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LIFE, MATTER, POETRY: *BLURRED LINES* AND BILAYERED REPRESENTATIONS OF MATERIALS SCIENCE

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Abstract

This article charts the development of a collaboration between poet Dr Caitlin Stobie and scientist Dr Paul Beales, resulting from their partnership in the Leeds Creative Labs: Bragg Edition. The authors show their motivations for working together and the philosophical conversations that developed as they discussed artificial life, synthetic matter, and shared terms from the humanities and sciences. Initial plans for the project were challenged and delayed in 2020; the authors discuss how they adapted to digital collaboration and secured follow-on funding for further outputs, mapping new possibilities for public engagement with materials sciences during the COVID-19 pandemic. In particular, Stobie and Beales consider the layering of biophysical research images with experimental poems which aim to convey complex yet complementary concepts from philosophy, without distorting the underlying scientific data.

Leeds Creative Labs is a collaborative arts program that brings researchers from the University of Leeds together with creative professionals to encourage interdisciplinary play. Participants are paired together based on shared interests and asked to explore their ideas together without a specific brief. Unusually for a funded opportunity, there is no expectation for these collaborations to produce an output.

The edition of the Creative Labs that saw Caitlin and Paul paired together focused on creative partnerships with scientists from the University’s Bragg Center for Materials Research. The Bragg Center combines fundamental and applied research with the aim to discover, design and create new materials. An interesting feature of this collaboration was the combination of visual representations of research from materials science and the oral/aural nature of experimental poetry: a dichotomy that has proven advantageous on multiple fronts.

Motivations

The public perception of science can be that it is a precise and absolute undertaking. However, at the forefront of scientific research, the black and white certainty of scientific ideas blur into shades of gray and a great deal of creativity is required to push the boundaries of current knowledge. This playful sense of creativity is, of course, a well-recognized trait of the arts. Introducing freedom of creative thought into a scientific research environment has the potential to provide a disruptive influence that forces the research team to think and engage outside of the comfort of the prevailing intellectual framework of their field with the potential to unlock new, innovative ideas. This is one of the motivations for Paul’s involvement in the Creative Labs.

This is not Paul’s sole motivation. The creative arts open opportunities to engage sections of the general public that are difficult to reach with traditional science outreach. These are often groups that provide significant public funding for scientific research via their taxes, and the importance of societal trust in science has never been more prevalent than in the past two years. But the primary motivation is enjoyment, and this cannot be understated. In a busy academic work culture, it is vital that non-essential activities are a fun distraction from core business. Stepping outside the safe environment of one’s own discipline and being challenged by new ideas and viewpoints that lead to elegant creative outputs is extremely rewarding. We will return to these points later in the article.

In contrast to science, the arts and humanities are typically perceived as abstract and vague, particularly when a subject is rendered through poetic metaphor. Yet, as the publication schedule of

any successful novelist demonstrates, creative outputs require months --- if not years --- of methodological planning and research. The term ‘liberal arts’ is traditionally associated with a sense of freedom from formal constraint or scientific accuracy. However, many artworks are the result of hypothesizing how to communicate to an audience, and then testing this theory by performing an experiment. As Bern Mulvey has argued in the case of creative writing instruction, there is a ‘science’ to what is learnt and performed in the arts [1]. As a writer with thematic interests in bioethics, Caitlin is interested in contributing to creative-critical conversations about common methodologies from multiple disciplines.

Writing is an infamously solitary activity; unlike more embodied artforms, there are few opportunities for dialogue with other writers or potential audiences until the output is complete. Even if one actively participates in workshops or readings, there is a high probability that one’s work-in-progress would benefit from being exposed to a more diverse audience prior to publication. Caitlin’s participation in the Leeds Creative Labs is thus also motivated by the sense of organic inspiration that develops when interacting with fresh disciplinary and personal perspectives during collaborative arts projects. It is equally refreshing to work on a funded opportunity where neither one’s participation nor outputs are monitored. She felt comfortable taking risks by writing more experimental poetry, knowing that she could discuss the content and themes of the poems with Paul and his research group.

Both of us have been involved with creative partnerships in the past. Featured in a gallery exhibition titled *In the Open*, Caitlin’s collaboration *Read These Leaves* with artist Bethan Hughes explores animal studies, (dis)embodiment, and materiality and the digital [2]. Caitlin has also been involved with projects that discuss global legacies of modernist poetics, such as an experimental poetry event associated with the international conference *Beastly Modernisms* [3]. Paul, meanwhile, has worked with Jim Bond on artistically interpreting findings from the Beales Research Group about creating new membrane compartments in artificial cells [4], as well as with artist Julie Light on a public engagement project about the use of peptides on membranes in searches to develop new cancer treatments [5].

Process and Philosophy

A central theme to our discussions has been the blurred lines between living and non-living matter. It may surprise many that science has yet to provide a precise definition of what life is. NASA have proposed a broad definition of life as a “self-sustaining chemical system capable of Darwinian evolution” [6]. However, the benefits and limitations of this definition are widely acknowledged. An alternative approach might be a Turing test-like method to recognizing life, where the criterion would be based on whether a living cell interacts and communicates with the artificial cell as if it was also living [7]. This has implications when incorporating biomimetic properties into artificial cells, but also for ethical understandings of where life begins and ends. The ‘new materialism’ is a theoretical turn in philosophy that combines perspectives from the sciences and humanities, arguing that metaphysical questions about terms like agency must be approached by considering fundamental studies of ‘matter’. Many new materialists are interested in ethical questions surrounding everything nonhuman --- that is, not only animal life, but also vegetal bodies, minerals or manmade materials, and broader ecological systems that arguably display lifelike properties. These blurred lines form the fulcrum of our conversations, giving rise to the title of our collaborative project.

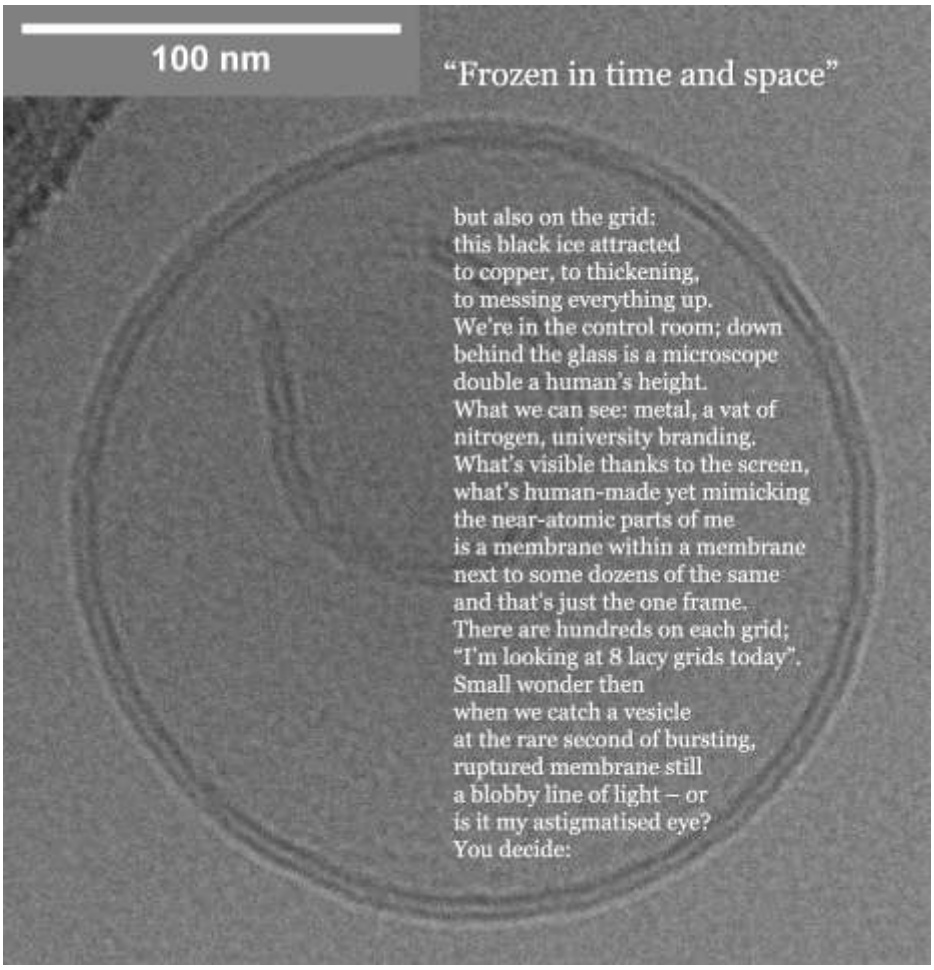

Fig. 1. Caitlin Stobie, “Frozen in time and space”, 2020. This poem responds to an unusual image of a vesicle within a vesicle. [Research image credit: Rashmi Seneviratne.]

Initially, we responded to bioethical issues in materials science through a mix of digital encounters and physical meetings, sharing research images online and through time in the lab. In January 2020, for example, Caitlin visited the lab to observe doctoral researcher Rashmi Seneviratne’s work with a cryo-electron microscope (see Fig. 1), examining frozen samples containing thousands of tiny artificial structures called vesicles [8]. At the same time, other members of the group were uploading images to a shared folder to illustrate the scale of their research. Paul regularly met with Caitlin to discuss the science behind the research images. Often, these meetings involved sharing two different approaches to one term or concept, like ‘intra-action’, a term which recurred in Caitlin’s doctoral research about representations of abortion in southern African fiction.

Coined by physicist-turned-critical-theorist Karen Barad, “intra-action” has strong synergy with the term “emergence”, where life can be considered as an emergent property of its chemistry [9]. Caitlin is interested in the interdisciplinary potential of such terms – but with a background in postcolonial studies, she is also wary of new materialism’s tendency to focus on white philosophers’ work, propagating the misconception that a focus on material reality is novel when various indigenous knowledge systems have been tackling such questions for decades. Zakiyyah Iman Jackson, for example, provides an inspirational critique of how ‘new’ materialist studies of somatic cellular processes may replicate racialized discourse of social processes: “the prison ‘cell,’ the political party ‘cell,’ and the military ‘cell’” [10]. While our collaboration does not actively discuss critical race theory, we found ourselves returning to similarly tricky questions about bioethics and language, particularly as global conversations arose early in the pandemic about whose lives matter, and in which contexts.

This revelation about different terms representing similar concepts shaped both the direction and form of our collaboration. Words were muddying the waters between our overlapping fields, but they also held the potential to create a shared lexicon, a conversation, between materials sciences and new materialism. Could a poem that argues against imposing pain in nonhuman animals be interposed with research images on developing nanopainkillers --- research that would, ultimately, require animal testing? Conversely, what would happen if photographs of separation in biomembranes were explained through a most human narrative of attachment and drifting apart?

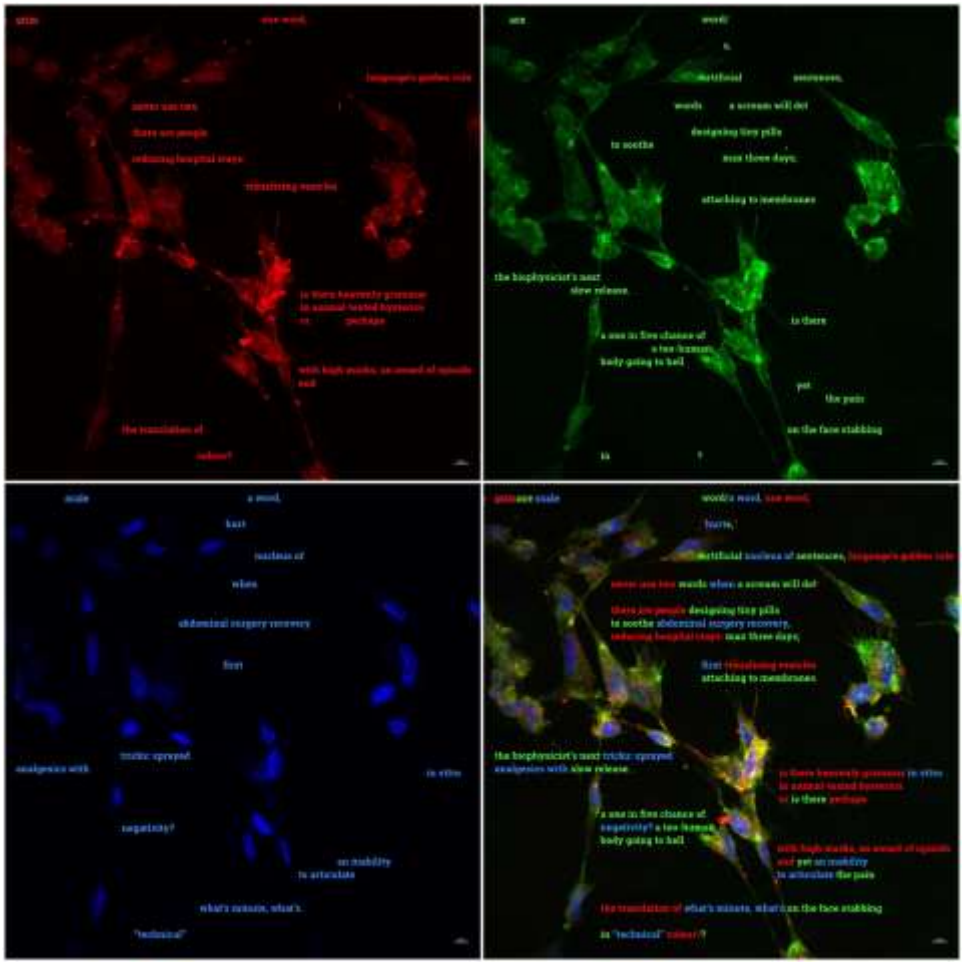

Fig. 2. Caitlin Stobie, “Grimace Scale”, 2020. This four-in-one poem responds to visuals where each segment of the cell is represented by a different color: vesicles are red, membranes are green, and nuclei are blue. Three experimental poems were written to mimic this process of breaking up an image, using words that explore the ethics of developing nano-painkillers. [Research images credit: Juan Martinez Ojeda.]

The combination of a literary art form with materials science provides a complementary alliance that allows both disciplines to present their best features in the creative outputs. Paul and Caitlin decided to combine images from the Beales Group research with Caitlin’s poems or short stories, thereby bringing original, visual data into the public domain with the literary arts, presenting a point of entry for the public to engage with broader questions surrounding the research. Perhaps ironically for a collaboration on materials science, the benefits of our *immaterial* conversation --- between images and words --- were only reinforced as we came to move our collaboration online

in 2020.

Change of Plans

After the initial share event in January 2020, we applied for follow-on funding for two activities: a poster presentation of the poems and research images at a local arts-science night at The Tetley pub, and a collaboration with a visual artist to project images and videos from our collaboration at Leeds Light Night, the UK’s largest annual festival of arts and light. Although our application was successful, it was clear by April that neither of these activities would be feasible.

Thanks to a grant from Arts Council England, Caitlin was able to continue meeting with Paul and producing poems digitally. We decided to turn our attentions to exploring the development of soft matter online with a website titled *Blurred Lines: Life, Matter, Poetry*, developed with support from the University of Leeds’s Center for Practice-led Research in the Arts (CePRA). This exhibition of our outputs is accessible to a much wider audience than initially planned; it allowed us to promote our growing collaboration throughout the pandemic in online research seminars, at digital poetry readings, and through social media.

While we have contrasted the immaterial nature of poetry with the material nature of artificial cells and biomedical materials , we increasingly came to feel that words, as well as research images, could be used for visual impact. The figure above provides an example of false coloring in multichannel fluorescence microscopy images being mimicked in the colored text of a poem (Fig. 2); below, lines of poetry are arranged to imitate the α-helical structure of a peptide (Fig. 3). Caitlin also explores the molecular scale structure of membranes (Fig. 4). The schematic representation of phospholipids, with their headgroup and two tails mirrored into the bilayer structure of the membrane, is emulated by the arrangement of the poem “Bilayer” (Fig. 5). These illustrations show how the poetic elements of the collaboration became increasingly experimental as we discussed how to convey the implications of research findings through both literary content and form.

It is important to stress once again that Caitlin’s background is in postcolonial literary studies.

Originally from South Africa, she was not merely inspired by the visual appearance of concrete poetry; as Greg Thomas observes, the development of this genre from the 1950s to 1970s followed ‘a broadly though not exclusively northern European and North American bent’ [11]. Given her literary-critical interests in the postcolonial legacies of Anglophone modernisms and southern African literature [12], during the creative process she was also preoccupied by how the poetry would be read both aloud and on the page. This is, once again, where both the materiality of the research and the immateriality of words produced an interesting – but not merely binarized – contrast.

The bilayer soon became a central tool in our creative methodology. It symbolizes several two-pronged concepts that recurred in our discussions, such as the relationships between: signifier and signified; written and spoken poetry; abstract and representational art; and terms from the fields of philosophy and biophysics. Stobie’s task was to write poetry that could be superimposed on the original scientific research – which, in turn, is composed of “layers” of color and light. At the same time, the chosen words would have to tell an accurate story about the science if read aloud at live events or in video recordings. This brings original data into the public domain, which is in contrast to many art-science collaborations that use a physical artform such as sculpture to present a creative interpretation of scientific concepts. Our very outputs are thus bilayered, encompassing multiple connotations beyond the level of a biological membrane.

Engaging the Public through Art

We discovered there were several layers to the question of ethics too. Initially, Caitlin was interested in how nonhuman bodies and pain feature in the development of research with medical applications --- as communicated by the poem “Grimace Scale”, which focuses on Juan Martinez Ojeda’s work on developing experimental painkillers for abdominal surgery recovery (Fig. 2). Yet conversations with Paul revealed that another significant ethical challenge lay in communicating potential medical developments to the public. For example, the poem “Polybia-MP1” focuses on a peptide in wasp venom that displays anticancer properties (Fig. 3) [13]; some journalistic articles on these findings have resulted in miscommunication with members of the public, who are led to believe that new drugs are close to clinical application, where the research is still

at an early stage of development [14]. There are thus concerns about not only the ethics of conducting research on artificial cells and biomedical material technologies, but also about communicating preliminary findings in a responsible way.

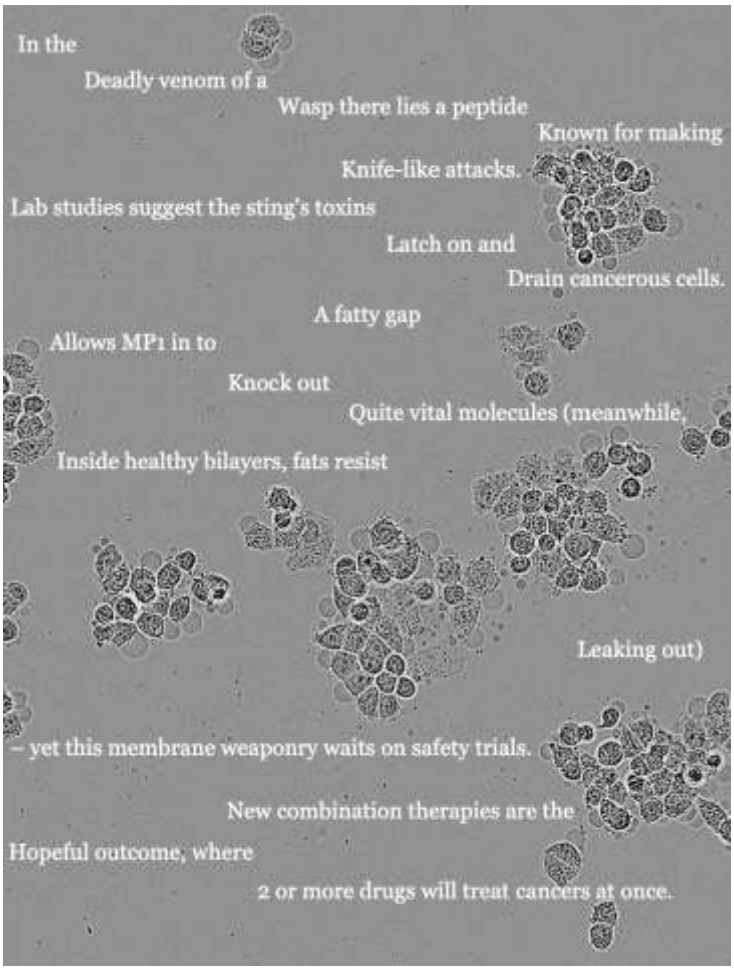

Fig. 3. Caitlin Stobie, “Polybia-MP1”, 2020. Polybia-MP1 (IDWKKLLDAAKQIL-NH2) is a peptide extracted from the Brazilian wasp *Polybia paulista* that has been shown to attack the membranes of both bacteria and cancer cells. Each new line of the poem starts with a letter from the peptide sequence, and its coiled structure mimics a chain of amino acids. [Research image credit: Dagmara Kobza-Mroczkowska.]

Engaging the broader public with science can be challenging. While a subset of the population engages with traditional science outreach, many have a preconception that science is difficult and

not for them. The creative arts can break down these barriers as people are generally more comfortable with forming their own thoughts and perceptions in response to art. An amalgamation of science and art therefore provides the public with a relatable entry point into the science and establishes a platform for them to further engage. This platform should create interesting and varied dialogues which are led by the public and their interests and scientific understanding.

The fun, playful elements of art-science engagement extract scientists from their usual points of reference; conversely, artists are exposed to a new world of research and data that may serve as fresh inspiration. The artistic partner may find that their creative practice starts to shift in response to both their collaborator’s research methods, and public perception of the outputs. This is particularly true when the majority of the outputs are published online and are thus easily accessible to a range of demographics. For example, our presentations have led to engagement by audiences from Canada to France, with participants based in the arts, sciences, or outside academia (particularly at University of Leeds alumni events). We also use Twitter and Instagram to share our outputs, particularly when they are published in online experimental journals, which encourages engagement by younger audiences.

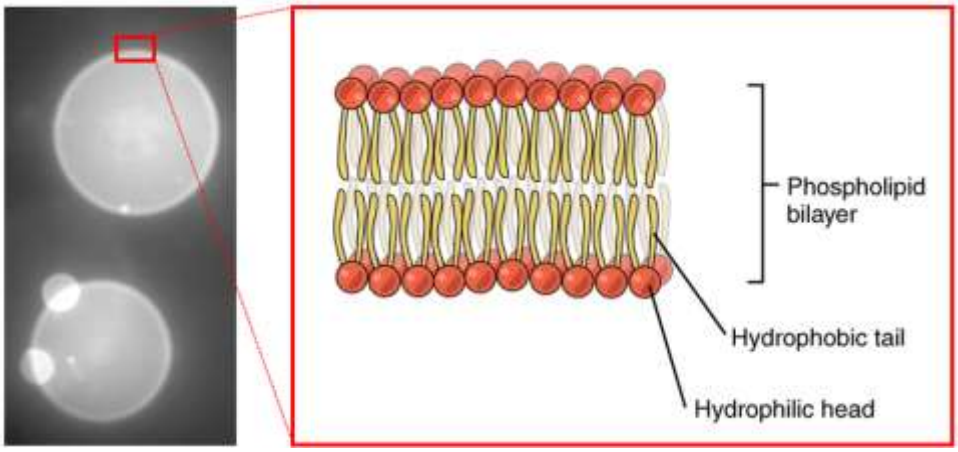

Fig. 4. Fluorescence microscopy image of giant phospholipid vesicles and a cartoon representation of a lipid bilayer membrane illustrating the back-to-back assembly of phospholipid molecules in two layers, symmetric about the mid-plane of the membrane. [Adapted from https://cnx.org/contents/FPtK1zmh@8.108:q2X995E3@12/The-Cell-Membrane © OpenStax Anatomy and Physiology. Source: Wikimedia Commons.]

Fig. 5. Caitlin Stobie, “Bilayer”, 2020. Taking the development of artificial cells as its point of departure, this poem is written over a research image of giant unilamellar vesicles (GUVs). It experiments with mirroring words to mimic the molecular scale structure of the lipid bilayer, a continuous barrier found in all cells. [Research image credit: Andrew Booth.]

Outlook

Fiona Johnstone notes in a recent report on projects involving artists and academics in the medical humanities that creative partners report several benefits to collaboration: there may be intellectual and/or methodological value, an improvement of one’s practice, or access to new people or settings [15]. It is important to note here that Johnstone makes a distinction between ‘commission’ and ‘collaboration’, arguing that the former is characterized by a set fee and time-frame for

a response to research, whereas the latter involves a more open-ended process of exploratory dialogue between artists and researchers [16]. The Leeds Creative Labs defy these categorical boundaries on several levels. Firstly, the artist is paid for their time, but this ‘commission’ is not dependent on any output. Secondly, while an artist is initially contracted for a pre-defined period, there are various opportunities for follow-on funding, encouraging exploration and play throughout --- and after --- the initial commission period. Thirdly, and perhaps most importantly, the collaborations are neither described as artist-researcher nor scientist-researcher-led. This allows for respectful communication between disciplinary perspectives, helping both partners to achieve their goals through the outputs.

While one of our main goals was public engagement with science through literary arts, we also wanted to foreground literary experimentation with interdisciplinary methodologies. As two researchers situated between multiple research areas in our respective fields, we are aware of the often arbitrary demarcations between disciplines; in a sense, then, our collaboration highlights the artificial nature of academic boundaries, in addition to the blurred lines between living and nonliving matter. A broader interdisciplinarity such as what has arisen in our collaboration may serve both the arts and sciences by informing education and pedagogy: for example, Caitlin has used *Blurred Lines* as a case study in creative writing lectures with students who have backgrounds in both the humanities and sciences. Interdisciplinarity also promotes creativity in research culture and scientific approaches in the arts.

Earlier in this article we challenged some stereotypical associations surrounding the sciences and arts/humanities, arguing that there are elements of both structure and creativity in our respective disciplines. Following this logic, and considering Johnstone’s categorizations of different collaborative modes, it appears that an arts-science collaboration program requires both precision and openness, or a balance between defined parameters and intellectual/artistic freedom. As one example from many successful pairings, we have welcomed the balance between a methodological structure arising from similar research interests (as defined by the overall theme of the Bragg Research Center), and creative freedom in terms of outputs. It has also been rewarding to work as part of a ‘cohort’ of pairings, as we were given access to work on similar projects --- another unique element of the Creative Labs.

With the ongoing development of the National Poetry Center in Leeds, it is clear that the humanities, and particularly the literary arts, have an important role to play in creating research impact. The website from our collaboration is just one example of how words --- those most immaterial artforms --- may be used to engage the public with developments in material research as researchers continue working remotely [17]. With the removal of COVID-19 restrictions in the UK, we were able to finally showcase our collaboration at Leeds Light Night in 2021, fulfilling one of our initial goals. Moving forward, we are excited to engage a wider audience both through in-person events and social/online media, such as the recent publication of a short story in an online edition of *ZenoMagazine* [18].

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