My initial curiosity about how artists can work with scientists was piqued in 1998 when I became aware of the SciArt scheme. SciArt gained traction in the 1990s due to effective public engagement techniques supported by artistic remuneration, technological advancement and collaborative innovation. It is now widely understood that debates concerning technological advances in science may be facilitated by using the arts to reach those who do not consider themselves to be scientifically knowledgeable. Research suggests that art experiences—especially participatory ones—may offer a gateway into thought-provoking scientific concepts. In many fields, including public engagement in science, multidisciplinary and transdisciplinary art and sciences are coemerging. This paper discusses how incorporating an artist into a scientific institution provides considerable advantages. Art and science working together may bring interesting thinking and the "happy accident" back to life. These were formerly significant forces behind scientific innovation, but current funding constraints have made them less effective (Dumitriu & Farsides, 2015: 4-5). Since 2010, I have sought out Life Scientists to collaborate with because the methods we employ to create images are connected. We both use laser technology (I make laser-cut lightboxes), which requires knowledge of light, optics, and computer visualisation methods, and I am fascinated by how I can use scientific image data innovatively. As a result, since 2010, a central part of my practice

has involved contributing to scientific research projects as a team member. I worked in the three advanced imaging and microscopy labs (detailed below), observing, participating, and documenting science as events unfolded, contributing to interdisciplinary approaches in advanced imaging and microscopy at:

- Cell Signalling Imaging (CSI), the Centre for Membrane Proteins and Receptors (COMPARE) and The School of Life Sciences at the University of Nottingham, Queen's Medical School, the University of Nottingham
- The Core Research Laboratories Imaging and Analysis Centre, Natural History Museum (NHM), London
- The Centre for Cellular Imaging (CCI), Sahlgrenska Academy, Gothenburg University, and The Biofilms Research Centre for Bio-Interfaces, Malmö University, Sweden

I conducted research to find out how an artist-researcher might contribute to new interdisciplinary methods in advanced imaging and microscopy. To discover the consequences and implications of when an artist collaborates with positivist fact-checking life scientists and conducts interpretative research on life science. I worked at these three disparate core-imaging labs, where I trained in how to act as a bridge between my colleagues, the lab and the research institution. Working with scientists in labs, I saw there was a lack of understanding between the two disciplines of approaches to imaging and its potential. I noted a separation between the disciplines of art and science in terms of methodology, processes, terminology, and representation techniques. I wanted to address this gap in knowledge for understanding and representing science—one that advocates the vital role of an artist working in conjunction with small groups of scientists. I devised a four-stage approach based on action research (AR). AR was selected as the methodological approach because of its cyclical reflective nature; it encompasses contemplation, planning, action, observation, and reflection (Dickens & Watkins, 1999: 127–140).

As a result, a central part of my practice has involved contributing to scientific research projects as part of the research team. I was introduced to an impressive network of international contacts who are world-renowned in their field. These scientists were delighted that I was interested in what they had to say and eager to share their results.

The focus of this article is research I conducted at The Centre for Cellular Imaging (CCI), Sahlgrenska Academy, Gothenburg University, in collaboration with "SkinResQU," part of the Biomedical Photonics group at the University of Gothenburg, plus The Biofilms Research Centre for Bio-interfaces (BRCB), Malmö University, Sweden, and industry partners in 2016–2019. The outputs were exhibited at two scientific conferences: the 14th Annual Workshop of Biofilms, 2018, and the Research Centre for Bio-Interfaces, Malmö University. Exhibition and conference presentation at SCANDEM 2019, Gothenburg University.

CCI houses advanced procedures and analysis tools for medical, biomedical, and clinical research. CCI's manager (Fernandez-Rodriguez) wanted to promote Art–Science collaborations in Sweden and the Nordic nations. In 2016, Fernandez-Rodriguez initiated a multidisciplinary research project and asked me to participate and present the findings in 2018 and 2019. This was a significant opportunity to work with professionals in bio-interfaces on an international project using Multiphoton Microscopy (MM) to image deep skin samples. I collaborated with four researchers who shared their knowledge. They had never collaborated with an artist-researcher and were curious about its impact. From this privileged position, I have been able to build relationships over time. From the onset, there was a mutual desire to engage in meaningful collaboration.

I reframed the situation by introducing play as a disruptive concept. My aim is to trigger a reactionary response to the scientific method and to convey play's significance as an essential part of this collaborative process (Winnicott, 1989: 15; 138). I noted that play, as a disruptive concept, is rarely expressed through scientific methods or principles. My collaborators were unaware of play's ability to aid innovation since it was beyond their normal sphere of reference; it was a concept they had no experience of, nor did they comprehend it. Taking on board Huizinga's concept of the "magic circle" (2016: 20), I enclosed myself as the player within several safe spaces, separate from the normal routine. I investigated CCI as an underutilised (visually, cognitively, and technologically) artist-researcher resource. I expanded my knowledge of advanced imaging and microscopic systems capabilities, computer visualisation techniques, and software. I invented new rules for engagement, which gave me the flexibility to adapt. I participated in and documented events in the lab, the advanced imaging lab, made artwork from scientific data, and disseminated this to scientists at scientific conferences.

Understanding this subversion of the precise and rigid methods that scientists employ was important. My approach tested my collaborators' boundaries, as there was a perceived lack of awareness by these scientists of play and playfulness as a productive activity within science. I noted how playfulness came through as scientists adopted interdisciplinary methods of working, and my teammates gained confidence after realising that an entirely empirical evaluation of their study was flawed. All gained valuable insights from reflecting on what interpretive, artistic research and play may mean for scientific experimentation. My collaborators shared their thoughts, excited to have the opportunity to view their research from another expert's vantage point.

My presence as a British researcher collaborating on a transdisciplinary Swedish project at CCI had an immediate impact. Scientists discussed that the theoretical analyses they employed to establish facts and reach conclusions frequently lost sight of science as a creative endeavour. Having an artist on the team brought a fresh perspective to their research; it facilitated alternative productive discussion. Scientists revealed how they were too easily reliant on cultural references to provide worthy representations rather than producing their own illustrated conceptual insights (Ericson, 2016). They acknowledged how they had lost the capacity to advance their concepts beyond a purely empirical understanding. They recognised that if they shifted their attention away from a purist approach, new insights may be created, hence improving the influence of scientific dissemination for the public (Ericson, 2016). I had complete freedom to use empirical data as I thought fit. My goal is to develop innovative visualisations. I presented my research back to scientists at two international conferences in Sweden, contributing to Art-Science international cross-disciplinary exchange.

Stage one: dataset one generated in the lab

In stage one, the CCI lab became a key site that encouraged transactional discourse as I conducted action research (Huizinga, 2016: 10–11). I examined how my presence in this lab had affected my teammates' behaviour as they interacted. I found role-playing and swapping roles, performing my duties as a pseudoscientist, liberated this biomedical investigation beyond one way of understanding science. In my role as a pseudoscientist, I shadowed and copied my colleagues' practises, participated in scientific experiments at the bench and in the imaging lab, and was educated in specialist techniques and

empirical procedures. I expanded my knowledge of multi-photon (MM) imaging, computer visualisation techniques, and software. I learned protocols, customs, and methodologies, becoming a competent member of the team. I asked my collaborators to swap roles, and they functioned as documentary photographers, taking pictures of me as I performed my duties as a pseudoscientist. Swapping roles allowed us to adjust our actions, test, and explore new ways of working. We became less inhibited and openly shared our theories, which prompted a discussion about what an artist's role might be in science and what science can offer an artist. Curious and, at times, awkward exchanges liberated this biomedical investigation beyond one way of understanding science, which deepened our connection. As a participant observer, I used semi-structured interviews and generated the first sets of data. Other group events, including midday discussions, helped build trust across the week-long programme. At this point, as my knowledge progressed, I critically analysed scientific procedures and data, offered alternative findings, and asked broad and precise questions. I recognised there was a lack of awareness within this lab regarding play as an alternative method and concept to steer and understand science.

Prior to completing this case study, my understanding of role-playing was unclear. The realisation of two sets of behaviours—artist and scientist—and our relationship with scientific method, investigation and documentation became clear. I realised that play boosted our cognitive capabilities. I noted we each had new roles to fulfil and had to adapt, and through active cooperation, we broke through disciplinary barriers and conventions. This led to a better understanding of relational aesthetics (Bourriaud, 2012). We each shared our experiences, and we became less inhibited, which liberated this biomedical investigation beyond one way of understanding science, which deepened our connections. I assisted, replicated and documented postdoctoral researchers' movements at the bench and on the MM. She functioned as a documentary photographer, taking pictures of me as I prepared specimens and performing my duties as a pseudoscientist.

Through this shared experience, which happened over several days, I obtained an insight into her as a scientist, her hobbies and her opinions. In addition, I learned about the customised handcrafted techniques (scissors to cut skin) and tools she used to prepare skin samples for imaging, such as the skin cutter and rubber mallet. The crude

techniques used to prepare samples were in stark contrast to the digital imaging technologies used to create visually exciting image data. I pondered the creativity of human intervention, the dexterity of this scientist's hands, and the methodological rigour necessary to prepare samples for imaging during these routine tasks. I compared the labour-intensive procedures and craftsmanship of scientists as I studied their methodological approaches. This brought attention to scientific methods spanning the instinctive and creative, as well as the mundane and the gruesome. It illuminated how both fields can ask simple questions; in this case, the post-doctoral researcher wanted to ask, "How far does cream penetrate skin?" While her question appeared simple, her research demonstrated the complexities of gaining this knowledge. Through interplay and role-playing, I could make good use of this knowledge. This enriched my documentation and visualisation methods, as I explain next.

I was trained to operate and image deep samples on the MM to measure two topical drugs' bioavailability on pigskin. This imaging method was used to image 250-micron-deep skin samples. As a novel microscopic process, MM evolved into a new visual instrument. I found the illumination of the image on the screen enthralling as, for example, I observed the microscope travelling through an active, complex living organism. Incredible visual discoveries were made, such as cross-section structures of sweat glands and hair follicles, natural auto-fluorescence, radiant iridescent colour, and supernatural views of structural detail, all recorded as stills, 3D videos and multi-layered Zed Stacks. I analysed optical colour, the impact of travelling through layers of skin, its structure (the stratum corneum, epidermis, dermis, subcutis, and fibrous collagen), depth, and scale. I was able to comprehend scientific concepts such as excitation, diffraction and fluorescence with greater clarity. I found it vital to be there during scientific studies to gather experiential knowledge and to call attention to the aesthetic elements of my collaborators' data. The dynamic motion of biological matter enabled me to reinvent visual conceptions, thus expanding skin research dissemination outputs.

I encouraged scientists to voice their personal opinions on science, enabling them to give a response that extended debate beyond empirical issues (Huizinga, 2016: 5). Individual, aesthetic, technological and methodological problems were discussed to better understand each other's perspectives. As I got to know the person behind the research, they revealed more about what they were thinking and feeling. As an example, the

postdoctoral researcher believed scientists always told the truth; she assumed the public didn't understand how hard scientists worked and thought they performed miracles. I was surprised by her opinions, imagining she was immersed in empirical bias and not looking beyond the scientific laboratory. I was able to challenge her perceptions, which encouraged me to further investigate how I could bridge the gaps between art, science and the public through exploring play as a disruptive concept. I came to the conclusion that I had to actively engage in multidisciplinary practice if I wanted to transform it.

I sought to interrogate what these scientists' thoughts were about ethics, medical benefits, the cosmetic industry, anti-wrinkle creams and Moroccan essential oils. Chemical modification led me to consider adaptation and deconstruction as visual strategies to interact innovatively with data. Adopting an agile mindset and deploying ludic strategies helped me to traverse challenges, and I uncovered connections between art, technology, science, myself and others (Caillois, 2001: 33). I realised I was focusing on purely scientific data, which is only one part of the narrative. At this point, I wanted to illuminate the experimental process, behaviour, and traits of various scientists. For example, I wanted to show unusual gestural movement, which I saw as an indicator of scientists' labour-intensive creativity at the bench and during imaging experiments. For this reason, I introduced experiential aspects of this research into the 2D large-scale prints (125 x 200 cm) (see Figure 1) and moving-image work I was making. My focus shifted from cellular form to incorporating archived data, photos, film footage, and audio—all used to widen the context of this research. For example, lab film excerpts were incorporated into a film about skin (timed at 14:49 minutes and 22:26 minutes). I began to see unpredictable events, offbeat, surreal encounters and the unusual sounds of different accents (Swedish, Spanish, and Lithuanian) as examples of how play functions. Play as a concept became the bridge connecting my inner actuality with external events happening in this lab (Winnicott, 1994: 3). For example, when watching Fernandez-Rodriguez (2016) set up the MM. At the beginning of the week, she exclaimed suddenly and unexpectedly, "What is going on? Oh, my God! Don't tell me that the guy isn't working. Let's see if there is any complaining. If we get red, we get mmmmmmmmmmmmm."

As she spoke, she mimicked the laser's movement by shifting her upper body at a 90-degree angle, extending her arm in front of her, and turning her hand upward when

the objective lens moved onto the stage. Fernandez-Rodriguez (2016) declared: "On Mondays, when I switch off the guy for some reason, things are always bad." While all collaborators crammed into the tiny, microscopic laboratory, we observed this nonsensical interaction as we patiently awaited her to set up the system. Suddenly, a loud noise broke the tension, and we all laughed. Experiencing tension in order to invest in an uncertain outcome, given that the result is not predetermined, was useful (Rodriguez, 2006: 2). I saw how risk and speculation were necessary components of testing, and I witnessed how play manifested itself in the lab. As a result, this project turned into a lively cultural exchange. From this, we debated technical instructions and shared our impressions as we looked for remarkable traits of the skin's surface. For example, finding out what causes image blur and choosing the right technology led us to several exciting process discussions that challenged our assumptions.

Stage two: dataset two gathered through practice-based research

In stage two of this framework, I concentrated on practice as a method to disrupt scientific image conventions. My intention was to come up with novel ways to visualise image data that went beyond empirical representation. I did this by pinpointing how the use of advanced imaging and microscopy can expand art and scientific methods of imagery. I tested how I could extend data by manipulating it.

The scientific computer lab became a crucial space for inquiry, as I was free to set my own agenda. I tested parameters and variables. This sparked a never-ending testing process where I played instinctively, tactically, and divergently with software tools. I created novel data sets of magnified collagen and cross-sections of skin with hair follicles and used this databank of visual information to develop practice-based outputs.

Once I returned to my studio, I was able to reflect on the entire experience. I considered how coexisting with scientists in an international lab conducting a multidisciplinary research project with SkinResQU and BRCB at CCI was socially important. First, I reviewed the entire body of work (documentary, film, and photography, as well as raw and reprocessed data). My goal was to show how this research can be conveyed innovatively to my collaborators and a diverse international community of scientists at conferences beyond standard scientific conventions. I used play in a planned way, having

considered all the information received. My objective was to reveal the data's inherent aesthetic qualities, which is why I focused on the unconventional details, optical colour, and structure of skin. The aesthetic features I am referring to are derived from raw data collected during stage one: Zed stacks, stills, and videos of fibrous collagen, sweat glands, and hair follicle cross-sections.

Furthermore, the aesthetic elements of the reprocessed data that I created—topological and stereographic films—were startling in their novelty. These aesthetic components reflect my interest in the technological world of biotechnology, all of which act as a link between my practice and this scientific community. My visual sensibilities relate to the aesthetic aspects of topographical modernism built on precedents established in the late nineteenth century, where artists used new images, materials, and methods to create artworks that they felt better reflected the reality and ambitions of modern cultures. During this time, composition and pictorial harmony were demystified by science and found a new basis in a set of abstract theorems such as those of Fechner, Young, Helmholtz and Hering. In this work, I subtly deconstruct modernist traditions in order to convey scientific representations of biological realities in a distinctive manner.

Practice-based activities involved three approaches. First, I extended a deductive semi-systematic drawing technique. I focused on the visual attributes of skin image data, such as scientific colour and structural detail. I drew pixel-level detail at high magnification using a 0.75-point vector rectangle with an unfilled outline. I incorporated solid and dashed lines using an overly bright CMYK vector line, and this acted as a contrast to the highly saturated coloured image data underneath. I worked systematically but not accurately and introduced improvisation as one drawing strategy to allow for flexibility. I found that combining dashed lines created nuance—offsetting digitally drawn uniformity—which is what I wanted to achieve. I investigated how instinctive and calculated play expanded exploration as I carried creative activities to excess (Bourriaud, 2002: 28; Caillois, 2001: 33). I made complex compositions that illuminated the relationship between image data and drawing (see Figures 1 and 2). During the first exhibition at Malmo University, a scientist (whose sister was an artist) remarked that the colours I used were too similar to scientific colours, prompting me to reconsider my use of colour, but I decided that emphasising the luminescent MM scientific colour was essential. I realised I was focusing on purely scientific data, which is

only one part of the narrative. At this point, I wanted to illuminate the scientific procedure and focus on the experimental process. I wanted to document unusual gestural movement, which I saw as an indicator of scientists' labour-intensive creativity at the bench and during imaging experiments. For this reason, I introduced experiential aspects of this research into the 2D large-scale prints (125 x 200 cm) and moving-image work I was making.

Finally, I produced moving-image work by adopting an exploratory approach to advance aesthetic conventions. Here, documentary footage, raw data, and reprocessed experimental data were reconfigured, juxtaposed and layered. 30-second films of a still image of skin with a moving section complemented more complex work (Huizinga, 2016: 20). Collaboration with conductor Edmund Hunt further developed creative outputs. Hunt composed a new piece for Northumbrian Pipes (duration 14:49 and 22:26 minutes)—an electroacoustic composition to accompany both skin films. *Skin-2* consisted of a compilation of layered information from the CCI lab, including edited surreal footage of humorous moments such as Fernandez-Rodriguez setting up the multi-photon microscope (see stage one). *Skin/Kin* was performed at The Lab, Royal Birmingham Conservatoire. *Skin* movie was shown at the 14th Annual Workshop of Biofilms, Research Centre for Bio interfaces, and Biomarkers in 2018, with Hunt's sound design contributing to the undertone of experimental play.

Stage three: the third data set created at the scientific conference

In stage three, I embraced the scientific conference centre as a safe space to gather data from exhibitions, conference presentations, surveys and feedback. I presented practice at two temporary exhibitions to initiate feedback at both conference events. Both events underscored the uncertain relationship between exhibition value and user value, over which I had limited control as an artist-researcher exhibiting at two international scientific conferences. The first was the 14th Annual Workshop of Biofilms, Research Centre for Biointerfaces and Biomarkers, 2018—Methods and Technologies Conference. This was followed by the 70th Annual Meeting of SCANDEM 2019, the Nordic Microscopic Society. I was the sole non-scientific researcher to present at both conferences. At the 14th Annual Workshop of Biofilms, Research Centre for Biointerfaces and Biomarkers,

2018, I exhibited next to 23 ABSTRACTS-poster presentations; there were 91 conference attendees, including students, academics and secondary school children. At SCANDEM 2019, my artwork was shown alongside 48 ABSTRACTS-poster presentations, 26 industry stands and 300 attendees. Notably, I was the only non-scientific researcher and conference speaker to present my research to scientists.

At both events, I exhibited artwork based on the conference organiser's guidelines. Unlike other exhibitors, who displayed academic posters following strict empirical guidelines, I was allowed to display alternative scientific representations for scientists. As the only non-scientific researcher in attendance at both events, I found the presentations and exhibition challenging. At Biomarkers 2018, installing large-scale work without technical help was difficult; design specs were inaccurate, and artwork was problematic to attach to spongy exposition panels. At SCANDEM 2019, the artwork was reassigned to the main lecture theatre's exterior entrance wall; large-scale prints (e.g., 95 x 125cm) were attached with white tack; the film *Skin*, which was scheduled to be shown on the HD monitors, was not shown; and only a small A3 portfolio of artwork was presented alongside the artwork. Both events underlined the distinction between art and science exhibition aspirations. I noted the advantages and pitfalls of presenting for a scientific audience. Neither event went as planned, but I was determined to overcome obstacles. I was better able to interact and develop new connections at both events. The idea of a British artist-researcher collaborating with Nordic scientists doing biological research seems to pique the interest of conference participants. They wanted to discuss images, strategies and concepts and appreciated my contributions to this sector. I valued the opportunity to present my research to an international multi-disciplinary audience, including industry partners, life scientists, material scientists and biotechnology scientists. I received positive feedback from all.

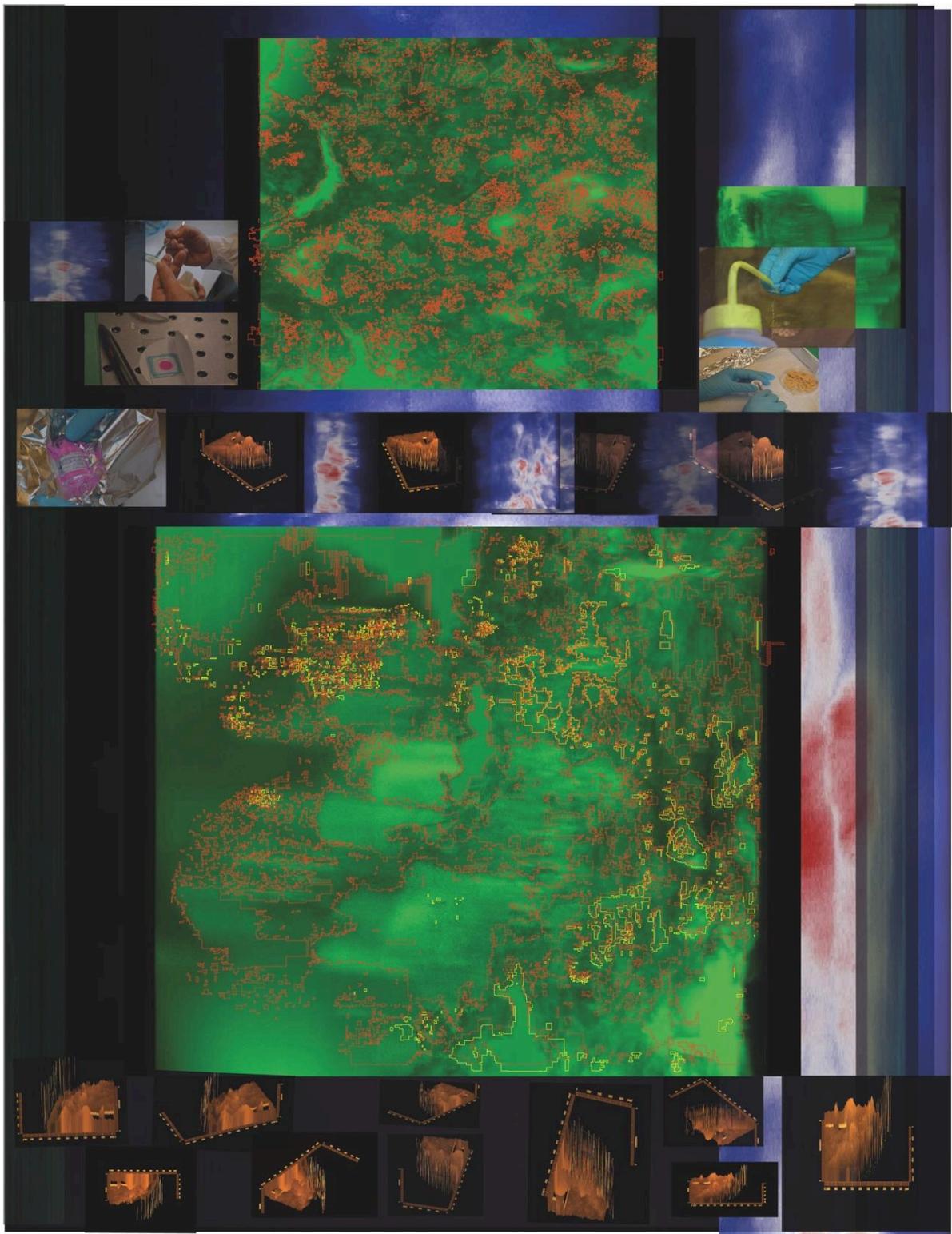


Figure 1. Berry, J. (2019) 021_5scrollprojectionrightscalewithframeincontinuingmay19.pdf. 95 x125cm © Jo Berry.

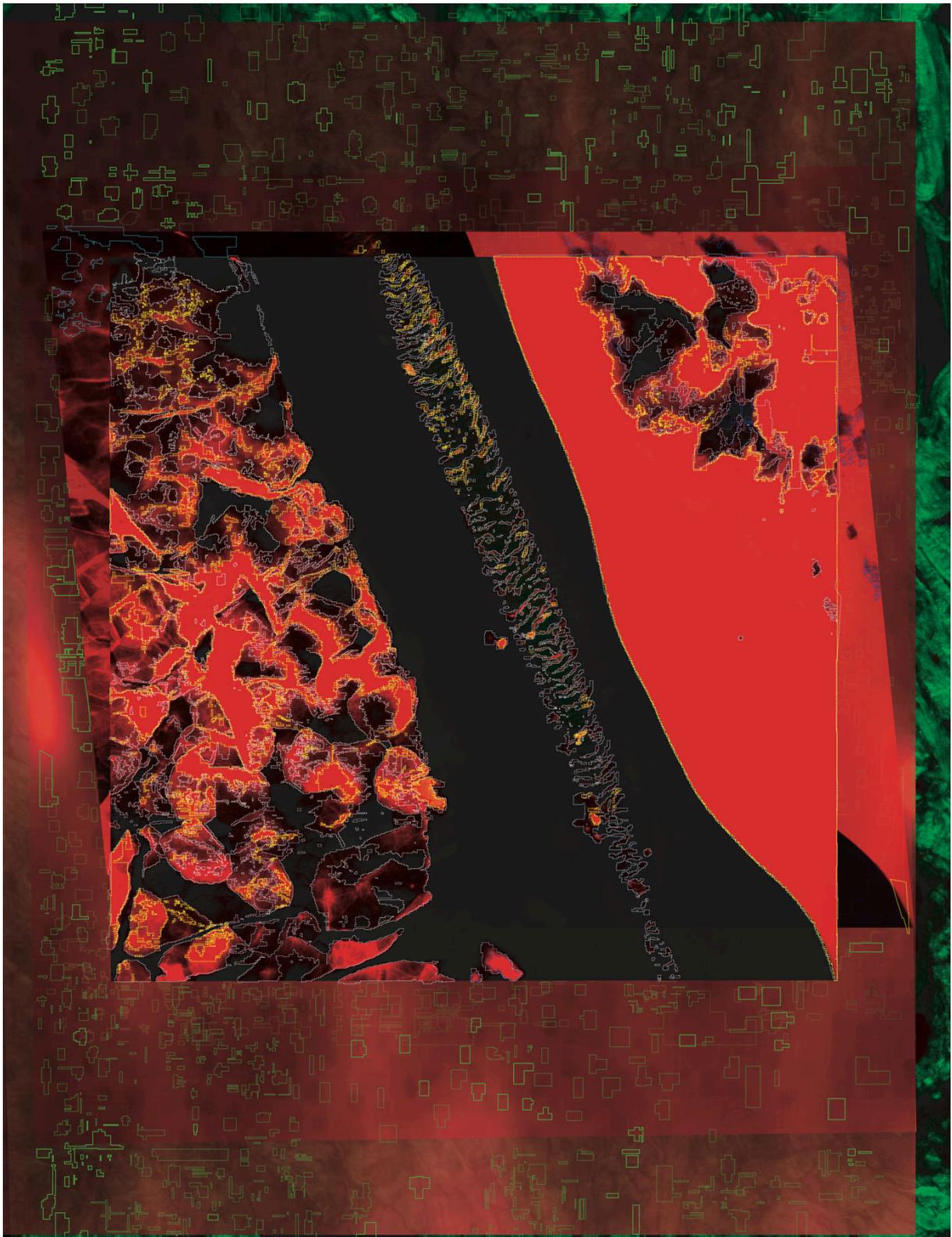


Figure 2. Berry, J. (2019) sweden1bitesize2v1.pdf. 95x125cm © Jo Berry.

Poster presentations, seminars, and conference dinners all contributed to the expansion of my knowledge. All events highlighted the importance of testing this hypothesis—to see how play as a concept can impact behaviour, interdisciplinary collaboration and practice when an artist-researcher collaborates with scientists and responds innovatively to biointerfaces. I was interested in scientists' willingness to hybridise imagery to test their hypotheses (Wadasak, 2018) and was fascinated by scientist's admissions that they did not know how certain systems worked (Helmstaedter, 2019). Their findings supported my argument that joining a scientific research team as a researcher from a different discipline was important, as it provided an opportunity to understand how scientists adapt, think and take risks. Throughout both events, I explained and demonstrated why an artist should be an integral part of a scientific team. I highlighted the importance of asking unconventional questions, testing imaginative visualisation techniques, and pursuing technological improvisation.

I was a new voice and presence at both events, able to navigate conversations and interact while not being a specialist. Validation came from being publicly introduced and acknowledged at both gatherings. At the opening of the Biomarkers conference, I described my position as a researcher within science, art and communication. At SCANDEM, I was the only non-scientific expert to present a twenty-minute research presentation. Fernandez-Rodriguez was ecstatic that guests asked me a few questions and that significant new contacts with scientists were established. Both events became key signs of the effective inclusion of artistic research into scientific research projects and conference events. Responses to questionnaires were limited, yet still enlightening. Scientists claimed a similar appreciation for observing colour and form through a microscope with a desire to design new scientific experiments, protocols and hypotheses. These respondents saw that artist-researcher acting as a conduit in their labs was an ideal channel for scientists to use as a form of reflection and as a method of dissemination, allowing their knowledge to be communicated to the public.

Stage four: reflection

In this final stage, the different data sets from all stages were analysed. Through reflection, I assessed the framework I created. I can confirm that working in a foreign laboratory as part of an international scientific team and being involved in the entire research process, followed by presenting my research at two international conferences, improved my research skills and was crucial to my project in the following ways. It brought my findings to the attention of international scientific institutes. My exhibits and talks influenced scientists' perceptions of their findings. It demonstrated that my framework and protocol could be used to break through divisions. Furthermore, I developed vital new relationships with potential collaborators.

Play, introduced as set out by my framework, extended our thought patterns, communication strategies and rules as follows: it facilitated non-standard discourse and helped redefine classifications and roles. Play as a disruptive concept extends subjective and objective knowledge between me as an artist-researcher, my collaborators and a scientific audience. Experiential learning enabled me to investigate underdeveloped technological advancements and contributed to my intellectual and visualisation skills. Working directly with biotechnology and microscopy specialists on a socially relevant project with direct industry links was valuable for the reasons I have explained. It is worth reiterating that conference attendees stated that they appreciated my contributions to biomedical research. My presence and approach gave these scientists a new perspective on art's capacity to disrupt their singular methods of working, advancing their and my assumptions of what art can achieve (Gadamer, 1998:19; 130). It emphasised the limitations of predetermined cultural expectations and encouraged the audience to interact with something different. My feedback from the audience indicated that this was a clear benefit, giving them an opportunity to widen their perspectives.

Distributing the research findings to audiences unfamiliar with art and science interdisciplinary collaboration surpassed my expectations and those of my collaborators. This paved the way for further new Art-Science collaborative opportunities by offering future models of best practices that can help break down silo mentalities (Groth et al., 2020: 16). Interaction helped us to cross-pollinate ideas without feeling obliged to produce identical outcomes. Testing play as a concept helped me comprehend the

significance of the creative instinct (Winnicott, 1994: 69–70). Introducing play as a way of thinking and comparing objective and subjective knowledge helped me, my collaborators, and this scientific audience to question empirical norms (Huizinga, 2016: 1). Scientists valued this approach and the framework I devised, as it allowed them to express their creativity beyond scientific conventions. The four-stage adaptable approach activated a feedback loop of reflective information, altering the behaviour of everyone involved and contributing to advancements in practice-based research, modes of representation and Art–Science interdisciplinary knowledge.

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