A Mirror of Flesh: An Exploration of Materiality in Living Bioengineered Art

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Abstract

Living works of bioart force an encounter with the visceral, ethical and embodied actualities of bioengineering, through the liminal form of the non-human art subject. Intertwining and intentionally confounding traditional dualisms of self/other, living/non-living and subject/object, bioart challenges perceptions of living matter and human relationships with other forms of life. Using a pluralistic approach, this thesis comprises of a descriptive, theoretical and aesthetic exploration of bioart, which includes consideration of facture, uses and application of biotechnological tools and processes in art construction, and the visual forms of living bioart works, in addition to theoretical engagements with posthumanism, ethics and new materialism. Furthermore, aesthetic notions of the abject and the uncanny, together with understandings of the phenomenological art encounter are explored alongside these theoretical considerations.

This research suggests that the use of living materials and tools of biotechnology by artists is a purposeful act which intentionally challenges and critiques contemporary genetic manipulation and uses of living materials. This critique is enabled through the visual, material form of bioart, which appears to inhabit a new uncanny valley; producing a sense of eeriness and a conflation of familiarity and unfamiliarity enabled through living materiality, bioart places the viewer in a unique position of perceiving the artworks simultaneously as of the self and other, thus enabling both critical and emotive perspectives. It would appear that this act of transposing living matter into the role of art media can be perceived as being a transgressive act, thus exposing a cultural double-standard whereby the artist is publicly scrutinised in ways that bioscientists are not, despite using the same materials and processes. This, in turn, appears to be an important aspect of bioart practices as it offers new perspectives for critique of extant practices by disrupting the expectations of both scientific materials and what art should or can be. Bioart offers a platform for discussing these questions and for facilitating an encounter with

ideas and technologies that are often hidden or packaged palatably. Bioart is, therefore, a confrontation with the values and processes of the Anthropocene, bringing the viewer face-to-face with the impressive yet accelerating power of current technological capabilities.

For my grandparents, David. J and Karen S. R. Johnstone,
and for Polly

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Introduction

This thesis explores the materials of living bioengineered art. These materials are at once both familiar and foreign. Made from animals, tissues or cells, these works can also be made from human flesh, but having been removed from the body these biological components have become malleable materials for art practices. Bioart is an emerging practice that has seen artists appropriate the materials and processes of biotechnologies, repurposing them as art media. These technologies are concerned with improving biological structures, adding to them, removing from them, and reimagining their natural form. Used by artists, biotechnologies have become the material and conceptual basis for a new form of cultural exploration and critique. Bioart is not only a sign but a reflection of a cultural shift where knowledge has enabled the human to move beyond the limitations of nature, consequently forcing a reassessment of contemporary ideas of natural and artificial and living and non-living.

Contributing to current critical discussions of bioart through detailed exploration and analysis of the materials, processes and understanding of the practice, this research contributes to the current gap in the literature by both addressing the issues of definition and offering a concise study on a specific type of material-based bioart. In paying attention to this, this research aims to understand how and why artists are using these materials as art media and the consequences and effects of doing so.

The Anthropocene

The twenty-first century is a time of profound technological change. These changes are occurring at a rate that continues to accelerate exponentially, evident in the continual release of new consumerist technologies. More recently, this acceleration of technological developments is apparent in the production of multiple potential vaccines after the outbreak of

the Covid-19 pandemic. The first outbreak of the bubonic plague in the fourteenth century, before the development of modern science, lasted around four years, killing a quarter of the population of Europe, and approximately 25 million people across Asia and Africa (Frith, 2012). Today, modern science has offered several vaccines for SARS-Cov-2 in less than a year, whereas previously, a vaccine has not been produced in under five years (Davis, 2020). These technologies are beneficial to public health, populations and agricultural production, however, they also raise questions about human relationships with nature, the environment, and our own bodies.

Historically, human populations have produced technologies ever since we have been able to access materials and craft tools to alter and improve the suitability of the environment for agriculture and for human health. Periods of human history are now often referred to using these materials: the stone age, the bronze age, the iron age. The current epoch of time we are living in is often referred to as the Anthropocene, so named as it reflects the human-centric nature of many human/environment interactions and relationships towards the environment and its lifeforms. The notion of the Anthropocene is, however, not uncontested with some suggesting that the term is unofficial, ambiguous and that the timeframe of human impact is not significant enough at this point to signal a newly defined epoch (Demos, 2017). Despite this lack of consensus, the term is often used to describe the current "multi-layered posthuman predicament that includes the environmental, socio-economic, and affective and psychic dimensions of our ecologies of belonging" (Braidotti, 2018, p.32). While the Anthropocene reflects the impact of human behaviours on the Earth, this does not necessarily refer to it as being a positive impact, but one which has led to the development of a posthuman rhetoric; a movement intended to shift the focus away from a narrow field of human-centric values, to a broader acceptance, care towards and respect of life beyond the limited traditional configuration of the human.

The technologies of the Anthropocene are vast, ranging from the built environment and transport, industry to information and communication, and biotechnologies. These technologies have provided us with global connectivity, the Internet, intensive food and commodities production and medicine. Biotechnologies are the tools of the Anthropocene and are routinely produced and used daily, infiltrating human life in many different ways; the drugs and pharmaceuticals we consume, medical processes and treatments, and the crops and animals produced for consumption are all products of bioengineering. It is this subliminal omnipresence of biotechnologies which have altered fundamental human relationships with nature that, therefore, challenges what we understand as being natural in the twenty-first century. Nature, as a term, is itself a complex and problematic concept that has been created by and for humans that serves to separate humans from the rest of the ecological system we exist within (Jiménez de Cisneros, 2016). Therefore, when understanding ideas of the natural aspect of bioart and bioengineering, the natural and artificial are not clearly defined concepts, but categories attributed to different aspects of the interconnected ecological network of the planet. Consequently, bioengineering can be understood as the application of modification technologies to living materials; there are many different methods of modifying biological matter as will become apparent in this thesis, however, as new technologies develop, the limitations of possibilities are further eliminated. This increasing plasticity of living matter has seen it become art material for exploration, construction, and critique.

Living Matter to Living Materiality

Living materials and living organisms as materials, whether for scientific research or art production, pose significant ethical, moral, logistical, practical and legislative issues. Contemporary bioengineering practices see living materials grown from cells, genetic modification of living plants and animals, the merging of genetic materials of more than one

species, and bodily modifications of the human. Many questions emerge regarding the different types of living materials used for bioengineering practices, in addition to how these materials are acquired or grown. Furthermore, issues such as whether there is a perceived difference between human material, as opposed to the manipulation and growth of animal materials, bacteria and other microscopic materials and plant materials, is an essential consideration for such practices. The explicit manipulation of living materials using biotechnologies requires a society that is complicit or ignorant of it to allow life to be altered, used, and commodified. The use of living materials as art mirrors or parodies uses of living materials as scientific materials. In many ways, bioart increases the visibility of using living materials and asks how far this should go.

Bioengineering, therefore, reveals many questions that extend beyond the scientific process and into the values and standards of the cultures that practice, allow and accept it. The dilemmas that biotechnologies can evoke have, however, already been addressed directly and indirectly in fiction. Ursula K. Le Guin's, 1973 short story, *The Ones Who Walk Away From Omelas*, tells of a utopia in which there is perfect happiness, however, this happiness is dependent on the suffering of a single child. Residents of the town are told about the suffering of the child when they are old enough to understand, and the majority of the residents choose to accept the suffering in order for them to continue to live in their utopia. In this way, the acceptance of biotechnologies that cause harm or suffering to animals in our current societies, while controversial, is ultimately accepted and legislated in many countries for human benefit.

Similarly, Kazuo Ishiguro's 2005 novel, *Never Let Me Go* tells of a dystopian reality where human clones are grown and raised for their organs to be harvested and transplanted into others, resulting in a short life for the clones. In the novel, the use of clones for transplants is generally accepted by both the wider population and the clones themselves. Most famously perhaps amongst literature which is closely associated with the biotechnologies is Mary

Shelley's, *Frankenstein*, 1919; the story of a young scientist with ambitions to discover the spark of life, creating his own living 'creature' from an assemblage of dead materials, only to later reject his creation as a 'monster'. As such, these fictional scenarios reflect the existential anxieties that emerge alongside the production and implementation of new technologies, which challenge existing structures of the human and how it can change when the substances of our own bodies become materiality.

It is this juxtaposition of anxiety amidst 'progress' that has manifested in the emergence of bioart, a practice that appears to play on these coexisting tensions within the uncertainty of the effects of current scientific endeavours. By using and recontextualising these living materials and bioengineering processes, bioart appears to provoke, question, and expose the technologies currently being developed and interrogates how these technologies affect us both cognitively and emotionally. In bioart, traditional dualisms of art/science, living/non-living, natural/artificial and subject/object are blurred, suggesting that these works offer multiple levels of ambiguity. In order to understand, contextualise and theorise the ways in which encountering living biotechnologies make us feel, and to what ends, the exploration of living materials in this thesis takes a pluralistic approach which considers multiple aspects of bioart thus providing a thorough and complex picture and engagement with bioart. This approach includes the descriptive, theoretical and aesthetic considerations of bioart together with the uses of living bioengineered materials as an artistic medium. The initial component of this approach focuses on the descriptive elements of bioart, which includes the facture of bioart works and the materials they are constructed from, in addition to the biotechnological tools that are used in the construction processes. This attention to describing the artworks is essential for later theoretical explorations in understanding the purposes, aims and wider socio-cultural engagements of bioart works and bioartists. Furthermore, by detailing how works are constructed, what they are constructed from and how artists are engaging with specific tools of

biotechnology, this provides a detailed orientation for the later discussions of the theoretical and aesthetic properties of bioart.

The second component of this methodological approach is, therefore, theoretical in nature and, as such, considers the theoretical engagements of bioart, how these perspectives can assist in understanding the effects of bioart, together with its ambiguous moral, ethical and categorical status. This theoretical exploration of bioart includes discussions on posthumanism, ethics, considerations of materiality including new materialism, approaching materiality and the ways in which bioart challenges and highlights material and ethical understandings of biotechnological practices; together with art practices situating bioart in a broader context and the connection of this practice to wider contemporary perspectives.

The final component of this approach focuses on aesthetic considerations of bioart works, including theoretical frameworks prominent within visual culture, consisting of the abject, the uncanny and monstrosity, together with an exploration and analysis of how works appear and how they are presented to audiences, thus offering insight into how these visual aspects of bioart can effect interpretation and subjective phenomenological understandings through the art encounter. As such, this pluralistic methodology provides a multifaceted and broad-ranging platform for the exploration of bioart and the role, effectivity and understanding of materiality in living works of bioengineered art.

An essential aim of this research is to understand what is meant by the use of the term bioart. Many of the works that this thesis will explore have been described using the term, however, what will become apparent is the broad range of different materials, processes, forms, implications and conceptual ideas in these works. Therefore, exploration of the term, its origin and what is intended to be included and what it refers to is ambiguous and the use of it unclear; consequently, a clearer understanding of what is meant by the term may reveal news ways in

which these works can be connected and what they might collaboratively contribute to new understandings of materiality.

The works of art selected as the focus for this research share material and critical similarities and include some of the most well-known and well-documented instances of bioart produced by the founding artists of the contemporary practice. The primary material of focus in this thesis is tissue culture; living material grown from the cells and genetic materials of humans and animals. There is, however, some variation in materials used for the works examined in order to reflect and include the founding works of the genre, including living animals and bacteria. Selected works also include some of the most recent examples of bioart to be exhibited, which I was able to view as a means of considering both the encounter with materiality personally and observe the ways in which bioart works are displayed. This, therefore, presents a broad scope of works spanning the recent history of the genre and provides a comprehensive indication of the bioart works that have been created and for analysis of the use of living materials in art practices.

In following this methodology, the primary objective of this research is to understand the complexities of living materiality in bioengineered art and how these materials can be understood through the art encounter; this includes considerations of how understandings of these living materials might change through the unexpected transposition from scientific practices into an art context. Furthermore, this research aims to understand how and why artists might choose to use these materials, the processes of construction, and what effects these may produce. This includes understanding accessibility to the materials and processes of bioengineering for artists and their motivations in doing so, as well as understanding how living materials may impact how and where such artworks are displayed.

Thesis Structure

The first chapter of this thesis considers bioart as a practice and how it has been treated in the existing literature. This includes exploring different definitions of bioart that have been presented to date, with perspectives from scholarly sources as well as from artists involved in the practice. The chapter also examines how living materials have been used in biotechnologies, both historically and in current practices. Ethical and political implications of these practices, and the use of living materials as new media art, are also addressed here.

The second chapter reflects on the theoretical considerations of matter and materiality; this includes a detailed examination of life as a material and concepts that concern the interrelationships of materials. An account of posthumanist philosophy and its connections to both the Anthropocene and to bioart practices is provided with particular reference to the works of Rosi Braidotti as a key theorist of posthumanism. This also includes subsidiary concepts that fall under the umbrella of posthumanism, including critical posthumanism and transhumanism and how these theoretical considerations can contextualise bioart works within the changing ideas of what the human is and is in the process of becoming. These could be characterised as the humanities' critical responses to scientific positivism. This chapter engages with the concept of the abject in relation to materiality and explores how Julia Kristeva's theory of the abject can explain negative reactions to the visceral materials of bioart works. Furthermore, this chapter explores Masahiro Mori's phenomenon of the uncanny valley in response to stimuli that are situated in liminal spaces between the familiar and the unfamiliar or the self and the other and how this can assist with understanding the categorical conflations present in bioart works.

The third chapter examines specific works of bioart and is divided into two parts. Part One comprises of in-depth descriptions of bioart works, including their visual appearance, their materials, how they have been made and any motivations that informed their construction. This

part will also provide contextual information about the oeuvre of each of the artists, as many of them are responsible for more than one work. The works have been selected according to their materiality in order to provide a cohesive and nuanced discussion of the range of living tissue bioart works produced to date. The second part of Chapter Three then focuses on various responses to these works of art. This includes the responses by viewers, critics, and scholars, as well as the artists themselves. The responses are discussed according to two central yet connected themes; the expectations of art and of science as separate cultural categories and the ethical problems of manipulating living matter for art purposes.

The fourth chapter is the first of two discussion chapters. This chapter analyses bioart as a window to bioengineering practices and what this can reveal about ourselves and the societies we live in. This is achieved through the exploration of how bioart can affect the viewer as a result of its materiality. This chapter addresses the effects of the viewer's encounter with living bioart as mediated by the materiality, in addition to an examination of bioart responses based on materiality, including abjection of materiality and living bioart as a continuum of the uncanny valley phenomena to stimuli. This chapter considers how responses to bioart, both by visitors and criticism, can be understood through psychological processes that are enabled through the subjective phenomenology of encountering the living works.

Chapter Five draws upon the findings of the previous chapter to explore the criticisms of bioart in a broader socio-cultural context. This includes connecting the visitor experience and responses to living bioart to the phenomenon of the 'yuck' factor in biotechnological practices; an effect similar to abjection, which is used to describe public aversions to certain new technologies that are associated with threats of contamination or evoke disgust. The role of institutional bioethics is also considered in relation to accessibility and control over bioengineering practices, including how a prospective bioethics for art practices might emerge. The relationship between subjective, embodied experience to ethical conduct is considered, as

well as the ways in which posthumanist perspectives contest the positivism of institutional bioethics.

Together, this thesis uncovers the ways in which bioart offers a critical reflection of our current technological practices and their impacts within the Anthropocene. Using and transforming living matter into art materials, bioartists appear to draw attention to our values and our ethical standpoints regarding bioengineering practices that we are becoming increasingly dependent upon. Through the exploration of bioart, its materials and processes, this thesis, therefore, reveals how this new, unexpected art encounter can both complicate our perceptions of life and simultaneously suggests new considerations for how we live, what we value, and our relationships with other forms of life.

Chapter One

Bioart: A Contextual Background

Bioart is a relatively recent emergence in contemporary art with a short yet diverse history of utilising life and living structures as artistic material. Predominantly located in the twenty-first century, the biological arts have few precursors before this time and instead have developed alongside the production of contemporary biotechnologies. Despite the recent expansion of the field, with complex artistic and biological engagements emerging across the world, bioart remains a relatively obscure genre; this is in part due to a plethora of legislative and ethical issues that manifest from it, and as a result of its very existence transgressing the norms and expectations of both art and science. Bioart is, therefore, a liminal art form, created through a purposeful transgression of traditional boundaries, problematising binaries of art/science, natural/manufactured, living/non-living and object/subject. At the threshold of these boundaries, biological artworks force an encounter with contemporary biotechnology through the use of these technologies as their materiality and processes.

Consequently, these works provoke contemplation on our perceptions and values of life, both human and non-human, as well as our relationship to these other forms of life in an age of pervasive biotechnologies. This chapter aims to understand what bioart is through the assessment of existing literature and consideration of current debates regarding definitions of bioart. Furthermore, consideration will be given to how the term bioart is used and by whom, together with a background to the origin of this term and historical examples of similar works. As bioart is a practice based on biotechnologies, this chapter will also explore exactly what biotechnologies are, how they are used, and the ethical and legal implications of their usage.

1.1 Contemporary Art and Biotechnology

1.1.1 Precursors to Bioart

There are a multitude of reference points to understanding the emergence and history of bioart and are found in the artistic uses of biotechnologies and biological materials, in the history of monsters and monstrosity, as well as in the twenty-first century through surrealism. While there are limited examples of material-based bioart before the 1990s, the interconnectivity of art and the natural sciences do have a small number of precursors, particularly during the Renaissance in the works of Leonardo.[1] During the nineteenth century, however, the arts and sciences suffered from a cultural divide, primarily stemming from the development of separated institutions such as science museums and art museums, as the result of an attempt to define each separately (Else, 2010). This division is famously noted by C. P. Snow in *The Rede Lecture* of 1959 in which he states that cultural forces had created "two groups – comparable in intelligence, identical in race, not grossly different in social origin, earning about the same incomes, who had almost ceased to communicate at all" (2008, p.1). It is from this analysis that Snow coined the phrase 'the two cultures' in describing an apparent cultural division between artists and scientists.

Following Snow's lecture, the second half of the twentieth century witnessed increasing attempts to reunite the two cultures, most notably through incorporating scientific technologies and ideas into art practices. This has been apparent across the scientific disciplines, from astronomy and mathematics to ecology and engineering being incorporated into contemporary art practices, with both artists and scientists instigating processes of collaboration and interchange. Some of these collaborations appear simplistic, only transferring subject matter from one field to the other, however, others have demonstrated processes of complex

[1] Historically art and science have not been as clearly divided as they have been since the nineteenth century (Whelan, 2009), with artists such as Leonardo contributing important innovations to both subjects equally, demonstrated by a dispute between the National Gallery and the Royal Collection, regarding whether a selection of Leonardo's anatomical drawings should be displayed in the science collection or the art collection (Jones, 2012).

fundamental interchange in which outcomes appear both works of art and scientific experimentation simultaneously.[2] Complex collaborations between the visual arts and bioengineering are, however, a significantly more recent and obscure phenomenon than other fields of science and have primarily emerged from the 1990s onwards due to the rapid expansion of biotechnological capabilities during this time.

The origins of bioart are situated in the expansion of biotechnologies and the subsequent ability to control and manipulate life at the turn of the twentieth century, with the "emergence of biotechnologically oriented industrial methods of plant and animal farming and production" (Mitchell, 2010, p.35). Such new technologies have allowed for greater control over the genetic properties and behaviours of living material, "radically reconstructing relations between politics and nature, and allowing for a reassessment of how we look at life today" (Pandilovski, 2017, p.141). These technologies were appropriated in the 1930s by Edward Steichen, whose works are considered to be among the first examples of an artist using biotechnologies in their practice (Stracey, 2009). Steichen was a plant breeder in addition to being a photographer and utilised plant hybridisation techniques to grow mutated delphiniums. These flowers were artificially coloured blue by Steichen through bathing the seeds in colchicine. In 1936 the Museum of Modern Art (MoMA) in New York held its only ever flower exhibition specifically for Steichen to display his delphiniums [Figure 1.1] (Hartmann, 2011). This work was considered successful not only in its art context but also for the developments Steichen contributed to agriculture through his production of new hybrid plants.

A second notable figure in the history of biological materials used for art purposes is Alexander Fleming, the Scottish physician known for his discovery of Penicillin. Aside from his scientific investigations, Fleming was a keen painter and a member of the Chelsea Arts

[2] This level of interchange between art and science can be found exploring a wide number of scientific fields, including chemistry, biology, ecology, physics and computer sciences, and can also be found in the cosmographical works of Katie Paterson's *All the Dead Stars* (2009), Ruth Watson's *Between Light and Dark Matters* (2005), and Karel Nel's *The Collapse of Time* (2008).

Club before he combined his two interests in the laboratory. In 1933, Fleming created a series of 'germ paintings' using bacteria incubated on culture-soaked paper (Stracey, 2009). Using bacteria pigmented with colour, Fleming painted a range of scenes, including ballerinas, soldiers, and stick figures [Figure 1.2], by inoculating areas of an agar filled petri dish using a wire tool (Dunn, 2010). The germ paintings were only temporary as the bacteria eventually grew obscuring the initial design, therefore "the lines between, say, a hat and a face were blurred; so too were the lines between art and science" (Dunn, 2010, para.4). It remains largely unknown why Fleming decided to produce these paintings with bacteria, however, these works are some of the first known living works of art and among the first predecessors to contemporary bioart.[3]

A further reference point for bioart is found in the long-held interest in monstrosity, often located in the context of change, transformation or category conflations. Monster "is a flexible, multiuse concept" which "has evolved to become a moral term in addition to a biological and theological term" (Asma, 2009, p.7). Furthermore, monsters are beings that "resist a fixed state or assimilation within existing systems of knowledge; they are interstitial, things of in-between identity" (Alder, 2017, p.1085). The idea of the monster is, however, a creation and often a marginalisation that is culturally created, and frequently carries negative connotations and is most often used to describe transgressions of biology, anatomy, or social behaviours, this is because "monsters terrify us, in part, because they are ontologically confusing – because they seem to exist in a non-relation to other living beings" (Danta, 2012, p.698). Monsters have existed throughout human history, some real and others imagined, yet have existed across all cultures and include "demons, dragons, ghosts, wrathful Buddhas, and supernatural animals [who] occupy the theology, folklore, and daily rituals of religious cultures around the globe"

[3] Bacterial paintings have continued to be produced, particularly by scientists, with the American Society for Microbiology hosting an annual Agar Art competition since 2015 (Bowerman, 2015). Works have included reproductions of paintings such as Vincent van Gogh's, *The Starry Night* (1889) and Edvard Munch's, *The Scream* (1893), in addition to scenes of landscapes, animals and portraits.

(Asma, 2009, p.14). While there are multiple uses and associations with the use of 'monster', the term itself

> derives from the Latin word monstrum, which in turn derives from the root monere (to warn). To be a monster is to be an omen. Sometimes the monster is a display of God's wrath, a portent of the future, a symbol of moral virtue or vice, or an accident of nature. The monster is more than an odious creature of the imagination; it is a kind of cultural category, employed in domains as diverse as religion, biology, literature, and politics (Asma, 2009, p.13).

As a warning, the figure of the monster exists in opposition to normative, expected and moral standards of a culture. For this reason, monsters are often transgressive and constructed from the fears and anxieties of the cultures they exist in. However, not all monsters exist exclusively within these boundaries of negative connotations, omens or transgression, and can be exemplified by dragons, which, in Chinese culture, are revered and celebrated as figures of national identity (Asma, 2009). This variation suggests that monstrosity is not a static concept, but it is one that is diverse and exposes many different forms of monstrosity; these include culturally dependent monsters and pancultural monsters, behavioural monstrosity and monstrous acts, monsters of variable moral alignments and the space for new ideas of the monstrous to develop. It is this understanding of monstrosity that is apparent in practices of bioart, that is a perceived monstrosity of the new and the othered living art subject and the consequential act of objectifying life; an othering that emerges through the technological manipulation of living matter for art construction, thus altering both the biological structures of matter and the subjectivity of the material as it becomes an art object.

Interest in the changeability and transformation of biological structures can be found throughout the history of art and literature, with Ovid's *Metamorphoses* being a prime example of this. The *Metamorphoses* detail more than 250 myths that engage in themes of transformation and change. These include changes from human to animal and plants, animals to human, and inanimate matter to human. The changing compositions of living and non-living matter suggest both the malleability of life and the transgressive act of moving from one type

of living matter to another. Book ten of Ovid's poem tells the story of *Pygmalion* who fell in love with the ivory statue he had sculpted, and upon prayer to Aphrodite that he might marry a woman who looked like the sculpture, the goddess brought the ivory woman to life. However, also in book ten, Ovid describes a transformation that, instead of giving life, reduces it. Following an incestuous relationship with her father, Myrrah, the mother of Adonis, was transformed from a woman into a myrrh tree, where her tears became the fragrant sap of the tree. These transformations demonstrate morphological changes between different bodies, species and forms of life and matter. Mirroring this transition between different types of life and the transformation of different forms of living matter, the materiality of bioart works are often situated between the living and non-living and between different species. The uncertain and fluctuating categorisation of the materials of bioart can, therefore, be historically connected to the changing biological compositions and life status of figures in the *Metamorphoses*.

While Ovid's writings are based on mythology rather than real physiological transformations of living subjects, interest in atypical, abnormal, or anomalous bodies as transformed or different examples of the normative expectations of the human body endured throughout history. During the medieval period, individuals born with physical abnormalities were regarded as divine warnings and omens (Durbach, 2010, p.2), which follows the meaning of the term monstrous to signify a warning. Ideas of the monstrous during this period continued to be associated with these sentiments until they became a subject of fascination and intrigue later in the sixteenth and seventeenth centuries. However, during this early period, "representations of monstrous bodies, rather than the physical bodies themselves, circulated freely within and beyond Europe in the print culture that witnessed an explosion in the early modern period" (Durbach, 2010, p.2). Monsters and beasts were consequently catalogued in manuscripts known as bestiaries. While bestiaries began in antiquity, it was between the twelfth and fourteenth centuries that they rose to prominence (Morrison & Grollemond, 2019).

Bestiaries documented and illustrated both real and imaginary creatures "showcasing natural history and a succession of animals that appeared real but unreal, preposterous yet frightening, or sometimes even whimsical. Their origins were steeped in the literature and mythology of many countries and cultures" (Candy, 2020, p.236). Including animals such as unicorns and gryphons, imaginary beasts often took the form of assemblages; several different animals combined to create new, unnatural and imagined creatures. As will become apparent in practices of bioart, assemblages comprising of living materials from different species is a central feature of many bioart works. In this way, many living works of bioart resemble the monstrous and imaginary assemblages found in historic bestiaries.

Following colonial expansion between the seventeenth and twentieth centuries, ideas of monsters and monstrosity moved from the literary and imaginary to the real through the advent of freak shows (Krishnan, 2014). Human bodies are not uniform, and "extraordinary bodies have been cause for both anxiety and worship" (Fordham, 2007, p.210). Living individuals with rare, unusual, or atypical biological or physiological features or disabilities have historically been transformed from subjects to objects of curiosity, amusement and rejection through the frame of freak shows. Freak shows featured

> three kinds of 'freaks'. 'Born freaks' were those who had been born with a particular physical anomaly, like Siamese twins or armless people. 'Made freaks' were those who had done something to their body to make it unusual, such as covering it with tattoos. 'Novelty acts' were performers who did something unusual for the show, such as pounding nails into their heads or swallowing swords (Fordham, 2007, p.2011).

One of the most notable figures from the freak shows of the eighteenth and nineteenth centuries was the Khoikhoi woman, Sarah Baartman, born in 1775 in South Africa. Also known as the Hottentot Venus, Baartman was initially sold into slavery aged 20, and in 1810 travelled to Europe where she was subsequently exhibited in numerous freak shows in London and Paris. The primary reason for Baartman's inclusion in these shows was that she "had what appeared to European audiences to be unusually large buttocks, which were read by some as a freakish

mutation and by others as merely typical of Khoikhoi women. To accentuate her buttocks, she appeared in a tight-fitting costume that closely matched her skin color, thus creating the illusion of nakedness" (Durbach, 2010, p.32). Consequently, Baartman was objectified through the colonial gaze, which saw her body transformed into a spectacle of eroticism and fascination. Even after her death, Baartman's body continued to be treated as an object and was displayed in the Muséum National d'Histoire Naturelle in Paris. However, by the early twentieth century, "fascination with the unusual body became more tainted with pity and disgust, causing the freak show to lose social status and popularity" (Fordham, 2007, p.2012), and after decades of requests by the South African government to return Baartman's remains to her homeland, French officials repatriated her body where it was finally buried in 2002. This reduction of the living human from subject to object parallels the concerns and processes of bioart; a practice that sees life become material to be transformed, viewed and objectified. Like freakshows, the display of bioart is alluring through the simultaneous discomfort and curiosity of the strange. However, in contrast to the natural anomalies most often found in the exhibits of freak shows, bioart works are intentionally and artificially engineered to exist as new and unique forms of life.[4]

A further referential precursor to bioart can be found in surrealism, which attacked the rational, the expected and the ordinary intentionally, and deliberately made the expected strange. In understanding this disruption to the expected, Hal Foster has suggested that

> if there is a concept that comprehends surrealism, it must be contemporary with it, immanent to its field; and it is partly the historicity of this concept that concerns me here. I believe this concept to be the uncanny, that is to say, a concern with events in which repressed material returns in ways that disrupt unitary identity, aesthetic norms, and social order (1993, p.xvii).

[4] While many individuals who were exhibited in freak shows did so as a result of natural physiological abnormalities, some, known as phonies, attempted to mimic these abnormalities such as the "'Armless Wonder' whose arms were hidden under a tight-fitting shirt" (Fordham, 2007, p.2012).

The uncanniness of surrealism that is situated in the disruption of expectations is apparent in contemporary works of bioart, which similarly subvert expected uses of living materials, biotechnologies and the art object being replaced with the art subject. Visually, many bioart works might also appear surreal through the recontextualisation of their materials, together with the aspect of living body parts existing separately to a body.

Surrealism's attack on the normal and the expected has often taken place through the body, with the female body frequently being a specific focus. In transforming the body, de-assembling or reassembling the body, and objectifying the body, surrealism has been criticised for its "violent objectification of the female" (Malt, 2004, p.3). However, as a reference point for bioart, it appears that the objectification and reimagination of othered and marginalised subjects has a clear trajectory in art history. Man Ray's *Le Violon d'Ingres* (1924) [Figure 1.3] is a notable example of how the surrealists simultaneously reimagined and objectified the body. The photograph features the figure of a seated nude woman, her robe fallen, with her back exposed to the viewer. The artist transforms the woman's body through the shape of f-holes placed onto her back, turning her body into a violin. While the female figure is objectified in the sense that she is the subject of the male erotic gaze, her body is also reimagined as an actual object in the form of a musical instrument. The criticism of this prevalent male gaze, and its objectification of the female body, has also been critiqued through surrealism, such as in Lee Miller's 1930, *Untitled (Severed Breast from Radical Mastectomy)* [Figure 1.4], which suggests a reinterpretation of this form of bodily transformation. Served on a plate, Miller presents the dissected breast with a knife and fork on a dining table. Offering the dismembered female body for consumption, Miller disrupts the sexualised consumption of the male gaze with trauma and violence, yet simultaneously reflects and subverts the traditional role of the housewife preparing and serving meals.

The displacement and disruption of expected categories and the surrealist merging of the expected and unexpected can be seen more recently in Damian Hirst's works which have preserved dead animals in formaldehyde. *The Physical Impossibility of Death in the Mind of Someone Living* (1991) [Figure 1.5] featured a four-metre tiger shark preserved in a tank of formaldehyde. The shark's open mouth and eyes, together with the blue-toned colour of the formaldehyde, make it appear as though the animal was alive and swimming towards the viewer. The disjuncture between the animal being dead and it appearing alive, although out of place through its display, follows the surrealist conflation of the expected and unexpected in both material and contextual ways. This material and contextual conflation is a significant aspect of bioart works as they utilise the materials of biotechnology, presenting them in art contexts. Furthermore, as a biological specimen that was caught and killed for the purpose of art display, Hirst's work serves as a historical precursor to bioart both materially as well as ethically.

These shared aspects of historical ideas of monstrosity and the subversions of expectations of surrealism assist in identifying and locating the practice of bioart within art history. This reveals a trajectory in which the simultaneous fascination and fear of monstrosity can be understood as a response to otherness and the encounter with the unexpected; this encounter with the unexpected is, furthermore, the intended motivation of surrealism's purposeful disruption of the normal, the expected and of rational categorisation. In bioart, therefore, the monstrous appears both in the form of the works created, as well as through the transgressive act of transforming the living subject into the art object through the manipulation of life. Similarly, through the unexpected use of living, biological materials for art purposes, transferring the contents of the bioengineering laboratory into the art exhibition space, the influences of surrealism are evident.

1.1.2 Early Bioart

Where these examples can be seen to inform bioart and provide a contextual trajectory for the development of practice, the microscopic level of intentional genetic alteration for artistic purposes is found later in the twenty-first century. While biotechnologies continued to develop throughout the twentieth century, it was the fundamental discovery of DNA (Deoxyribonucleic acid) by James Watson and Frances Crick in 1953 that changed the landscape of biotechnology and subsequently abilities to alter and manipulate life. Although hypothesised long before its discovery and first identified by Friedrich Miescher in the 1860s, the discovery of DNA provided a foundational structure for understanding the construct of all living material (Dahm, 2008). This intricate understanding of the structures of living material subsequently gave way to technologies being able to directly and purposefully manipulate life at a genetic level; for example, the ability to grow fresh produce with a longer shelf life or contain higher nutritional contents, without the need for generations of selective hybridised breeding. This understanding of DNA led to the development of molecular biology, where the inner structures of a single cell can be studied and consequently manipulated. The ability to manipulate life at a genetic level is the basis for many contemporary biotechnologies and has consequently been adapted into bioart practices.

One of the first known artworks to use this type of bioengineering is Joe Davis' 1986 work, *Microvenus* [Figure 1.6]. Formed from Bacillus subtilis bacteria, cells were genetically modified to create the outline of the Germanic rune of "female earth" [Figure 1.7] (Loder, 2017, para.2). This work was a response to the Pioneer plaques designed by Frank Drake and Carl Sagan, which were attached to the *Pioneer 10* and *Pioneer 11* spacecrafts, with the intention that it could, for the first time, pictorially introduce our planet to any extraterrestrial life that may encounter it (Davis, 2007). The images on Drake and Sagan's plaque include a nude male and female, the solar system and Earth's location within it. Davis' work is critical

of the censorship of the female figure's genitalia, which lacks detail in comparison to the male figure; consequently, Davis refers to the image as the "'man and Barbie' version of humanity" (Hussain, 2000, para.17). In creating his work, Davis encoded the structure of *Microvenus* into bacteria by coding the graphic rune symbols into a nucleotide sequence (Reder, 2016), therefore reproducing the shape of the rune in the fundamental structure of the bacteria. Since Davis first made the work in 1986, the *Microvenus* bacteria has reproduced itself into more than a billion copies. Furthermore, millions of these copies have been released into outer space as a rebuttal against Drake and Sagan's representation of the female anatomy (Reder, 2016).

The final decades of the twentieth century, together with the biotechnologies developed during that time, appear to have been a catalyst for many of the first artists to intentionally and critically engage with biotechnologies as part of their practice. By the late 1990s, genetic engineering had developed to the extent that the first mammal, a female sheep named Dolly, was successfully cloned in 1996 and announced to the public in 1997 (Best, 2009). Following this, the Human Genome Project, which mapped the entire set of genes present in human DNA, was completed in 2003 (Guihan, 2009), simultaneously piquing cultural interest in, and concern with, biotechnologies. The scope of this cultural anxiety extended beyond biotechnology to technology in general and is evident in the fear of the 'millennium bug' or 'Y2K bug' forecast to disrupt computer systems globally on New Year's Day in 2000 (Gere, 2008). It is during this time that many contemporary bioart pioneers began to include biotechnologies in their practice, with Eduardo Kac coining the term 'bio-art' in 1997 in respect of his work *Time Capsule,* which saw him implant a microchip into his own skin. Kac explains that the idea of bioart is connected to his earlier work, which he refers to as telepresence art that "is a new art form predicated on the creation by the artist of new telerobotic bodies that a remote participant inhabits in order to experience new, invented forms of presence" (Osthoff, 2007, para.11). This evolution from the robotic to the living is symptomatic of the

contemporary condition of human/non-human and living/machine binaries that are being eroded through technology (Kac, 2004). This culturally informed process of incorporating contemporary biotechnologies into art appears to have been a global phenomenon as in 2000, artists Oron Catts and Ionat Zurr established SymbioticA, along with biologist Miranda Grounds and neuroscientist Stuart Bunt. Located within the School of Anatomy and Human Biology at the University of Western Australia, SymbioticA is the first artistic research laboratory and offers interdisciplinary residencies, academic programmes and workshops, facilitating practical engagement with biotechnologies.

Collaborative processes between artists and biotechnologies have continued to emerge, developing an expansive and diverse field of complex creative works by a global community of artists. This engagement is the foundation for the practice that is known as bioart, which has emerged as a distinctive genre demonstrating intricate uses of biotechnologies to manipulate, change and grow living structures as the basis of artworks. However, bioart itself is a complex term and attempting to define it is problematic as a result of the intrinsic diversity of artworks labelled as such, in addition to the relative infancy of the term and its associated works.

1.1.3 Defining Bioart

Bioart is a collective name often used to describe artworks that engage with biological sciences and technologies (Mitchell, 2010). These projects are diverse in form, subject and materiality, however, the name 'bioart' is derived from the use of life and the artificial manipulation of life using the tools and processes of biotechnology. As the name bioart is coined from Eduardo Kac's work but is now used by artists, critics and theorists to describe a wide range of works, the term is itself ambiguous. The name 'bioart' suggests a focus on life and biological matter, however, what kinds of life and how this life should be used, presented or even whether it still must be alive remains uncertain. Robert Mitchell supports this complexity and ambiguity,

stating that “bioart is in many ways a confusing term with uncertain reference” (2010, p.16). Melentie Pandilovski concurs with this perspective, suggesting that “as bioartists expand their practice, it becomes very difficult for art critics and cultural theorists to fully understand the new sorts of artworks they produce, let alone find consensus or common ground” (2017, p.142-3). This current ambiguity in defining bioart is the result of it still being a relatively recent phenomenon and one that is constantly evolving alongside the technologies it utilises, and for this reason, Frances Stracey suggests that bioart is “still at the threshold of definition” (2009, p.496).

This lack of clarity has, however, not stopped the term from being used by artists or critics and has produced a wealth of interpretations as to what bioart is or could be. Marietta Radomska suggests that bioart “may be briefly defined as a current of contemporary art that involves the use of biological materials (cells, tissues, organisms) and scientific methods, tools and procedures” (2017, p.377). Similarly, bioartist, Suzanne Anker suggests that “Bio Art is an umbrella term for a host of practices that draw from fields such as synthetic biology, ecology and reproductive medicine, often combining art’s pictorial processes and nature’s living library. Simply put, Bio Art employs the tools and techniques of science to make artworks” (2015, p.6). This definition acknowledges the comprehensive sources of scientific influence found in bioart and the scope in outcomes and, as such, suggests that the processes involved in creating such works are implicitly tied to biotechnological processes. However, in the same book as Anker, *Bio Art: Altered Realties*, curator William Myers suggests, “Bio Art is a practice that utilises living biology as an artist’s medium, or addresses the changing nature of biology’s meaning through its output” (2015, p.7). In this case, Myers appears to offer two definitions; bioart being a media-based field reliant upon biotechnology as its very fabric, and bioart as a more general field of enquiry into biology through varied means.

The dichotomy of whether bioart is a media-based or thematic engagement with biotechnology is one that has been highly debated as it has the potential to threaten or undermine the use of the term. Here, Stracey favours defining bioart by its specific use of living biological matter "such as genes, cells or animals, as its new media" (2009 p.496), and Ramdoska suggests that "projects [that] often involve procedures conducted at a microscopic level (of cells and tissues), the 'beyond-the-skin' level of various embodiments" (2016, p.43). Alexis Rockman's 2000 oil painting, *The Farm* [Figure 1.8], has also been described as bioart. Rockman's painting was exhibited in New York, United States (US) in 2000 at the *Paradise Now: Picturing the Genetic Revolution* exhibition, and depicts a farm scene with animals and crops, however "as one moves to the right, the plants and animals seem to have been genetically modified to increase their exchange value" (Mitchell, 2010, p.16). While it is demonstrated through painting rather than living material, Rockman's work presents a future of the natural turned unnatural through biotechnology, explicitly for the financial benefit of humans with little regard for the animals involved. Consequently, through details such as a chicken with four extra wings, the work offers a vision of the dystopian future that is, in some ways, already occurring through the use of hormone implants to increase muscle in livestock for maximum capital gain. In this way, bioart can offer a critique of practices that see animals and other life forms become victims of human greed without engaging in the practices themselves, causing further harm while still being critical of them.

While it is possible for bioart to be an encompassing term, including both material and conceptual critical engagement of biotechnologies, some critics, including Eduardo Kac, reject this notion, emphasising that "one must distinguish between artists who simply engage biotechnology as a topic and those who engage with biotechnology on a material level by employing biotechnology as their very medium" (Mitchell, 2010, p.24). Biotechnologies as a medium are therefore distinct from conceptual engagement and from using life as a medium as

it suggests not only the use of living material but an intentional artificial manipulation of this material using these processes critically. This differentiation between engaging with biotechnologies on a material and a conceptual level is, therefore, a difference between presentation and representation. While many works such as *The Farm* do engage in critical debates that concern the impacts and outcomes of bioengineering, it does so through a representation of these issues. In contrast, artists who use living matter as their media and biotechnologies as their tools offer a direct presentation of these technologies and, therefore, a subjective, material encounter with the source of such debates and critical discourses.

A further aspect that complicates the ability to define the boundaries of what works can be conceived as being bioart is the number of different terms such works are presented under. Along with the various spellings of bioart, works have also been described using the associated terms of "'biotech art,' 'life art,' 'genetic art,' and 'transgenic art" (Mitchell, 2010, p.3). The use of so many different terms highlights the variation in the form of many works and the lack of unifying features with the exception of using biotechnologies. Furthermore, many of these terms have been used synonymously, and while they are all related, they do not refer to the same technologies. Despite this, many of these terms have been used interchangeably, thus highlighting the need for specificity in order to accurately define and understand such works.

As a name, biotech art is an unambiguous term and is perhaps even more precise than bioart as it suggests explicitly the involvement of biotechnology. Yet, as there is still controversy over whether bioart must utilise biotechnology as a process and a medium, biotech art could instead be deemed as a subset of bioart at present. However, in contrast, life art suggests a much broader and ambiguous reference to these artworks, with little to indicate a differentiation between life and the intentional critical engagement with living materials as subject matter. Genetic art and transgenic art are related terms, where genetic art could be applicable to any use or reference to genes, transgenic specifically refers to the implantation of

genetic material from one organism to another separate organism of a differing species. While all of these terms relate to aspects of bioart, they are not all synonymous and demonstrate the complexities of attempting to understand expanding bioart practices. Furthermore, the use of so many separate terms has highlighted issues with incorrect terminology being used to describe artworks accurately. Catts and Zurr suggest that critiques of bioart have been "marred by the misunderstanding of the different levels of engagement with life, overwhelmed by the complexities of life processes and outcomes" (2010, p.125). Consequently, the use of correct and accurate terminology can assist in understanding works of bioart and the ways in which they engage in biotechnologies and living material.

While it is evident that currently there is no precise definition of bioart or a rigid categorisation of which artworks should be considered as bioart, it appears that there are specific key characteristics that unify works involved. The first of these is that works of bioart collectively engage in discussions regarding biotechnology and provoke questions around our abilities to shape nature, the environment and ourselves. Secondly, this is achieved through the actualised usage of biotechnologies as tools in the creation process and through the use of living biological material as the basis for bioart works. While traditional media works have also been described as bioart, it is evident that the fundamental approach to engagement with bioengineering is through its actualised usage.

1.1.4 Bioart as New Media Art

While it is apparent that bioart is a diverse and complex field, materiality is a common theme that is present across current bioart research and art practices. Although there is currently no firm consensus on whether bioart should be considered as a media-based field, specifically incorporating the use of biotechnology as a medium, the issue of materiality has seen bioart linked to wider contemporary art practices. In particular, bioart has frequently been associated

with new media and interpreted as a new form of new media art. New media art refers to the use of new media communications, including computers and the Internet, which began to emerge and infiltrate everyday life in the 1980s and 1990s (Lievrouw, 2011). New media "has gained currency as a term because of its useful inclusiveness" (Lister, Dovey, Giddings, Grant, & Kelly, 2009, p.11). This inclusivity is significant as these new digital media are produced, created and utilised globally in many different ways. Therefore, new media "is a term with broad cultural resonance rather than a narrow technicist or specialist application" (Lister et al., 2009, p.12). This cultural resonance is evident in new media art which has seen artists borrow from this expansion of communicative technology and incorporate it into art practices, giving rise to many new fields of art, including digital art, computer art and video installations (Partridge, 2015). Given the varied nature of these distinct technologies and the numerous ways in which they can be used, new media art is again an expansive term with a wide field of reference, linked by the usage of technologies found in a specific techno-cultural epoch rather than formal similarities. In this way, Stracey's comment that bioart is "a crossover of art and the biological sciences, with living matter, such as genes, cells or animals, as its new media" (2009, p.496) suggests that living matter is the materiality of new technologies of contemporary cultures.

Examining bioart as a new form of new media art is, therefore, valuable in one respect as it invites a wider cultural perspective in which the art is intrinsically tied to the socio-cultural context it is produced in through the use of current technologies. In this way, bioart is a product of the contemporary fascination with and fear of biotechnologies that are fundamentally entangled in every aspect of daily living. Through consideration of bioart alongside art practices that draw from other types of contemporary technology, it is evident the ways in which technology infiltrates cultures and becomes both a medium and a source of exploration. Like other forms of new media art, this suggests that artists using biotechnologies are not bound

to using them only to engage in biotechnology debates, but because they are important and pervasive contemporary materials, like computers and the Internet.

It is, however, simultaneously problematic to define bioart as new media as a result of such a wide cultural resonance beyond biotechnology, as this overlooks the many complexities of bioart which serves to separate it from other forms of new media art despite using similar technologies. This differentiation is evident in the contrast between two recent artworks, both made using 3D printing technologies. Mat Collishaw's 2014 work, *All Things Fall* [Figure 1.9], is a zoetrope based on the biblical narrative *The Massacre of the Innocents* and 3D printed in epoxy resin. Dietmut Strebe's 2014, *Sugababe* [Figure: 1.10] was also constructed using 3D printing technology, however, printed using living chondrocyte cells, thus producing a living artwork. Although both works employ the same new technology, there is a marked difference in materiality and therefore where Collishaw's work is a static object, Strebe's is a living, growing subject. Consequently, bioart is simultaneously both new media art and something else entirely distinct and idiosyncratic.

A further problem with exclusively positioning bioart under the umbrella of new media is the dependence of this term on defining bioart by its specific use of biotechnology as its media, a definition which, as previously discussed, is not a universally accepted generalisation. Therefore, this association is contingent on a media-based definition of bioart, or at least a subset of bioart that is defined by its use of biotechnology as a medium. Despite these issues, however, exploring bioart in the frame of new media offers a broader perspective of the similarities and differences defining bioart in a wider art context.

1.2 The Biotechnology Revolution

Biotechnologies have existed in varying, albeit more simplistic forms since early human civilisation. From grain fertilisation for the production of beer in Egypt between 5500-3100

BCE to controlled crop fertilisation in Babylon around 2000 BCE, and calculated crop rotation in Greece around 250 BCE (Newell-McGloughlin & Re, 2006), it is clear that humans have consistently attempted to control and alter nature to suit our own needs and desires. Furthermore, such historical examples of biotechnology "shows not only that humans have been trying to put nature to use for a long time, but also this control has very often been deployed to serve commercial and political ends" (Stevens, 2016, p.21). Since this early time, it is evident that developing biotechnologies have altered our environment, our societies and ourselves, from the way that we control and manipulate agriculture for maximum capital gain to the ways that we fix and improve the human body using biomedical developments. However, the rate of these changes and the extent to which they have altered ourselves and our environment has led to the 1970s onwards being known as the biotechnology revolution (Pandilovski, 2017).

The catalyst for the development of modern biotechnology was the discovery of DNA in 1953, as previously mentioned, which provided the basis for subsequent generations to develop powerful tools in genomics, biochemistry and biomedicine, including immunology that "have further unfixed the definition of life" (Terranova, 2016a, p.409). While biotechnologies before the discovery of DNA had significant social or economic effects, it is the rate at which biotechnology progressed from the 1970s as a result of the DNA discovery that has led to the biotechnology revolution. Mark Herring (2006) suggests that in encountering tangible outcomes of biotechnology, such as improved food crops or more effective medical treatments, individuals are more likely to accept the technology, however, when processing such technologies in an abstract or removed sense, such as theoretically or in artworks, they express concerns that they "may have deleterious consequences and so it must be regulated" (p.10). Regulation of biotechnologies is, however, a contentious and ongoing issue, both in

terms of what research is appropriate to undertake together with the commercial uses of certain biotechnologies.

As a result of this rapid change in the pervasive omnipresence of biotechnologies, there has been widespread resistance to certain technologies, particularly on the part of the consumer over the potential damages these technologies could cause (Hallman, 2000). Of these controversial biotechnologies, the use of genetically modified (GM) foods has been one of the most persistently debated in the twenty-first century (Splitter, 2019). Commercially introduced in the 1990s, most GM foods are crop-based products, however, the technology is also used in livestock and medications and refers to produce that has had its DNA altered using genetic engineering (Murphy, 2011). Advantages of genetically engineered crops include the ability to control traits that inform the development of produce, such as their resistance to pests, their adaptability to environmental conditions, and that they can be grown more intensively than through traditional methods, increasing the potential yield (Thomson, 2006). Similarly, supporters of GM crops have argued that they can offer an improvement in global health, particularly in countries where famine and malnutrition exist, through increasing the vitamin content of grains such as maize (Thomson, 2006). Despite the assurances from official government organisations and biotechnology firms asserting the potential benefits of GM foods, there has been substantial consumer resistance. Public concerns include the safety of GM foods, their impact on the environment and a lack of agency or control in the decision to allow GM produce to be sold without being labelled as such, unless there is a substantial difference in the product (Jones, 2009).

The mistrust and suspicion over the pervasive mass use of biotechnologies in everyday life appears to sit behind the critical intentions of many bioart practitioners. In appropriating and utilising the same technologies that they are critical of and reinterpreting them in an alternative context, one in which the immediate capital values are less apparent, allows for

these technologies to be seen in new ways. While many bioart works often explicitly engage in such criticisms, in doing so, they have simultaneously received criticism of their own for appearing hypocritical in using the very technologies they are critiquing. Stracey acknowledges this perspective, stating that for many bioart practitioners, "their rationales and justifications for turning life into art often remain hidden behind aestheticism or scientism, or rather glib 'because I can' attitudes" and that "there is a sense of a lack of accountability on their part in the making of bio-artworks" (2009, p.496). However, this sense of accountability on the part of artists reveals a double standard in itself as it suggests that artists should be publicly accountable for their works in ways that scientists involved in developing such biotechnologies are not; this will be a key issue explored in later chapters.

1.2.1 The Politics of Biotechnologies

Contemporary biotechnologies and their uses are highly politicised issues, with politicians often including their viewpoints on many biotechnologies as part of their electoral campaigns (Moreno, 2012); examples include the legality of abortion and the fluoridation of drinking water (Manch, 2020). However, the lack of consensus and repeated political debates about these issues demonstrates that ability and policy are not always universally compatible with individual moral thought. As biotechnologies have evolved and more complex procedures have been developed, these political debates have become less clear cut and subsequently more divisive; this is particularly evident in biotechnologies that have become everyday parts of life, such as the genetic modification of crops and the new selectivities available in the now commonplace In vitro fertilisation (IVF) treatments.[5] However, one of the most significant political issues associated with the development of contemporary biotechnologies, evident in

[5] While IVF is a widely accepted process, the abilities to selectively choose specific characteristics such as sex or eye colour has led to concerns over 'designer babies', however these selectivities have been found to be more accepted if they relate to diseases such as cystic fibrosis (Cell Press, 2019).

both biomedicine and agriculture, is its commercialisation, prompting concerns over private companies controlling biotechnologies for capital gain. One such example is the patenting of GM crops by biotechnology firms, meaning that even when bought and planted by farmers, the crops are technically owned by the corporations, thus limiting the exertion of control of the farmers (Pollan, 1998). On this topic, Eduardo Kac comments that "it is not clear what are the benefits, if any, to the consumer" (2006, p.14), further suggesting that the GM food industry is built upon corporate profit rather than global social welfare. While in medicine, it is clear to see the benefits of certain medicines and procedures, there are similar issues relating to ownership of patents and patient accessibility to drugs due to high cost as a result of large profit margins of pharmaceutical companies (Deangelis, 2016).

The development, production and dissemination of pharmaceuticals are often owned and controlled by large private companies and it is then the "pharmaceutical executives [that] determined the costs of those drugs, which must be paid by the public" (Deangelis, 2016, p.30). Consequently, there have been numerous controversies and ethical debates surrounding the cost and availability of drugs, recently evidenced in the US, where several pharmaceutical companies were found to be "financially incentivising doctors and health care providers to promote their drugs, and compensating pharmaceutical sales reps [sic] based on the number of prescriptions written by the doctors they call on" (Archer, 2013, para. 1). Similarly, there have been concerns that drug manufacturers are implicit in the US opioid epidemic by downplaying the addictive nature of their products in their marketing (Semuels, 2017).[6] These examples demonstrate the interconnectivity between biotechnology and capitalism and highlight that beneficial biotechnology is not necessarily used for utopian benefit, and consequently

[6] The US opioid epidemic refers to the current increase in uses of prescribed synthetic opioids, such as Fentanyl, and the subsequent increase in deaths due to overdoses of these drugs; the crisis has been referred to as one of the largest public health issues in US history (Volkow & Blanco, 2020).

demonstrates the public mistrust of many technologies and those who own and manufacture them.

As part of an attempt to democratise biotechnology and its commercial by-products, there has been an emergence of a practice known as biohacking. Biohacking is a twenty-first century social movement, sometimes referred to as do-it-yourself (DIY) biotechnology, which involves individuals and small groups undertaking biotechnological experimentation and research outside of traditional research institutions (Ikemoto, 2017). One of the most notable aspects of biohacking laboratories and research centres is the involvement of non-specialists. While there are often mentors who have been traditionally trained, the underlying manifesto of biohacking aims to make biotechnology practices and products accessible and affordable, encouraging involvement and inclusivity (Guizzetti, 2017). Biohackers have gained controversial attention in the media for testing unlicensed procedures on themselves, exemplified by Aaron Treywick and Tristan Roberts, who injected themselves with an untested gene therapy that they anticipated would cure herpes (Cuthburtson, 2018). However, their actions are primarily deemed illegal by authorities, and some individuals within the biohacking community have voiced concerns that either government or pharmaceutical agents may have been involved in Treywick's sudden death in 2018 after considering him a threat (Cuthburtson, 2018). While this is only speculation, the concerns here demonstrate the inherent power structures present within bioengineering and, therefore, the underlying critiques present in the biological arts.

1.2.2 Bioart and Bioterrorism

The suspicions around both bioartists and biohackers engaging in biotechnologies can be found in the fears of bioterrorism, which is one of the biggest threats posed by biotechnology, particularly synthetic biology, in the twenty-first century (DiEuliis, Ellington, Kwik Gronvall

& Imperiale, 2019). Bioterrorism refers to the deliberate use of biological agents to cause harm and death and has

> a lot in common with naturally occurring public health emergencies resulting from infectious diseases. However, there are some important differences. Since it is a deliberate act to cause harm, there are the obvious security considerations. The resulting outbreak differs in some important ways from naturally occurring epidemics—for instance, it is more likely to be a point source outbreak initiated by simultaneous exposure to many people. The infectious agent used is likely to be uncommon and possibly not endemic to the region, might have been modified genetically to make it resistant to current medications and vaccines, and produced in a way that enhances its transmission or virulence (Green, LeDuc, Cohen & Franz, 2019, p.e3).

Bioterrorism is, therefore, a deliberate use of naturally occurring or biologically altered viruses, toxins or bacteria to harm or kill individuals or large populations. Those that pose the greatest threat include anthrax, smallpox, botulism, plague and Ebola (Niiler, 2002). The improved abilities of genetic engineering could lead to these harmful agents being altered in order to make them resistant to any known vaccines or can increase their predisposition for contagion.

Simplistic forms of bioterrorism and biological warfare have been used for centuries, demonstrated by some indigenous cultures of South American countries, for example, who frequently laced the tips of arrowheads with poisons secreted from frogs (Mayor, 2008). However, contemporary biotechnological developments have allowed for more sophisticated, directed threats. One of the first documented instances of bioterrorism in the twenty-first century, known as Amerithrax, involved the anonymous mailing of envelopes laced with anthrax in the US in 2001; five people died as a result of the poisoning (Niiler, 2002). Occurring the week following the US terrorist attacks on September 11th 2001, the US government consequently increased expenditure for research into biological warfare and into preparedness for other such instances of bioterrorist incidents (Niiler, 2002).

Bioterrorism is feared, therefore, as a result of the development of increasingly powerful biological materials that can be harnessed and used in unprecedented ways, whether by intent or error, and can cause widespread harm from the actions of a single individual. The

potential damage resulting from bioterrorism ranges from widespread human death to the loss of livestock and crops, suggesting both public health and economic concerns. Therefore, the potentially significant global impact of a single act of bioterrorism has resulted in social tensions and high suspicion over possible attacks.

Bioartists have not been immune to the suspicion and tension caused by the global tensions surrounding bioterrorism and is notable in the US government's legal case against Steve Kurtz of the Critical Art Ensemble (CAE). In 2004, Kurtz's wife and fellow CAE artist, Hope Kurtz, died suddenly, however during the routine police visit that followed, the Federal Bureau of Investigation (FBI) were alerted to investigate the presence of scientific equipment, including bacteria, in Kurtz's home. Initially, Kurtz was suspected of involvement in Hope Kurtz death, however after the post-mortem confirmed that she had died of natural causes, the investigation turned into one of bioterrorism. Kurtz was detained for five days and his "scientific equipment, his computers; his notes, a shelf of books on science, epidemiology and the history of biowarfare; his passport; other personal documents and Hope's body" were confiscated (Hirsch, 2005, p.22). Shortly after, members of the CAE were called before a jury investigation seeking to charge Kurtz with offences relating to the Biological Weapons Statute as it is prohibited to possess any "biological agent for any purposes except 'prophylactic, protective bona fide research towards educational or other peaceful purposes" and they believed that Kurtz's work was "being used for something other than 'research or educational purposes, something terroristic'" (Hirsch, 2005, p.22). Charges against Kurtz were finally dropped in 2008 due to a lack of convincing evidence against him.

This intense suspicion and subsequent extensive investigation demonstrates worst-case scenario thinking that is now commonplace as a result of social anxieties over terrorism

(Annas, 2006). In particular, these tensions are symptomatic of the post-9/11 culture.[7] Despite the threats of terrorism and bioterrorism being a legitimate concern and present across contemporary cultures, this isolated incident of artists being potential suspects of planning to cause harm reveals the inherent anxieties surrounding possession, use and abilities of biotechnologies and those who control them, in addition to the mistrust of the artist stepping over the traditionally expected boundaries of art. This case demonstrates the marginalised position of bioart, and the prevailing unease and suspicion of an art form that is still undergoing the process of definition, highlighting that "probably never in recent art history have we witnessed a case in which questions of content, public utility or epistemological and educational value are asked so directly and in real time to an emergent, marginal art form" (Hauser, 2008, p.94).

1.2.3 Bioengineering Anxieties

The pervasive presence of biotechnologies within contemporary culture has produced both dependence and subsequent positivism with respect to potential capabilities. Simultaneously, however, resistance and suspicion exist over the blind acceptance of all biotechnologies, as discussed previously in this chapter, thus challenging the motivations that sit behind the development of these technologies. Both the hypothesised threats of bioterrorism and the ongoing debates over safety concerns of some technologies demonstrate the intrinsic cultural anxieties produced by fears of potential new and uncontrolled technologies that threaten the current social order. Cultural tensions and anxieties often sit below the surface, only revealing themselves when confronted with a possible deviation from cultural, political or moral order

[7] Post-9/11 culture refers to the ongoing cultural impacts of the domestic terrorist attack on the World Trade Centre in New York City on 11th September 2001 in which 2,977 people were killed and more than 6000 were injured; the impact of this event has been experienced globally as well as domestically with a "significant and abrupt change in both the U.S. culture and the global relations, shifting the nature of civil liberties, causing divisive political climates, and birthing the War on Terror" (Light, 2016, p.536).

and therefore are concerned with a transgression of boundaries (van Amelsvoort, 2018). Tensions are present across cultures, with anxieties over terrorism, racial difference and biotechnologies evident amongst global news headlines, government policies and protests. The common thread found through social anxieties is a fear of a threat of otherness, however, these are often imagined rather than actualised threats. Consequently, anxieties surrounding biotechnologies are not limited to concerns about what scientists have produced but what they could potentially produce and the subsequent actions they could take.

The historic anxieties over the limitations and potential capacities of science are evident in Mary Shelley's 1818 novel, *Frankenstein*. In writing *Frankenstein*, Shelley stated that she wanted to write a story "which would speak to the mysterious fears of our nature and awaken thrilling horror" (2013, p.4); this she achieved through the juxtaposition of an overly confident young scientist and the monstrous creature he brings to life. While *Frankenstein* is fictitious, Shelley's writings reflect the advances in science during her own lifetime with experiments such as Giovanni Aldini's electro-stimulation of the limbs of executed criminal George Forster in 1803 (Taylor, 2019). Scientific investigations at this time into the 'spark of life' are mirrored in Shelley's work, as is the moral dilemma of overreaching social and moral boundaries. As a metaphor, "the monster was a visible, material manifestation of the troubled time and place wherein it made its appearance" (Dixon, 2008, p.680). The centuries following Aldini's experiments and Shelley's writing, have witnessed the continued stretching and redefinition of moral and social boundaries through scientific inquiries into the nature of life.

Similarly to Shelley's reflection of contemporary thought and scientific practices, by the end of the nineteenth century, H. G. Well's *The Island of Doctor Moreau* (1896), evokes the complex moral and ethical concerns of emerging biotechnologies, while also anticipates the developments of scientific abilities. The monstrous figures of Well's novel, known as the Beast Folk, are created by Doctor Moreau by vivisection on his secluded island home in the Pacific

Ocean. These creatures were created from animals to be transformed into humanlike figures, yet appear to be hybrids of both, visually and behaviourally. However, Well's writes that "strange as it may seem to the unscientific reader, there can be no denying that, whatever amount of credibility attaches to the detail of this story, the manufacture of monsters – and perhaps even quasi-human monsters – is within the possibilities of vivisection" (Wells, 2009, p.174). In this, Well's directly addresses his audience, telling them that despite the accounts of the novel being imaginary, these imaginary practices are in the processes of being possibilities. While the ability to create new, unnatural or hybrid lifeforms was not fully viable during this period, the novel "anticipates certain key developments in late-twentieth century molecular biology" (Danta, 2012, p.687). These developments are evident in the biotechnologies that have been appropriated by artists in the twenty-first century through bioart. However, the practices in Well's novel have also anticipated the associated ethical dilemmas that emerge from the biological alteration of the human, the non-human and the creation of new hybrid forms of life. A century following Well's novel, the technologies of the biotechnology revolution have allowed for new life to be grown in the laboratory. Dixon comments that,

> a progressive history of science would have it that these monsters have disappeared under the light of empirical inquiry, as once wondrous anomalies and aberrations are to be explained as excessive deviations from biological norms, while other fantastical forms are relegated to the realm of myth. And yet, biotechnology and bioart have brought us new wonders that deliberately exceed such norms (2008, p.680).

Bioart, therefore, reflects the changing political, cultural and social contexts of our relationship to biotechnologies by deliberately exacerbating these anxieties of potential misuse or crossing of boundaries through the actualised presentation and visualisation of these fears. Bioartists have created bioluminescent animals, responsive musical instruments and living dolls and, as such, these works present and realise the anxieties of potential unchecked positivism, partially through the technologies used, but also as a result of their complex dichotomy as living art object and living material subject. These anxieties manifest as a result of the fundamental

construction of bioart, "within liminal spaces that combine elements of the womb and the machine, the studio and the laboratory, the garden and the factory, the gallery and the morgue" (Dixon, 2009, p.412). These dichotomies further complicate our relationship to living works of art and, therefore, force an encounter with the complexities of how we perceive and understand life and our relationship to other forms of life, whether they occur organically or in the laboratory.

The anxieties invoked by biotechnologies refer, therefore, both to fears of the past repeating itself in the form of previous unethical behaviours exhibited, and to the future and the potential ways in which these technologies could be used that may fundamentally affect our species and our environment. These unethical behaviours can be found throughout human history, but within recent Western history it is the Holocaust that has

> left a scar on the human psyche. Determined not to let history repeat itself, most people developed an instinctive revulsion to all ideas appearing to have any kind of association with Nazi ideology. (And yet, it must be remembered, history did repeat itself**,** e.g. in the Rwandan genocide of 1994, in which the world did nothing but wring its hands as 800,000 Africans were slaughtered.) In particular, the eugenics movement as a whole, in all its forms, became discredited because of the terrible crimes that had been committed in its name, although some of the milder eugenics programs continued for many years before they were finally scrapped. These programs are all now almost universally condemned (Bostrom, 2005, p.6-7).

Through the actualised usage of these biotechnologies, however, bioartists allow these cultural tensions and fears to manifest, highlighting the anxieties that progress and new knowledge have brought with them in the past and the present.

1.3 Ethics and Art

A prominent issue in bioart discourse is the ethical implications of the practice. Ethics is a prevalent topic in the use of living materials in art practices and is one that many bioartists are fully aware of and appear to purposefully engage in. These ethical debates have centred on the ethical suitability of using living material for artistic purposes, how these works mediate or

force a confrontation with the ways we use biotechnologies and our relationship to other life forms, in addition to the problems of responsibility of care for living works and subsequently the disposal of them (Solon, 2011). Furthermore, ethical guidelines for the use of living material in applied scientific research have developed alongside the biotechnologies they were designed to regulate, however, due to the complexities of the collaborative processes of the biological arts, there appear to be potential problems in attempting to apply existing bioethical legislation to art. These issues are explicitly pertinent as they are largely unprecedented due to the recent emergence of such collaborations and, therefore, prompt unique ethical concerns (Vaage, 2016).

1.3.1 Bioethics

Bioethics is fundamentally regarded as the moral investigation of issues emerging from biological and medical sciences (Zylinska, 2009). As a specific institutional term, bioethics was coined in 1970 by American scientist Van Rensselaer Potter (Whitehouse, 2003) and initially was brought about in direct response to deal with the increasing capabilities of developing biotechnologies and the subsequent desire to implement a set of principles to safeguard human participants in medical and psychological experiments that may follow. Within medical history, bioethics is regarded to have roots in the aftermath of the Second World War (Lopez-Munoz, 2016). Following the end of the war, the Nuremberg Tribunal, held between 1945 and 1946, tried many officials associated with the Germain regime and included 23 doctors who were tried for committing experiments on captive individuals, along with murder; these trials consequently revealed explicit, inhumane and harmful acts of human experimentation and saw seven of the convicted doctors executed and another nine imprisoned (Craig & Desai, 2015). This exposition of medical professionals being responsible for cruel experimentation first prompted the need for ethical considerations to be made with regards to

experiments that involve human participation, which manifested in the presentation of the Nuremberg Code in 1947 (Craig & Desai, 2015). This code sets out many guidelines that are still evident in contemporary bioethical codes, and amongst them is the principle that participants in human experimentation must participate voluntarily.

Currently, applied bioethics functions as a legislative and regulatory framework, which can be used to resolve whether a particular action, experiment or behaviour should or should not take place. This process is often administered on an institutional basis, however, certain fundamental features of bioethics are contained within international legislation such as the Nuremberg Code and the 1948 Universal Declaration of Human Rights, and include the importance of free will in participating in scientific experiments. However, due to the institutional basis of many bioethical codes and the individualistic perception of such guidelines by ethics committees, there are levels of subjectivity in the application of bioethics.

Bioethics is a complex, inter-disciplinary framework of moral philosophy encompassing medicine, law and philosophy, in addition to art, business and politics. However, these areas often interconnect due to the complexities of contemporary biotechnologies and the issues they evoke. The scope of bioethics is, therefore, wide-ranging due to the ever-evolving nature of biotechnology; however, some key issues covered include the use of human tissue, genetic testing, the use of stem cells, cloning, abortion, the use of living animals in research, genetically modified crops and euthanasia. Bioethicists seek to decipher ethical codes of conduct, which dictate how these technologies should be applied, to reduce potential harm, to ensure beneficence, and in some cases limit accessibility to such technologies to avoid misuse; however, as discussed, misuse is not a clear cut idea with biohacking and bioart both being subject to ethical scrutiny.

1.3.2 Life as Material for Art

The use of living biological material as the basis for artwork has proven to be controversial and provocative, this is because "for many advocates and critics of bioart, the use of bioengineered living beings as an artistic medium seems to cross a technical or moral threshold (or both)" (Mitchell, 2010, p.6). Living materials used in works of bioart include bacteria, animal cells, human cells, living animals and often the materials and bodies of the artists themselves. The moral threshold of concern is two-fold; in one sense, a threshold is crossed by blending scientific practices with art, and in another, a threshold is more specifically crossed by using living material as art media, thus turning the subject into an object.

In one respect, bioart is inherently controversial because of the ethical and moral problems that are already present in contemporary biotechnology as a result of anxieties over the potential misuse of materials and the crossing of moral boundaries. This sense of unease and contention that results in controversial perspectives is fluid and changes over time as new, often more provocative technologies develop; for example, IVF treatments are now commonplace and widely accepted. However, in 2018 Chinese scientist, He Jiankui caused global controversy for gene-editing two embryos using the CRISPR gene-editing tool which eventually resulted in the birth of twin girls (Marx, 2019).[8] While He contends that the procedure was designed to generate a specific gene mutation that could produce immunity to HIV (human immunodeficiency virus) (Raposo, 2019), he was heavily condemned for his actions, which were deemed irresponsible, unethical and monstrous by global media, with Julian Savalescu, Director of the Oxford Uehiro Centre for Practical Ethics stating that "these healthy babies are being used as genetic guinea pigs. This is genetic Russian Roulette" (2018, para.7). He, has also been described as "'rogue,' 'China's Frankenstein,' and 'stupendously

[8] CRISPR is a gene-editing tool that is an anacronym for Clustered Regularly Interspaced Short Palindromic Repeats, and is often compared to genetic scissors, or a word processing copy and paste function for genetic information (Greely, 2019).

immoral'" (Cohen, 2019, para.2). Furthermore, He's experiment was illegal and a violation of the bioethical codes of the institution he was affiliated with, and he was subsequently investigated by Chinese authorities (Cyranoski, 2019).

Importantly, however, He's experiment was not only condemned for overstepping ethical thresholds but as being premature, as the later health effects and the long term impact of gene editing on the children are unknown (Cyranoski, 2019; Raposo, 2019). This, therefore, suggests that such editing processes of humans may not always cause this level of concern. Furthermore, in response to this, some researchers have suggested that gene editing in humans is likely to be inevitable (Rosenbaum, 2019) and would follow He's motivations of attempting to eradicate certain diseases and medical conditions. What this incident demonstrates, however, is that notions of acceptance and controversy in biotechnologies are fluid and change alongside their development, and in time many technologies that were once controversial subsequently become normalised.

There is, therefore, a threat present in biotechnologies, particularly those that appear to threaten human life, however, bioart is also controversial as such manipulations of living material are specifically for the purpose of art. However, Zurr and Catts suggest that bioart demonstrates a transgression for both art and science, as "scientific techniques, tools and methodologies are being used, subverted and elaborated on for the production of artistic knowledge, discourse and objects (which can be seen as contestable tangible items for cultural discussion)" (2004, p.1). This use of living materials suggests that bioart potentially threatens traditional art expectations and methods by "intentionally transgressing procedures of representation and metaphor, going beyond them to manipulate life itself" (Zurr & Catts, 2004, p.1). Consequently, bioart produces an actualised engagement through the realised presence of biotechnologies rather than through representation. In using and manipulating living material, it is apparent that some practitioners specifically engage in bioart as a direct engagement with

the ethical problems it provokes, and for this reason, use such works to create a critique and discussion with regard to the viewer's ethical positioning in respect to other forms of life and the concept of life itself. In doing this, artists "are forcing the audience to engage with the living artwork and to share the consequences/responsibilities involved with the manipulation/creation of life for artistic ends" (Zurr & Catts, 2004, p.2).

As wide-ranging as the implications and scope of bioethics are, there is still contention as to the suitability such frameworks offer to bioart, in part due to the unprecedented ethical controversies these works induce. Nora Vaage suggests that "bioethics is poorly suited for art-specific questions, which are also often posed in discussions of bioart" (2016, p.3). The primary reason for this unsuitability is due to the inherent subjectivity implicit in both the art object and in the viewer's relationship to it. Furthermore, bioethical frameworks are not necessarily rigid and work on the basis of attempting to achieve a result using the best option in order to cause the least harm and, therefore, are treated as a case by case scenario rather than one pathway fits all problems (Vaage, 2016). Consequently, subjectivity plays a significant role in the interpretation of bioart as the moral and ethical implications of such artworks is dependent upon the viewer's ethical standpoint and their subjective understanding and expectation of what art should do (Vaage, 2016).

Stracey (2009) comments that criticism of bioart has ranged from "accusations of promoting a new 'artful' eugenic movement, to cries of aesthetic indulgence in 'carnivalesque sadism,' to condemnation of the artists as naïve or unwitting pawns in a market-driven public relations game on behalf of bio-tech industries, using the allure of culture to sell controversial science to a wider audience" (p.497). These critiques suggest that it is not the science itself that is drawn into question, but the use of it by artists, "calling into account what exactly ought to count as 'art'" (Mitchell, 2010, p.8). Bioart, therefore, can be transgressive, not necessarily for the technologies used themselves but for being used in the construction of art.

1.3.3 Duty of Care and Disposal of the Art Object/Subject

The ethical concerns prompted by bioart are not only limited to the process of construction and materiality but also new uncharted concerns involving the care of and responsibility towards living artworks. Stracey suggests that it is a fundamental concern as to "who is responsible for the creation, care and disposal of a bio-engineered life form, regardless of whether it goes under the name art, science or both" (2009, p.496). These responsibilities are as varied and distinctive as each work created, as each will have different requirements for care dependent upon the materials used. However, living artworks generally require basic care, including specific environmental conditions such as controlled temperature and sterility, in addition to nutritional support if required.

As Stracey points out, these duties of care are necessary for all living structures irrespective of whether they are classified as scientific experiments or as living works of art. As is the case with bioethics dictating codes of conduct for experimentation within applied biotechnology research, there are similar governmental and institutional codes for the appropriate care of living animals for laboratory research; for example, the *Guide for the Care and Use of Laboratory Animals* (National Research Council, 2011) disseminated by the National Research Council in the US. These guidelines are apparent globally, and while they differ in terms of wording, all are built upon the extensive history of bioethics and aim to "assist institutions in caring for and using animals in ways judged to be scientifically, technically, and humanely appropriate" (National Research Council, 2011, p. xiii). Although these codes dictate specifically only the care of animals, not of living laboratory-grown tissue matter, they demonstrate the extent to which proper care is considered and delivered to living subjects, including the provision of specialist care staff and specific habitats. While tissue structures do not require the same extensive care as living animals, these codes suggest that within applied

biomedical research, the issue of responsibilities towards living matter is dealt with through extensive and specific guidelines.

Increased politicisation and consequential legal parameters surrounding the use of biotechnologies and control over possession and use of associated materials have proved problematic for artists involved in the biological sciences, as evident in the treatment of Steve Kurtz. However, before issues of suspicion of use of biotechnologies becomes an issue, there are many restrictions that artists face in accessing these materials in the first instance, along with subsequent issues in exhibiting works made from these materials. In a practical sense, the legislative difficulties in exhibiting bioart works that contain living media are a consequence of the strict regulations surrounding the possession of live biological materials. In the United Kingdom (UK), for example, institutions must hold a Human Tissue License from the Human Tissue Authority to display works containing living tissue (Solon, 2011). This complex form of licensing and control over the possession of human tissue follows the organ scandal at Alder Hey Children's Hospital, where organs were removed from a number of deceased children and stored without parental consent between 1988 and 1995 (De Cruz, 2001). In the US, similar legislation has had a direct impact on the ability of bioartists being able to exhibit their work, as demonstrated when in 2003 the curator of the *Gene(sis): Contemporary Art Explores Human Genomics* exhibition was prohibited from using live E. coli in Eduardo Kac's *Genesis* (Mitchell, 2010). This was due to the gallery's affiliation with the University of Washington, meaning that the university's biosafety regulations were applicable to the gallery. Consequently, the live bacteria was replaced with a projected video of live E. coli, satisfying the legal and safety restrictions but removing the element of the live encounter from the exhibition.

There are few examples of living animals as the primary subject of bioart, however, the issue of responsibility remains explicitly problematic in respect of bioart as created works are

removed from the laboratory and placed into a display context. The new and expanding nature of the bioart field means that these issues of care are generally unprecedented within museum exhibitions. Although all artworks and artefacts require the care of specific environmental conditions and conservation maintenance, living works of bioart possess needs that extend beyond these conventions in order to survive. This creates a level of unprecedented dependency, as while a painting may require a climate with a specific temperature, it will not immediately suffer if these needs are not met within a short timeframe; however, if a living artwork requires a climate of a specific temperature, this need not being met immediately may damage or even kill the work. Consequently, the stakes in the care of living artwork are more immediate than works made from traditional media.

Like scientific institutions, museums fall under the jurisdiction of governmental, organisational or institutional codes of ethics, such as the American Alliance of Museums (AAM) *Code of Ethics for Museums Operating in the US*, and the Museums Aotearoa Te Tari O Ngā Whare Taonga o te Motu's, *Code of Ethical and Professional Practice* in New Zealand. These codes set out best practice for a range of ethical obstacles encountered in museum settings, including issues of ownership, copyright, care for human remains, care for indigenous objects and the repatriation of artefacts. There is, however, little consideration given within these issues for the care of living artworks, predominantly as a result of bioart's relative obscurity and the limited number of bioart works and exhibitions. Furthermore, the AAM states that while they assume that the code of ethics will be followed by all museums, there is little legislation to legally enforce this, meaning that even if the care of bioart works were accounted for within such guidelines, these would be idealist rather than legislative (American Alliance of Museums, 2019). One of the only legally enforceable laws applicable to the display of bioart is the provision that in the UK, a licence from the Human Tissue Authority is required for the storage and possession of any human tissue. The GV Gallery in London was the first privately

owned gallery to acquire this licence alongside the larger museum intuitions of the Wellcome Trust, the Hunterian Museum, the Science Museum and the Natural History Museum (Solon, 2011).

Beyond this one specific piece of legislation that only regulates possession rather than care of human tissue in one particular region of the world, it appears that the maintenance of bioart works falls ambiguously between artists, curators and other museum personnel involved in such exhibitions. This creates a unique dynamic between the artist and artwork as the artist's role extends beyond that of the creator to also being a carer, expanding the relationship beyond the studio for the entirety of a work's lifespan. Furthermore, when a living work of art is placed into the care of a museum, a complex relationship of responsibility forms where it is ambiguous as to who is responsible for ensuring its care.

The Tissue Culture and Art Project (TC&A) were confronted with the issue of responsibility of care towards their work, *Victimless Leather,* when it was displayed at New York's MoMA in 2008. Consisting of a living tissue jacket shaped sculpture, growing and surviving inside of a glass bioreactor, the museum found that the sculpture was growing too quickly and that it started to block the wires inside the reactor used for its care halfway through the exhibition. Consequently, the wires were removed, effectively killing the sculpture. While the curator of the exhibition stated that she felt uncomfortable turning off the work's life support system, Oron Catts supported the decision, saying that it was necessary "to present the end of our projects in ways that remind people that these works are/were alive and that we have a responsibility towards the living systems that we engage in manipulating" (Schwartz, 2008, para.5).

While in this case, MoMA, rather than the artist, made the decision to kill the work, this demonstrates the absence of ethical guidelines in the display of living artworks, particularly on the part of the museum. However, it also provokes questions surrounding what would be in

a code of ethics for the care of living artworks were one to exist. The decision to kill the work is one that appears to not fit easily into a rigid set of guidelines, as it was an atypical and idiosyncratic situation for an artwork, which was dependent on the specific circumstances. Furthermore, the act of killing is in itself a complex issue and one that from many moral perspectives carries different emotive connotations dependent upon the classification of such life; for example, the difference in classification between microbes, insects and mammals. Therefore, given the diverse range of types of living artworks, implementation of a single set of guidelines would appear to be insufficient to be able to dictate appropriate care and disposal of such a wide range of artworks. Consequently, these issues are ones that are being encountered when they arise and in ways acted upon by subjective moral perspectives rather than guided by overriding principles. It is unlikely that ethical guidelines for the care of living artworks will emerge in the near future, instead, it is clear that as the field continues to expand, new unexpected ethical problems will emerge from bioart, forcing us to question our own ethical standpoints, which is perhaps one of the innate purposes for such artworks existing in the first place.

Bioart works are temporal and ephemeral because as a condition of being alive, they have a finite lifespan and as a consequence, will die. However, given the time constraints of exhibitions, it is often the case that works outlive the span of the exhibition. Ionat Zurr of the TC&A reveals that once works leave the laboratory for display, they cannot return due to the risk of contamination, consequently, the living artworks must be destroyed and disposed of (Solon, 2011). To highlight this responsibility towards bioengineered life, Zurr describes how the TC&A “have a symbolic device to raise discussion – the killing ritual – where we invite audiences and curators to expose the tissue to the external environment and touch it and contaminate it" (Solon, 2011, para.26). Through the involvement of the audience in the

destruction of the living artwork, they force an encounter with the entire life processes of laboratory-grown life.

The complexities of the transdisciplinary foundations that inform the construction of living biological artworks are mirrored in the difficulty of attempting to define such works. Drawing from developments in contemporary bioengineering and transposing them into an artistic context through the actualised usage of these technologies in the material construction of artworks has provoked a reassessment of the nature of life and our ethical obligations towards other life forms, particularly new life forms that are a direct result of biotechnologies. Furthermore, given the controversial nature of many of these new life-altering biotechnologies, the artists who incorporate them into their practice appear to create inherently controversial and provocative artworks. However, this appears to be an intentional aspect of bioart practices and consequently creates a platform for discussion and debate around our relationship with new technologies and the inherent fears and anxieties they produce.

Through the production of living works of art, new ethical considerations regarding the care and disposal of living biotechnological products are brought to the forefront of ethical debates. Despite the application of pre-existing ethical legislation to bioart works in terms of production in addition to artists and exhibitions, extant ethical codes were not designed to control or regulate art; therefore, consideration must be given to new ways of thinking about living artworks and how best to ensure technologies are not misused, but also allows for creativity and fair, democratised use of biotechnology.

Living biological artworks force an encounter with the 'other' by presenting actualisations of new technologies that are consequently liminal forms of life as they are situated between subject/object and organic/manufactured binaries. This marginalised life is a product of our current knowledge and abilities; however, transferred from the laboratory to the art museum, these technologies are stripped of their immediate capital benefit, revealing the

raw materials of life and thus forces a reassessment of our uses of biotechnology and our developing future with them. Bioart works vary vastly in subject and materiality, therefore, the next chapter will explore visual, theoretical and contextual frameworks in order to provide a background for understanding the implications of encountering living artworks.

Chapter Two: Theorising Bioart

The use of living materials as art media and the subsequent manipulation of them using the tools of biotechnology presents new perspectives and understandings of life, matter and our relationship to new life forms. This chapter aims to address the theoretical implications that bioart presents by outlining them and offering a background for the subsequent examination of specific works and their materials in the third chapter. These theoretical considerations include the concept of materiality and how new considerations of matter expand understandings of the abilities and capacities of matter to produce effects. Additionally, posthumanism and its associated concept of transhumanism will be discussed in relation to how they assist in understanding the ambiguous life status and ethical position of the works created by bioartists. Finally, this chapter will examine ideas of otherness, including the abject and the uncanny valley as a basis for understanding encounters with living bioart as an uncanny life form that is situated between the familiar/unfamiliar, subject/object, living/non-living.

2.1 Matter and Materiality

Following the emergence of conceptualism in art in the mid-twentieth century, and later the material turn which infiltrated through all of the humanities and social sciences, the importance of materiality has become a primary issue in art theory (Berger, 2019). The material turn considers the roles, functions and capacities of objects and matter and "has been motivated by the perceived inadequacies of the linguistic turn and by new scientific definitions of matter, including living matter" (Mondloch, 2018, p.10). Drawing attention to the matter, the physical substances and materials that are used in the production of art to become the very basis of the work, in addition to how these materials play a role in the interpretation, understanding and embodied phenomenological experiences of art, the importance of materiality is equally

significant in our understandings of art. This recent focus on materiality has found prominence in critical discourses surrounding new, unusual, and non-traditional art media (Berger, 2019), which is significant in the emergence of bioart, in which biotechnology replaces traditional art media in the production and physical materiality of the art produced.

Matter, from a scientific perspective, refers to a physical mass that exists in physical space and can be thought of as principally being biotic, that is, living matter including humans, animals, plants, bacteria and cells, or abiotic non-living matter such as minerals, metals, water and light (Sharma, 2008). However, it is important to understand that biotic and abiotic matter co-exist in the same ecosystems and frequently, either directly or indirectly, interact with each other; these are often necessary interactions, such as the photosynthesis of biotic plant matter enabled through the abiotic light from the sun. The co-dependencies of biotic and abiotic matter demonstrate the complexities of separating one from the other conceptually, as together, they create interdependent networks.

Issues of attempting to define what it means to be living and fully understand the origins of our consciousness as living beings are contentious and have been researched and debated for centuries (De Sousa, 2013). While it is not currently possible to define life in an absolute sense, or precisely how the fundamental physical components of life come to emit consciousness distinct from non-living material entities, there are several characteristics of what life does that have allowed us to reach some degree of consensus from a biological perspective. As with most aspects of biological understandings, however, there are many exceptions to each rule, thus increasing the difficulties in attempting to categorise and define life, as discussed in Chapter Two. Human attitudes towards different types of matter and the uses of such materials are, therefore, complex and multifaceted and are often culturally informed. In this way, matter can be understood in more ways than its physical properties. Despite the importance of these fundamental properties, matter can be understood in more

dynamic, emotive or phenomenological terms than simply whether it is living or non-living, natural or artificial. This idea of the natural and the artificial being different forms of being has origins in Ancient Greece with the use of the terms *physis* and *techne*. Where *physis,* equivalent to the Latin, *natura*, refers to life and objects that come into being independently, its antithesis, *techne*, refers to objects that are produced and, therefore, "do not have their origin in themselves" (Dunshirn, 2019, p.1).

These divergent attitudes towards different types of matter are evident in treatment and attitudes towards different kinds of animals, plants or bacteria; these attitudes are often dependent on whether living matter is perceived at a molecular or organism level (Woese, 2004) and in terms of the genetic and relational proximity of the life form to humans, such as companion animals and primates (Carvalho, Gaspar, Knight & Vicente, 2019). This notion of a closer affinity or proximity to other animals, however, is a result of "the systemic and quite gymnastic categorisations we humans invent impotently [to] order the diversity of biota only to obscure our relations with the rest of the living world" (Zaretsky, 2007, p.267). Consequently, attributions of difference in attitudes towards different animals or living beings is a human construct that has occurred through the humanist categorisation of life, causing a rift in different human/non-human relations.

This is notable in regard to which animals are deemed 'acceptable' for slaughter and consumption. In certain countries or within specific religious beliefs, there are variabilities as to which animals are considered acceptable to kill and eat. Across some European and Asian cultures, horse meat is frequently eaten, whereas, in the US, the idea is more commonly regarded as being objectionable as horses have a close relationship with humans, both as companion and working animals (Enders, 2015). Similarly, in Hinduism, respect for animals and minimising their harm through food consumption is important and, therefore, many follow a vegetarian diet, however, among those who do consume meat, they do not consume beef due

to the cow being a sacred animal to the point that most states in India have a ban forbidding cow slaughter (Biswas, 2015). Both horses and cows are living mammalian animals with similar biological structures, and yet their materials are considered in different ways by different populations. Furthermore, studies have shown that people are more likely to be uncomfortable with large animals such as chimpanzees, monkeys, dogs and dolphins being used for testing purposes but express more neutral reactions to smaller animals being used, including rats, pigeons and carp (Bradley, Mennie, Bibby & Cassaday, 2020). Consequently, "categories of disgust elicitors are fairly uniform across cultures, although the particular items assigned to those categories manifest variation, such as the foods that are considered noxious; thus disgust is both pancultural and culturally variant" (Korsmeyer, 2012, p.754). This demonstrates the complexities of understanding material affectivity and the range of possible responses elicited based on specific materialities.

In the twenty-first century, however, distinctions between types of matter have become more complicated and interconnected, thus calling for new understandings of matter. These new understandings of matter have, therefore, emerged alongside the changes in scientific abilities in creating and altering matter, as the traditional scientific notions of living/non-living and natural/artificial no longer suffice in understanding and describing matter in the twenty-first century as "in the short space of these three decades, human beings have learned how to animate heretofore inanimate materials. It is by no means an oversimplification to say that we have, in at least in a few first, cautious steps, learned how to bring ideas to life" (Davis, 2007, p.249).

Living substances, including biological components, therefore, are no longer restricted to occurring naturally with the advent of synthetic biology. Still emerging as a research discipline, synthetic biology seeks to create and alter biological components and systems in the laboratory. These technologies are not just theoretical but are manifesting, with the first

completely functional synthetic genome, a synthetic poliovirus, being created in 2002 (Whitehouse, 2002), and the first bacterial genome, Caulobacter Ethensis-2.0, made by a computer in 2019 (Puiu, 2019). Being both biological organic matter but structures not emerging directly from or found within the naturally occurring world, contemporary science renders the categorisation of matter more complex and ambiguous than ever before. Consequently, these developments have, and will continue to have, significant impacts on the ways we think about, categorise, and ultimately utilise living matter. These new developments blur the boundaries between what we think of as being natural or unnatural, born or manufactured. In exploring the uses of biological materials and bioengineering technologies in the production of art, an understanding of the properties and capabilities of materiality is important. However, as with scientific definitions of matter, understandings of matter philosophically have changed and developed through history and continue to do so as our abilities to manipulate and create materials change alongside them.

2.1.1 Vitalism

An early philosophy of matter that concerns the relationship between life and matter is that of vitalism. Aspects of vitalism can be seen in the religions and beliefs of many cultures throughout history (Coulter, Snider & Neil, 2019). However, as a specific philosophy, the theory rose to prominence among biologists in the eighteenth and nineteenth centuries (Greco, 2005). Vitalism posits that living entities are intrinsically different from non-living matter, despite being made from the same physical elements, and that the origin and nature of life cannot be explained by physics, chemistry or biology; instead, vitalism deems life as an independent phenomenon that cannot be reduced to a scientific theory (Coulter, Snider & Neil, 2019). This independence or separation of life as a characteristic from the physical materiality

that it inhabits innately places the living hierarchically above the non-living, deeming it special and not able to be replicated by humanity, but only as decreed by some higher force.

This perspective is found in Mary Shelley's *Frankenstein* (1818), where the assemblage of body parts stitched together to create the creature requires a 'spark of life' from outside of the physical body in order to animate it. However, rather than by divine force, electricity is used, with Shelley's work is situated firmly in contemporary scientific beliefs, with her stating that "perhaps a corpse would be reanimated; galvanism had given token of such things, perhaps the component parts of a creature might be manufactured, brought together, and endued with vital warmth" (2013, p.x). Shelley's words reflect the influence of the scientist Luigi Galvani whose work with electricity during the late eighteenth century aimed to uncover the cause of life or what was required to animate the inanimate. Using electrical currents, Galvani was successful in making the legs of a dissected frog twitch and move (Pera, 1992). While now this is understand to be nerve reflexes activated by electricity, at the time this was thought to be a potential answer to understanding life and is why Victor Frankenstein uses electricity to bring his creature to life in Shelley's novel. However, vitalism during this period often takes a spiritual perspective with an emphasis on an approach that embraces the unknown and the unknowable, and that in opposition to materialism, not everything can be reduced to the same singular essence or force (Normandin & Wolfe, 2013). In the twentieth century, however, this form of vitalism was largely marginalised and replaced by new theories that valued the empirical evidence of the combined research of biologists, chemists and physicists, that the origin of life is endemically positioned within the chemical reactions of a being's physical constitution (Ramberg, 2000). This perspective is known as materialism as it suggests that all matter, including living beings and their conscious psychological processes stem from a fundamental material basis.

2.1.2 Materialism

In opposition to vitalism, materialism proposes that matter is the foundation for everything that exists, "rejecting a distinction between the physical world and the social constructs of human thoughts, meanings and desires" (Fox & Alldred, 2019, p.3). In this way, materialism posits that everything is a result of, or a by-product of, material interactions at a fundamental level. Like vitalism, the core concepts of materialism can be found in antiquity, with some of the preliminary examples of materialism found in the works of Epicurus, among other classical philosophers (Wolfe, 2016). However, the meanings, associations and usages of the term materialism have changed and evolved over time, and as a distinct philosophy, materialism began to emerge from the Enlightenment, with philosophers offering a contrasting view to René Descartes's dualism of the body being separate from the mind. Instead, materialists proposed that all of reality can be understood in empirical measures and that the spirit or the mind is included in this so that all properties that can be experienced have a material-based foundation.

As a philosophy that has grown and changed alongside the evolving scientific theories of matter, there have been many interpretations of matter and the behaviours and characteristics it can possess. These include Aristotle's understanding that matter is an empty, waiting vessel for containing forms and Isaac Newton's perspective that matter is fundamentally the subject of the laws of physics (DeLanda, 2015). Despite these differences, all of these changing conceptions of matter stress that all physical and non-physical properties of the universe are the product of material-based presence and the interactions that they produce. However, materialism has attracted criticism that its principles essentially "reduces everything to 'dead' matter, and that it eliminates the 'higher' intellectual or spiritual parts of life, and thereby cannot but be immoral" (Wolfe, 2016, p.6). This argument is particularly held by many religious perspectives which hold that life is something divinely appointed and fundamentally

separate from the physical world. Furthermore, criticism has also been directed towards the philosophy's dependence on scientific theory, which is subject to constant amendments as knowledge changes and, therefore, is an unstable philosophy.

Contemporary notions of materialism have, however, expanded and evolved into further branches as a means to understand the properties and behaviours of matter as being more than passive building blocks for forms. Of these branches, new materialism has come to the forefront of contemporary thought, offering a reinterpretation of the fundamental concept of matter and our relationship to it. New materialism reconfigures an understanding of matter as being active material, with its own unique capacities and behaviours. In this way, matter is not a static or passive substance but is "engaged in its own divergent, open-ended evolution, animated from within by immanent patterns of being and becoming" (DeLanda, 2015, p.16). This idea of matter being innately imbued with the capacity for action and effect is explored more in-depth by Jane Bennett in her approach known as vital materialism, however, the shared principles of both vital materialism and new materialism stress the unique capabilities of all matter.

2.1.3 New Materialism

New materialism marks a "theoretical and practical 'turn to matter'" (Fox & Alldred, 2019, p.1) in the humanities and social sciences that emphasises the importance and effectivity of the materials of the world. This includes both the natural, the artificial, the living, the non-living, spatial qualities, natural forces and human concepts and processes such as thought and feelings; while the inclusion of all of this matter as being of the same kind does not fit with traditional scientific concepts of matter, new materialism posits that all of these things have the equal ability to produce material effects and are contingent on each other (Fox & Alldred, 2019). The turn towards matter as being of importance follows "a perceived neglect or diminishment of

matter in the dominant Euro-Western tradition as a passive substance intrinsically devoid of meaning" (Gamble, Hanan & Nail, 2019, p.111). In a practical sense, this change of perspective has implications for traditional divisions of the natural and unnatural, the human and the non-human which has a consequential impact on our perspective of these relationships and environmental or ecological methodologies.

These new perspectives of materialism "signals a growing cross-disciplinary effort to challenge longstanding assumptions about humans and the non- or other-than-human material world" (Gamble, Hanan & Nail, 2019, p.111). As such, this renders new materialism as a prominent perspective arising out of a critical lens of anthropocentric attitudes that divide the natural world into dualisms, in which the human stands in opposition to nature rather than a part of it. Through the understanding of materiality to possess its own form of vitality and that this not only has the ability to cause effects, but that it does so because all matter is intrinsically interconnected, suggests a new understanding of the physical world and its relationship to the conceptual world. With this new attention towards matter, "new materialists consider that the world and history are produced by a range of material forces that extend from the physical and the biological to the psychological, social and cultural" (Fox & Alldred, 2019, p.2). In this way, matter is not a static, isolated physicality that is detached from the world and other forms, but is interconnected and produces both affects and effects. Rather than dividing types of matter, new materialism posits that all matter is "invested with a vitality or liveliness, as opposed to being inert and passive matter" (Fox & Alldred, 2019, p.2).

The notion of vital materialism as a specific approach to new materialism is put forward by Jane Bennett in, *Vibrant Matter: A Political Ecology of Things* (2010). Replacing traditional notions of non-living, or even non-human life as being passive objects, Bennett emphasises this ability all matter has to cause effects and "to give voice to a vitality intrinsic to materiality, [and] in the process absolving matter from its long history of attachment to automatism or

mechanism" (Bennett, 2010, p.3). The focus on the vitality of matter, irrespective of its life status or capacity to physically move, suggests a re-formation of ideas of life or what it means to be living. Even inert matter can have some kind of life force despite it not being intrinsically biologically living, as it has the ability to produce effects on the environment it is part of and the other materialities that it is inextricably interconnected with as part of the environment. This is because "new materialism opens up the possibility to explore how each affects the other, and how things other than humans (for instance, a tool, a technology or a building) can be social 'agents', making things happen" (Fox & Alldred, 2019, p.3). Furthermore, by

> conceiving matter as possessing its own modes of self-transformation, self-organisation, and directedness, and thus no-longer as simply passive or inert, disturbs the conventional sense that agents are exclusively humans who possess the cognitive abilities, intentionality, and freedom to make autonomous decisions and the corollary presumption that humans have the right or ability to master nature (Coole & Frost, 2010, p.10).

Tied into theories of posthumanism, new materialism decentres the human as the centre of issues of matter and instead considers all matter as being imbued with a sense of agency and force. As a standpoint that seeks to move beyond the anthropocentrism that currently operates in human/environment relationships,

> new materialism's post-anthropocentrism shifts humans from the central focus of attention, not only emancipating the affective capacities of the non-human but also establishing an ethics that can engage productively with human culture, with other living things, and with the wider environment of inanimate (Braidotti, 2013, p.60).

This understanding of matter as being active is also to understand that matter is not isolated but forms dynamic interconnections that work together. As Bennett explains,

> a landscape possesses an efficacy of its own, a liveliness intermeshed with human agency. Clearly, the scape of the land is more than a geo-physical surface upon which events play out. Clearly, a particular configuration of plants, buildings, mounds, winds, rocks, moods does not operate simply as a tableau for actions whose impetus comes from elsewhere (Bennett & Loenhart, 2011, para.3).

Furthermore, by understanding the forces of matter, and their capacities to interact and cause affect, there comes forth a worldview that rejects fundamental "differences between 'natural' and 'cultural' realms, human and non-human, structure/agency, reason/emotion,

animate/inanimate and – perhaps most significantly – between mind and matter" (Fox & Alldred, 2019, p.3). Instead, agency or force is not the sole possession of the living or the human but can be found in new and different ways amongst all materials.

For bioart, this way of thinking can open up new insights into the use of biological materials that are both alive yet not classified as independent living beings. As an art practice that is based on the use, reuse and repositioning of specific materials, a deeper understanding of materiality is required. This is required both for understanding the practice and for understanding its position and place as a new cultural form of life. The concepts found in new materialism help to understand and contextualise the materials of bioart. Marietta Radomska uses the term 'uncontainable life' in respect to the material understandings of bioart, suggesting that,

> this concept is intended to refer to an understanding of life as a material, dynamic, and excessive force of transformation that traverses the divide between the living and non-living, organic and inorganic, human and non-human, growth and decay, and, ultimately, life and death, as they are currently conceived (2016, p.32).

This uncontainability of life, or the ways in which understandings of matter as an expansive and affective force that cannot be reduced to a simplistic definition or idea, manifests through the marginal position of bioart as it resists categorisation. Radomska confirms that "uncontainable life dwells in the sphere of the in-between: it is processual, dynamic, and multiplicitous" (2016, p.32). In considering matter as complex active agents that are vast and interconnected and produce effects that are contingent on their environment and the people who interact with them in these environments, living biological artworks consequently suggest a reconfiguration of how we think about the affectivity and immersive embodiment of these works. The composition of bioart works, blending the natural and the manufactured, the living and the non-living, art and science, reveals new challenges and complexities in understanding and experiencing our relationships with other forms of life and different forms of matter.

2.2 Posthumanism

Posthumanism is a branch of philosophy that has emerged since the late twentieth century, which seeks to reconsider ideas of humanism through a displacement of the human-centric world view that humanism holds (Ferrando, 2013; Roden, 2015). By critically questioning "the very structures of our shared identity – as humans – amidst the complexity of contemporary science, politics and international relations" (Braidotti, 2013, p.1), posthumanism repositions the human in favour of a state of being 'beyond human'; that is, a reconceptualisation of what humans are as a species, what we are in the process of becoming, and our relationship with the rest of the planet as a consequence of contemporary scientific and technological advances. Posthumanism does not seek to replace or dismiss humanity but instead to reconsider the omissions that a Eurocentric, anthropocentric perspective neglects to consider (Miah, 2007).

Inextricably linked to advancements in medicine and technology, although with a distinct and separate foundation from each, posthumanism is often used as a framework for discussions of the ethical concerns that arise from both of these industries (Miah, 2007). These ethical concerns can be largely divided into two fields; the first being how medicine and technology will be able to permanently change or enhance human biology, and the second being the new forms of life created by these technologies. Concerns regarding the inevitability of medical augmentation of humanity, and the future capacities and rights of artificial life including Artificial Intelligence (AI), androids and cyborgs, posthumanist debates "provoke elation but also anxiety about the possibility of a serious decentring of 'Man', the former measure of all things" (Braidotti, 2013, p.2).[9] This displacement of the human, the definition of which is also brought into question, creates a new world view that challenges the dualistic boundaries between the natural/unnatural, nature/culture, and human/non-human.

[9] Artificial Intelligence (AI) is the development and implementation of computer programs which are able to perform tasks otherwise only able to be performed by humans; this includes problem solving and decision making. An android is a robot which appears human in physical form. A cyborg, or cybernetic organism is a being which has both organic and mechanically enhanced body parts.

As a critical theory, posthumanism is fundamentally a rejection and critical questioning of the established doctrines of longstanding Western humanist philosophies (Sterling, 2020). Founded during the Renaissance as a revival of the secular civilisations of antiquity, humanism displaced the idea of God being the centre of the universe in favour of man (Bolter, 2016). With the human being of greater importance than the rest of the natural world, humanism advocated for critical thinking and autonomy in navigating life, however, it simultaneously retained the humancentric hierarchical structures of many Western religions. This hierarchical configuration of the natural world can be seen in the *Great Chain of Being* [Figure 2.1], a Medieval Christian structure demonstrating the order of importance from God at the top, down to humans, animals, plants and minerals (Nee, 2005). A hierarchical system placing humanity above and separate from the rest of the natural world endured despite contemporary notions of humanism often rejecting religious viewpoints.

Contemporary humanism is most often associated with a secular perspective, with religion almost entirely removed from its philosophy and is built upon the premise that humans are fundamentally rational beings that are distinct from other animals, possess free will and are autonomous (Roden, 2015). In this anthropocentric view that places humans at the centre of the world, it is important to note in doing this, humanism emphasises the fundamental differences and privileges of humans over non-humans (Roden, 2015). Humanism advocates for secularist science and human agency over superstition, religion and ideas of preordained fate, however through these beliefs, humanism inherently privileges and favours the human, and therefore relationships with everything non-human, that is, animals, the environment, the artificial and the technological, are mediated through human interest, agency and opportunity.

Humanism and the anthropocentric values it advocates have faced challenges in the recent criticism of ecological change and environmental damage caused by human actions. The issue of climate change and environmental damage sits at the forefront of contemporary

political and social issues, with constant calls for global governments to take action and prevent any further destruction from occurring as most damage derives from preventable and avoidable human behaviours.[10] These behaviours include plastic pollution, greenhouse gas emissions caused by intensive farming, reliance on fossil fuels, deforestation and destruction of habitats, and the spread of urban development as a result of overpopulation. The cause of much of this damage is attributed not only to human behaviour but the lack of responsibility exercised towards the preservation of ecological health through the anthropocentrism of human activities. With this, there has been a movement towards posthumanist approaches with respect to ecological management and towards reducing and potentially reversing climate change that is caused by human activities. However, despite these problems being human-induced, posthumanism has highlighted the lack of equality present in humanity as

> not all humans are equal and the human is not at all a neutral category. It is rather a normative category that indexes access to privileges and entitlements. Appeals to the 'human' are always discriminatory: they create structural distinctions and inequalities among different categories of humans (Braidotti, 2020, p.466).

In addressing a potential move to beyond humanistic, anthropocentric attitudes towards the environment and other life forms, posthumanism advocates that to do this there must also be a move to inclusivity in recognising that humancentricism does not include all humans, but is often "based on a simple assumption of superiority by a subject that is: masculine, white, Eurocentric, practicing compulsory heterosexuality and reproduction, able-bodied, urbanised, speaking a standard language" (Braidotti, 2020, p.466). In this way "not all humans have been considered 'human enough' and not all living beings have been ascribed the status of 'life'. Being expelled from the ontological status of the human or of the living entails consequences at the level of ethics (respective ways of treatment, e.g. exclusion, discrimination, exploitation)" (Radomska, 2017, p.378). Therefore, to move beyond a human perspective

[10] In September 2019, more than 6 million people joined strikes and protests in more than 100 countries across the world to demand governmental action to address climate change (Taylor, Watts & Barlett, 2019).

means to move towards inclusivity of marginalised perspectives, which includes all humans as well as the environment and its other life forms.

The development of posthuman discourse deviates against the anthropocentrism of humanism and instead advocates for a theoretical approach that looks beyond the human and human hierarchical dominance. Critical posthumanism is "an interdisciplinary perspective informed by academic poststructuralism, postmodernism, feminist and postcolonial studies, and science and technology studies" (Simon, 2003, pp.2-3). In rethinking the divisive humanist structures placing the human in opposition to the concept of nature, critical posthumanism suggests that "a new, subtler, and more complex relationship to our planetary dimension is now needed and that a more egalitarian relationship to non-human others is called for" (Braidotti, 2017, p.10). Critical posthumanism, as a theoretical discourse, therefore, seeks to not only deviate from humanism but to deconstruct it entirely in the ongoing renegotiation and re-evaluation of what it means to be human in the twenty-first century; that is, "what it means to be human under the conditions of globalisation, technoscience, late capitalism and climate change" (Herbrechter, 2017, para.1). Consequently, critical posthumanism presents a reinterpretation and redefinition of humanism, in a way that takes into account contemporary socio-cultural, economic and ecological environments, and a "shift that also brings to an end the categorical distinction between life as *Bios*, the prerogative of *Anthropos*, and the life of animals and non-humans, or *Zoe*" (Braidotti, 2017, p.12).[11]

This breakdown of the distinction between types of living organisms parallels the efforts of new materialism in attempting to contest the separation and categorisation of types of matter and its qualities. The two approaches share a similar rejection of hierarchically based

[11] *Bios* and *zoe* are two concepts of life deriving from Greek; Braidotti describes the terms as "life is half animal: *zoe* (zoology, zoophilic, zoo), and half discursive: *bios* (bio-logy). *Zoe*, of course, is the poor half of a couple that foregrounds *bios* defined as intelligent life (2002, p.13).However, following the posthuman turn "the decentring of *Anthropos* challenges therefore the separation of *bios*, life, as the prerogative of humans, from *zoe*, the life of animals and non human entities" (Braidotti, 2016b, p.381).

attributions of power, impact or abilities, and instead suggest that more nuanced demonstrations of these qualities can be found across all materials and life forms. In this way of rejecting hierarchies, posthumanism anticipates and seeks a concept of the human that is postanthropocentric,

> decentring the human altogether, post-anthropocentricism emphasises the technological, ecological and biological entanglement of humans and non-humans in every dimension of earthly affairs. This ontological shift focuses attention on things and processes that may transcend or subvert human intervention, whether as individual objects or as variegated assemblages (Sterling, 2020, p.1030).

Therefore, the distinction between the Anthropocene and the post-Anthropocene would be a restructuring of the concept of human agency, and our relationship to technologies and the applications of technology, in addition to the rest of the planet and its other life forms; through this approach "what comes to the fore instead are new human-nonhuman linkages" (Braidotti, 2017, p.12).

Posthumanism has, however, not been universally accepted as a necessary or even legitimate approach to renegotiating human/non-human relationships and the de-stabilisation of human-centred approaches to ethics and morality. Kate Soper (2012) suggests that posthumanism is flawed in its reasoning of attempting to rid humanism of human exceptionality as the discourse is only able to exist through human abilities of moral reasoning that define humans as a different form to other forms of life. Soper states that "posthumanist representations and ontological claims, to put it crudely, are produced exclusively by and for human beings, and no other animal, a fortiori, no tree or stone, will ever question its own status as a being" (2012, p.376). However, Soper does concede that posthumanism can be successful in focusing on attempting to redefine what it means to be human, especially in relation to new technologies, but remains firm that human exceptionalism continues to exist, even if not in the way humanism originally defined it.

In addition to criticisms of the suggested irony of posthumanism only being relevant to humans, a further potential flaw with posthumanism is situated in the very notion of what it means to be human. By this, posthumanism and its many branches attempts to simplify the human, reducing it to a number of generalised behaviours, traits and statistics (Lang, 2018), therefore leaving it unclear as to what it refers to and fundamentally omits the inherent individuality of individuals, cultures and populations. Further to this, Zakiyyah Iman Jackson states that in ideas of posthumanism it is imperative to understand "what and crucially whose conception of humanity are we moving beyond?" (2015, p.216). A wider concept of the figure of the human in posthuman discourse is fundamental to account for the diversity of the human as a species, as Jackson (2015) suggests that without this acknowledgement the theory risks overlooking issues such as race, instead presenting a Eurocentric perspective of humanity. As an emerging discourse that focuses on a deconstruction of limited notions of the human, posthumanism continues to expand its remit to accommodate the diversities of race, gender, sexuality and disabilities in order to better understand the potential that the theory can offer in terms of understanding relationships between species and environments.

It is important, therefore, to define the theoretical difference between posthumanism and the figure of the posthuman, as while both terms are part of the same discourse, they have separate associations and the presence of one term does not inherently imply the presence of the other. As discussed, posthumanism, particularly critical posthumanism, is concerned with the theoretical reconsideration of humanism and of what it means to be human. However, the posthuman figure is distinct from this discourse in referring specifically to the individual that is, as the name suggests, in a state of being beyond human. The figure of the posthuman can include, therefore, the actualised and imagined technologically enhanced human, the robot, cyborg or android, or the form that is in other ways beyond human (Herbrechter, 2017). Through the use of technology, the figure of the posthuman is a transformed or enhanced

human which is most associated with a particular branch of posthumanism known as transhumanism.

2.2.1 Transhumanism

In many ways, posthumanism is an umbrella term for many associated concepts, most notably, critical, cultural and philosophical posthumanism, transhumanism, new materialism, antihumanism, posthumanities and metahumanities (Ferrando, 2013). While all of these concepts share a similar perspective in identifying the flaws and gaps in traditional humanism, they differ considerably in terms of their own philosophies and approaches to a state of being 'post human'. Of these different subcategories, transhumanism is one of the dominant and most commonly discussed discourses and is markedly distinct from the others. Transhumanism refers to the potential advancement of human beings, with the aim of perfection and betterment, in order to enhance the human body and mind. Also referred to as H+, transhumanism is distinct from posthumanism in that rather than seeking to disestablish the humancentric perspectives of humanism, transhumanists envisage a world of transformed humans, with an emphasis on humanity's uniqueness amongst the universe and how this could be enhanced and preserved beyond the natural body (Vigo, 2018). While critical posthumanism addresses the ways in which we approach human-centric notions and seeks balance rather than a hierarchical worldview, transhumanism champions the beneficial applications of human enhancement through new technologies and medicine. These enhancements are physical, intellectual and biological in nature and are found in the developing technologies of biomedicine, prosthetics, cybernetics and robotics.

The foundations of transhumanism as a technology-focused aim of improving the human can be found in technology research of the 1960s, with futurology research led by FM-2030 at the New School in Los Angeles, being one of the earliest advocates for human

technological advancement.[12] However, the first use of the term 'transhuman' predates futurology and is suggested to have been coined by Julian Huxley in 1951, in an eponymous paper concerned with overcoming the biological limitations of humanity, however, it has also been suggested that the phrase was used prior to this by Canadian philosopher W. D. Lighthall in 1940 (Harrison & Wolyniak, 2015). Despite the ambiguous origin of the term, transhumanism is now defined by the aspiration to fundamentally alter the human body at a biological level to improve human lifespans and abilities (Mirkes, 2019). As a branch of posthumanism, the philosophies of transhumanism are therefore concerned with the transformation of the human through taking control from nature, to be able to manipulate, change and evolve the human through the application of biotechnology, nanotechnology and information technologies (Roden, 2015). Furthermore, it is not only this possible manipulation that underscores the fundamental ideas of transhumanism, but that this transformation and enhancement is an ideal and desired outcome. The importance of this idea to the philosophy of transhumanism is clearly stated in Article One of the World Transhumanist Association manifesto, published in 1998, in that "(1) Humanity will be radically changed by technology in the future. We foresee the feasibility of redesigning the human condition, including such parameters as the inevitability of ageing, limitations on human and artificial intellects, unchosen psychology, suffering, and our confinement to the planet earth" (Allenby & Sarewitz, 2011, para.4).

The foundations of many of the technologies envisaged by transhumanists are already being created in laboratories and commercially sold globally, thus the perfection of the human body is becoming an ever-increasing reality due to the advancements of biotechnology and biomedicine (Mirkes, 2019). Through this conflation of humanist ideals and biotechnology,

[12] FM-2030 was one of the first transhumanists and legally changed his name from Fereidoun M. Esfandiary to FM-2030 inspired by his belief that technology would allow him to live for more than 100 years; born in 1930, his 100th birthday would fall in 2030, thus the inclusion of this date in his name. The FM derives from his previous initials. FM-2030 died in 2000 aged 69 and therefore did not achieve his goal, however, his body is currently preserved through cryonics.

transhumanists “believe that the traditional methods that humanists have used to foster them have been limited until recently by the material constraints of human biology and of nature more generally” (Roden, 2015, p.13). Procedures and technologies for enhancing the human body are already widely available commercially. Some enhancements are primarily aesthetic such as cosmetic surgery and anti-ageing treatments, however, others have been designed to enhance the abilities of disabled individuals and, as such, seem to function better and more efficiently than the human alternative, for example, running blade prosthetics (Greenemeier, 2016). Prosthetics, especially those designed for competitive sport, have the advantage of removing any flaws inherent in human body design, for example, running blades weigh less than feet, are more aerodynamic and are more energy-efficient (Greenemeier, 2016). Furthermore, there are also body modifications that are designed to make the human more compatible with the technological world, including microchip implants under the skin designed to be used in place of contactless travel passes or credit cards.

These modification technologies allow humans to change the way they look, the ways in which they move and the fundamental abilities of the body beyond its innate biology and physiology and will continue to do so into the future as technologies continue to evolve. However, it is important to note that these enhancements are not universally accepted, and in some instances, procedures such as microchip implantation have proved to be highly controversial with fears that given the ever-present threats of cybersecurity and government surveillance, it could become a compulsory procedure (Schwartz, 2019). Furthermore, in technologies becoming part of the body, the body becomes technologically connected to external corporate agencies who can then access information contained within the body and, therefore, in some way could claim ownership over part of the body. Despite the potential concerns these procedures posit, many individuals are choosing to adopt such technologies,

with Sweden having one of the highest uptakes, with over 4,000 individuals having undergone the procedure as of 2018 (Savage, 2018).

Commentary and criticism of these issues can be found in performance art and body art, with body modification and augmentation having been actualised, as evidenced in the works of Orlan and Stelarc. Such works demonstrate the potential for individuals to move beyond the confinements of the traditional concept of the natural body by using biotechnologies to enhance and modify their own bodies. Stelarc's *Ear on Arm* (2007) [Figure 2.2] saw the artist grow and implant an ear onto his left forearm. The ear was constructed using an ear-shaped Medpor scaffold implanted inside of his arm, then the skin over the top was suctioned to allow it to fit inside of the scaffold, revealing the shape. However, the ear is not only designed as a visual replica of the artist's own ear but was also fitted with a wireless microphone that was connected to the Internet, allowing others to listen to what the ear is hearing. Stelarc suggests "this additional and enabled *Ear on Arm* effectively becomes an Internet organ for the body" (Stelarc, 2021, para.2). The ideology behind the construction of the third transposed ear closely ties into posthuman and transhumanist ideas, with Stelarc stating that "a facial feature has been replicated, relocated and will now be rewired for alternate capabilities" (Stelarc, 2021, para.2). These alternate and new capabilities for the body, achieved through the use and application of technology fused with the natural, organic being suggests an actualisation of transhumanist thought materialised through performance art.

Performance artist, Orlan's work, *The Reincarnation of Saint-Orlan* (1990-1992) [Figure 2.3], also used biomedical procedures to artificially enhance and modify the artist's own body. Over a period of two years, Orlan underwent several cosmetic surgeries in order to re-present her face as famous faces of ideal beauty from art history, including Venus, Diana, Europa, Psyche and the Mona Lisa (Vaage, 2016). Using these figures as models, Orlan used her body as a tool and a medium for exploring the changing ideas of beauty throughout human

history, demonstrating the pervasive availability and use of cosmetic surgery in contemporary society as individuals seek to change their appearance alongside these changing aesthetic preferences. As an advocate of cosmetic surgery, Orlan embraces the aesthetic modification of the body, which coincides with the transhumanist aims of being free from the constraints of the natural body. Cosmetic surgery employs new technologies such as lasers and implants which allow the body to be reimagined, redesigned and recreated, ultimately producing a new and improved body. While these improvements are only aesthetic and sometimes procedures such as Botox are only temporary, they highlight the potential malleability of the body.[13]

The works of Sterlac and Orlan are both positive and supportive of new technologies and what they can do using the human body as a canvas. These works are more closely aligned with the aims and values of transhumanism, with both being extreme examples of self-experimentation and artistic bodily enhancement through technology, rather than critical posthumanist theory, however, there is a strong presence of posthumanism within contemporary art, distinct from bioart practices, as well as bioart-based posthumanist engagements. As a theory focused on dissolving the hierarchies of humanism, expanding definitions and understandings of what the human is or can be, in addition to drawing attention to and elevating other forms of life, contemporary posthuman art takes many forms, from sculpture to robotics and offers new immersive interactions with posthuman life, cultures and environments.

2.2.2 Posthuman Art

Posthumanism, as a critical theory, seeks the reinterpretation of the human, in part through the embrace of technology and utilising technology to advance humanity. Throughout history, the

[13] Botox is the commercial name for the cosmetic use of the commonly used toxin, OnaboulinumtoxinA, which is injected into the skin and reduces visibility of wrinkles by paralysing muscles that cause facial movements (Berkowitz, 2017).

visual arts have frequently played a vital role in carrying and amplifying the messages of new socio-cultural movements, and the posthuman movement has been no different (Kordic, Godward, & Martinique, 2016). Given the inclination for artists to demonstrate new and different perspectives through their work, it is clear that the contemporary visual arts are a space to imagine, create and envision the posthuman, and a perspective that is not necessarily favourable and hierarchical for humanity, instead utilising other perspectives and identities.

The origins of posthumanism within art can be traced to the Futurist movement of the early twentieth century (Kordic, Godward, & Martinique, 2016). Born out of the rapid development of industry, the Futurists placed a heavy emphasis on embracing the new, the fast, the mechanical and the modern while firmly rejecting notions of the past. Initially founded by poet Filippo Tommaso Marinetti in 1901, Marinetti envisaged a reinvention of Italy which, to his mind, was remained conservative in embracing the potential benefits that new technologies could bring. Solidifying his ideas, Marinetti published the *Manifesto of Futurism* in 1901, which set out principles of embracing a technologically informed future. In this manifesto, Marinetti stresses the importance of embracing technology with passion and vitality, stating that

> 4. We declare that the splendour of the world has been enriched by a new beauty: the beauty of speed. A racing automobile with its bonnet adorned with great tubes like serpents with explosive breath ... a roaring motor car which seems to run on machine-gun fire, is more beautiful than the Victory of Samothrace.
>
> 5. We want to sing the man at the wheel, the ideal axis of which crosses the earth, itself hurled along its orbit (Marinetti, 2020, p.3).

While in form most Futurist art bears little resemblance to posthuman art, in part due to the fluid diversity that comes with posthumanism, the critical philosophical ideals demonstrate a grounding for posthumanism. However, one key difference in the values of the two ideologies lies in the attitudes towards technology. While posthumanism embraces technology on a wide scope, the Futurists firmly celebrated technology as a conquest of the human over nature

(Berghaus, 2009). This acceptance and promotion of technology is found in parts of posthuman thought, particularly in branches such as transhumanism, however, it is not necessarily ubiquitous of the entire field. In many respects, many posthuman discourses critique and comment on the destructive capacities of technology, particularly when used by humans to control and profit from the environment, consequently causing damage.

Nevertheless, the art of Futurism has evident similarities with posthuman ideologies. Uberto Boccioni was one of the first artists to join Marinetti, and his works, such as *Unique Forms of Continuity in Space* (1913), clearly set out the legacy of connectivity between Futurism and posthumanism. However, it is Jacob Epstein's *The Rock Drill* (1913) [Figure 2.4] that displays a compelling and significant foundation for this relationship. Epstein presents a humanoid form, but angular and distorted in its hard metal frame. Like a futuristic vision of a cold, metal human, it appears hostile and unemotional in its gaze, raising the question of how much humanity is left in this new metallic form of humanoid. Symbolising a new era that witnessed the First World War, and with it, a growth in the forces of human and machine brought together for the first time in an unprecedented way, *The Rock Drill* is symbolic of this new age. After the news of the deaths of British soldiers during the war, Epstein removed the drill from the figure in respect of the dead. In doing this, the work not only shows a figure of the posthuman but in this act, the work, like posthuman discourse, becomes a critique of our relationship to technologies and the potential for the negative impacts they can propagate under human use. This sensibility can also be found in contemporary practices, where artists have chosen to understand, critique, question or engage with new technologies, new lifeforms and new humanity in order for the audience to reconsider their position in relation to them.

In contemporary art, the impact of posthuman thought is present across a wide range of practices which include the assimilation of non-human life into the everyday, transhumanist body augmentation and imagined new forms of life. As previously discussed, Sterlac and

Orlan's physical bodily modifications have a close connection to transhumanism and actively engage in improving and changing the human, and appear to present an optimistic view of the use of these technologies. However, there are many more artists who demonstrate complex and diverse engagements with posthuman ideas, this is evident in the practice of Australian artist, Patricia Piccinini. Many of Piccinini's works, such as *The Young Family* (2002) [Figure 2.5] and *Still Life with Stem Cells* (2002) [Figure 2.6], have been included in discussions around bioart as they focus on hybrid-like creatures. However, Piccinini's works are large-scale installations made from silicone and polyurethane and, therefore, would not necessarily ubiquitously fall under the category of bioart unless the artist specifically stated they were engaging in bioart using a theoretical or critical approach to bioengineering and concepts of life. Piccinini's works nonetheless present an engagement with posthuman life forms, often depicting hybrid creatures, slightly humanoid in some features, yet uncanny and grotesque in the animal-like forms they take (Mondloch, 2018). These works highlight a blurring of boundaries between the natural and the technological, and the self and the other (Toffoletti, 2007). These hybrid biological specimens are often engaged in exchanges with humans or in family groups with other similar forms and suggest strong emotional responses of both affinity and aversion. While the figures often appear monstrous in form, they call for responses of empathy from the viewer by their tangible humanity despite appearing fundamentally unhuman (Mondloch, 2018). Speaking about these fusions of binary dualisms presented by contemporary biosciences and technology in relation to her 1997 video series, *Protein Lattice*, Piccinini explains

> it is no longer relevant to oppose the artificial to the natural. This dualism, which was rendered self-evident by the juxtaposition of the 'mechanical' against the 'organic', can no longer be sustained. It is not even a question of championing the artificial against the natural, as Huysmans did. The organic is now the stratum through which the cutting edge of technology most regularly passes. It is commonplace for human children to be conceived and born via artificial means. To call the progeny of an IVF conception an 'artificial' or 'unnatural' person is as ludicrous as to deny the fundamental involvement

> of technology in its birth. It's not so much a question of claiming, as Donna Haraway does, that we are all cyborgs. It is more to the point to acknowledge that technology is getting increasingly natural (Piccinini, 1997, para.1).

The visual presence of a life-form that is not quite human but too human-like to be non-human presents an uncomfortable confrontation that is on the cusp of reality given the omnipresence of bioengineering practices. Provoking questions of what is human and non-human, what is natural or artificial is poignant to contemporary technologies and to posthuman discourse, as the artist places the viewer in a position of a voyeur, observing the vulnerable life-form which appears almost human-like in its facial expressions, yet it is an art object. As imagined hybrid creatures, Piccinini's sculptures visualise transgenic practices on a large scale, however, the artists' position on whether this is a positive or problematic future remains unclear, reflecting the ambiguities of bioengineering practices in general. Fundamentally, Piccinini's works are inanimate, abiotic sculptures and are stationary objects that are only imagined futures. There are, however, other forms of life explored within posthuman art which conflate the dualisms of object/subject, natural/artificial further without being actualised bioengineered life forms; this includes robotic life, artificial intelligence, and life which fuses both the natural and the artificial in the form of the cyborg.

Robotic life has become a central focus in posthuman art, both as subject matter and as the material basis for works. Vincent Fournier's photographic series *The Man Machine* (2009-10) features a number of images in which different androids participate in scenes of everyday life alongside humans who appear to not notice their difference. The series proposes the idea of a future in which robotic life forms have assimilated into everyday life, however, this future is also the present as the android's featured in the work are all pre-existing machines. In one photograph, an android known as ASIMO, made by Honda in 2000, is seen walking through the corridor of a museum, looking around the space at the classical sculptures within it [Figure 2.7]. In another photograph, REEM-B, an orange and grey cubist-looking humanoid robot,

made by PAL Robotics in 2008, is pictured standing on an outdoor basketball court, holding the ball ready to shoot, with two small children standing nearby seemingly playing with the robot [Figure 2.8]; and in a third image a small self-balancing, bicycle-riding robot named Murata Boy, developed by Murata Manufacturing in 2005, is seen being assisted by a woman kneeling by its side [Figure 2.9]. Fournier describes the work as "a balance between the spectator and the robot, between a process of identification and distance" (Yellowtrace, 2019, para.2), as the photographs show an assimilated society that is possible of the future, yet suggest an inherent apprehension in these changes through the development of a new society that is not fully human. Despite robots and androids being created by humans using human knowledge, there are deep-seated fears of robots and artificial intelligence threatening to usurp humanity. In 2017, *The Guardian* reported that more than 70% of US citizens were concerned by a future where robots and artificial intelligence would take on human roles and jobs (Solon, 2017).

The conflation or assimilation of human and robotic life is present in Patrick Tresset's *Human Study #1, 5RNP* (2012-2018) [Figure 2.10], a robot installation that utilises five robotic 'arms' to complete pen portraits of the viewer seated opposite. Named Paul, the robot uses cameras to 'see' the sitter and then copies their likeness onto paper by drawing using its arms. Like Fournier's work, Tresset destabilises the idea of the human by showing the ability of a robot to draw, presenting a future in which behaviours thought only to be human, such as creating art, become democratised among all life forms, thus confronting the viewer's preconceptions of human superiority and what defines us as being different from other life forms, or indeed if we are not. These posthuman perspectives challenge and destabilise the human, our place, behaviours and social order through the insertion of the artificial life which can assist us but is inherently an unhuman 'other'.

2.3 Otherness

In order for there to be a concept of the 'self' as an individual subjective identity, it precludes that there must be, by default, an 'other'. The other is the opposite of the self, is marked by difference and is key to ideas of identity and identity construction (Kastoryano, 2010). The other is located outside of the self and is an external presence that is often considered a threat to the self. Otherness is often found in political discourse to describe the condition of socio-political exclusion and alienation of difference and those who are marginalised by the state, its institutions, and its holders of power as "definitions of others in a negative way, especially by the more powerful groups, often lead to the other being denied access to vital societal resources, accessible to the more powerful group (Okolie, 2003, p.2). The idea of the other is, therefore, a key and fundamental role in the creation and maintenance of social relationships, hierarchies and power, in addition to interpersonal relationships and ideas of self-identification and definition (Kastoryano, 2010).

The figure of the other is central to Emmanuel Levinas' philosophy of ethical relationships within human societies. According to Levinas, the fundamental part of the phenomenological encounter with the other is the face, which both differentiates the self from the other, but also is the key element in creating a relationship to the other. This is particularly true of an ethical responsibility and relationship with the other, as Levinas' states that it is the face which "orders and ordains us" (Levinas, 1985, p.95). By this, Levinas is fundamentally referring to the face-to-face encounter, rather than through images or other non-direct encounters, and in this way, it is the face that is the embodiment of the other, which has similarities to the self but is an external other. The face, therefore, gives the other humanity and in the face-to-face encounter it demonstrates a defenselessness. Furthermore, it is through this encounter with the face that reflexively reveals that the other is not reducible to the face but that the other is more than only a face. Recognising the humanity of the other through

seeing the face, the face of the other is a symbolic plea for ethical and responsible behaviour and consequently requires the self to act in this way.

The ethical responsibilities to the other that are employed by the face are significant and complex issues in contemporary culture due to the ubiquitous presence of the Internet. The twenty-first century has witnessed a drastic shift in how we encounter the world and mediate relationships with other people. With the interconnectivity afforded by the Internet, individuals are able to communicate globally en masse with strangers through social media platforms, for example, thus interacting without the face. This has resulted in a culture which can operate in reverse to Levinas' philosophy, in that encounters which occur without the human face no longer have obligations of no harm and may, therefore, result in a culture of different ethical standards where the other can be attacked without being morally aligned by the sight of potential human pain. As a consequence, the lack of accountability to the face as a reminder of ethical responsibilities, online abuse and cyberbullying have become significant social issues causing real-world harm to individuals, manifesting in psychological and emotional harm, particularly among young and vulnerable individuals (Peled, 2019). These online behaviours and interactions have been found to be significantly different from offline encounters due to the absence of the face, which is the reminder of the real, vulnerable human presence. The Internet, therefore, has the ability to alter human behaviours and despite these behaviours taking place on digital platforms, they have real-life impacts and consequences and highlight the inherent nature of relationships between the self and the other. This emphasises the importance of the presence-based encounter in terms of ethics, responsibility and a decider of an individual's moral stance, all of which is relevant to encountering works of living bioengineered art.

The notion of the other inherently divides and separates individuals and groups into opposing dualisms of the self/other and us/them. These dualisms exist within societies

constantly, as Zygmunt Bauman states that, “woman is the other of man, animal is the other of human, stranger is the other of native, abnormality the other of norm, deviation the other of law-abiding, illness the other of health, insanity the other of reason, lay public the other of the expert, foreigner the other of state subject, enemy the other of friend” (Bauman, 1991, p.8). With these opposing others, societies are divided with seemingly nothing in-between these divergent categories, rendering every individual into one of two states, the self or the other, the same or the different. Furthermore, existing outside of these dualisms automatically renders the individual as other by failing to fall neatly into the expected this or that, self or other form of categorisation. These divisions are innate among many species, not only human cultures, and demonstrate instinctive defensive and self/species preservation behaviours, such as aggression between adult female chimpanzees of one population when confronted with a female from another group, which often leads to the killing of any infants belonging to the newcomer (Pusey & Schroepfer-Walker, 2013). By othering potential threats such as an animal of one species moving into the territory of another population of the same species, this prevents danger to the self as the other can be harmed and killed as it is not the same. However, these behaviours are damaging in their divisions, alienating and marginalising the other for being different, placing them outside of the norms and accepted values of a society.

2.3.1 The Uncanny

The uncanny is a broad-ranging yet ambiguous psychological phenomenon. In many ways, it is unspecific, provoked by experiences that are in some way a confrontation of the expected with the unexpected. It is a sensation of unfamiliarity but tinged with a feeling of the familiar, as it is “not simply an experience of alienation but a commingling of the familiar and unfamiliar” (Royle, 2003, p.1). The uncanny is most often associated with the feeling of strangeness and “involves feelings of uncertainty in particular regarding the reality of who one

is and what is being experienced" (Royle, 2003, p.1). It is this conflation of reality and the imagination, the known and the unknown or even unknowable, the familiar and the alien that is at the heart of uncanniness.

In contemporary usage, uncanny is often used to describe an unsettling feeling caused by a close resemblance of two things or something familiar which is out of place, such as two strangers who in appearance look as though they could be twins but are not related. While the resemblance itself is not uncanny, it is the realisation that they are not the same person or share the same DNA that is unsettling. However, identical twins are also uncanny in that they visually appear as doubles and a repetition which is innately uncanny as it is not typical for individuals to appear as such. The twin is, therefore, a natural form of the double. The double or the doppelganger has a long history associated with feelings of unease and is often found in European folklore, for example, an old premonition stating that meeting your doppelganger is a premonition that you are about to die (Royle, 2003). The idea of the double is found in Sigmund Freud's interpretation of the uncanny, where he suggests that the double represents a resistance against the threat of the extinction of the self. By this, he suggests that the double increases the chances of survival.

The first in-depth exploration of the concept of the uncanny as a psychological phenomenon was undertaken by Freud in his 1919 essay, *The Unheimlich*; however, prior to this, the idea was explored by Ernst Jentsch in his 1906 work*, On the Psychology of the Uncanny*. Freud used the German term *unheimlich*, meaning strange, weird or unhomelike, and contrasted it against the *heimlich*, meaning homelike, but also with a double meaning of hidden or concealed. In his work, Freud suggests that the strangeness of the ordinary is present and gives a sense of being out-of-place and that the unheimlich is a sense of the re-emergence or revealing of what has been hidden or repressed. For Freud, the uncanny "belongs to all that is terrible—to all that arouses dread and creeping horror; it is equally certain, too, that the word

is not always used in a clearly definable sense, so that it tends to coincide with whatever excites dread" (1919, p.1). This unveiling of the hidden or the unknown produces feelings of anxiety, dread and unease as the unknown becomes the known, yet it is 'other' and not able to be assimilated into the self.

Feelings of uncanniness are brought about often suddenly in response to the unexpected and is most likely to arise when the boundaries between the imagined and the real are blurred (Royle, 2003). In this way, the uncanny is a response of uncertainty and a signal that what is experienced is not what it seems at first glance. There are many things that evoke the uncanny, including "fear of losing one's eyes or genitals, realising someone has a missing or prosthetic body-part, in the strange actuality of dismembered, supplementary or phantom limbs" (Royle, 2003, p.1), in addition to dolls, human-like robots (androids) and cyborgs, and twins and doppelgangers, among other things (Rahimi, 2013). For Freud, "dismembered limbs, a severed head, a hand cut off at the wrist, feet which dance by themselves —all these have something peculiarly uncanny about them" (1919, p.14). These provocateurs of the uncanny blur elements of the unexpected and the expected, causing discomfort; dolls, robots, mannequins and other human-like forms are not living, and yet they possess an agency and a presence which continually makes us question whether they might be alive. Similarly, dismembered body parts become uncanny when they are separated from the body, evoking a visual threat to the sense of self through the conflation of the expected and unexpected. The uncanny response from objects that are human-like in appearance, yet not actually human, or are human but not attached to a body, elicit a response of intense rejection, theorised as the uncanny valley.

2.3.2 The Uncanny Valley

A newer insight into the understandings of the uncanny is the theory of the Uncanny Valley, as described by robotics researcher, Masahiro Mori in 1970. Despite being published half a

century ago, Mori's essay titled, *Bukimi no Tani Genshō* (不気味の谷現象) describes a future filled with robots who would look and act almost identically to humans (Katayama, 2011). While these robots would be able to perform useful tasks, such as production line assistance in a factory, Mori points out that with a human appearance, these robots would be seen as monstrous in their apparent humanness. Mori's essay was first translated into English in 1978 by Jasia Reichardt in her work, *Robots: Fact, Fiction, and Prediction.* It is from this work that the phrase 'The Uncanny Valley' derives, however, there has been some dispute regarding the accuracy of this translation of *Bukimi no Tani Genshō*, with some suggesting that *Valley of Eeriness* is a more accurate translation (Hsu, 2012). Despite this difficulty of translation, the fundamental concept behind the theory is expressed by both interpretations as it is concerned with intangible feelings of discomfort and creepiness.

The idea of the uncanny valley is based on the relationship between how much an object resembles a human and how people emotionally respond to the object. Mori suggests that when objects such as robots, prostheses or computer-generated images closely resemble humans but are not humans, nor look exactly human, the observer experiences a feeling of eeriness and creepiness. Specifically, the uncanny valley describes the positive correlation of the affinity between people and objects that look and act like humans, up until a point where the likeness becomes uncanny and the correlation sees a large dip, or 'valley', where affinity turns to rejection and aversion [Figure 2.11]. This sense of unease or uncanniness derives from a sense that something is not quite right and not quite human. However, the eeriness comes from a conflation of appearing too human to be non-human, but not exactly humanlike; it is a jarring experience of the non-human appearing to be human which is then perceived as a threat to the self. When developing the idea through his robotics work, Mori explains that "you know those wax dolls at exhibition halls? Like Columbus discovering America? I never really liked those. When I started working with robots, I remembered those dolls, and I thought, wouldn't it be

creepy if there was a human who didn't blink? If their eyes just stared and stared at you …" (Katayama, 2011, para.3). Similarly, the phenomenon of the uncanny valley can be found in expressionless faces of the deceased, even though they are human, however, by lacking the distinctive behaviours of being alive such as breathing and blinking, the dead appear eerie and therefore the level of affinity drops.

In identifying the point where the humanlike similarity descends into the uncanny valley, Mori suggests that ASIMO, the humanoid robot made by Honda in 2000, sits just before the drop of the uncanny valley (Katayama, 2011). ASIMO is a 130cm tall, bipedal android with a white, rounded plastic body that has been described as looking like a spacesuit and has a large black screen in place of a face [Figure 2.12]. ASIMO is able to walk, recognise human gestures and interact with its environment. In contrast, the Actroid line of humanoid robots, produced by the Kokoro company since 2003, are highly representative of the uncanny valley. In particular, the Repliee androids resemble women and wear human clothing, making them appear almost identical to the human models they are based on [Figure 2.13]. Furthermore, they are designed to simulate breathing, blinking and are able to learn new behaviours by observing humans. These two examples demonstrate the boundaries of the acceptable and the uncanny and exemplify the uncanny valley's suggestion that humans generally feel more affinity towards non-humanoid robots and usually prefer them over humanoid robots.

There have been several recent occurrences of the uncanny valley within popular culture, most notably the 2019 film adaptation *Cats* [Figure. 2.14]. Using computer-generated imagery (CGI), actors were animated with feline features in post-production with the end result of human-cat hybrids which prompted strong criticism from both critics and audiences (Malvern, 2019). The film was critically denounced, with some suggesting that "many of its uncanny images are sure to haunt viewers for generations" (Hans, 2019, para.5). Furthermore, in early 2019 Paramount Pictures released a trailer for its film adaptation of the video game

character *Sonic the Hedgehog* [Figure. 2.15], however, akin to the response to *Cats*, audiences strongly criticised the eeriness of the humanised characters (Lodge, 2019). However, as the film had not been completed at the point of the trailer being released, Paramount Pictures redesigned the character before the release to greater public approval.

The uncanny valley is predominantly considered to be a theory of aesthetics, particularly associated with how humans perceive and judge robots and other humanoid objects, however, it is possible to draw parallels between the discomfort in appearance with uncanny uneasiness arising from materiality and, as such, this is where the uncanny valley meets media-based bioengineered bioart. This connection between bioart and the uncanny has been suggest by Marcus Wohlsen, who suggests "the irony of much bioart lies in the creepiness or queasiness it induces: The more the 'materials' used in the work resemble 'us,' the less comfortable we feel around it" (2011, p.201). Bioart then has the potential to invoke feelings of uncanniness, causing revulsion and a separation of it as other from us as the 'self'.

2.3.3 The Abject

Abjection is another concept that is intricately related to the uncanny and to ideas of otherness in general. Literally meaning 'to be cast off', the abject is concerned with the breakdown of the boundary between the self and the other (Felluga, 2011). However, rather than the self and the other being assimilated, abjection marks a repulsion and rejection of the other as the self no longer recognises the other. Like the uncanny, the abject is concerned with dualities of recognition and a failure of recognition, the known/the unknown, and the self and the other. The abject is often associated with the visceral qualities of horror in both film and literature; for example, excessive blood is a common feature used for inciting horror, as seen in Peter Jackson's *Braindead* (1987), as is the use of excessive excrement and waste, seen in Bong Joon-Ho's *Parasite* (2019). Used in excess, these bodily fluids and waste products force the

viewer to experience discomfort and disgust as they are presented with the return of hidden or discarded matter. Furthermore, the abject is also used in discourses of otherness, and in discriminatory behaviours, wherein it has been used to describe the stigmatisation of individuals and bodies which do not fit societal norms.

These discourses on the abject generally stem from two prominent theorists; psychologist, Jacques Lacan and then later, Julia Kristeva. Lacan's work on the idea of the abject is based on theories of psychoanalysis and makes links between the symbolic order and the abject. Kristeva's work is heavily influenced by Lacan's initial connection between the abject and the symbolic. The symbolic order, according to Lacan, refers to the collective structure of language and the cultures which produce language, including the interconnectivity between language and culture, and the intersubjectivities within them (Sheikh, 2017); and, therefore, experiences of the subject are mediated and understood through language. However, the abject, as the instinctive disgust of the repressed, exists outside of the symbolic order (Hook, 2003). Lacan's abject can be understood as a psychological process of separating and detaching that which is not the individual nor can be assimilated from the individual's environment. That is to say that abjection is the response process to an external other rather than the other being inherently abject. Consequently, existing outside of the symbolic order, the way things are understood and processed, encountering the abject causes a disturbance and signifies something which cannot be assimilated by the individual.

Kristeva's theorisation of the abject posits that the abject is the disintegration of the boundary between the self and the other that causes a lack of recognition of the other and, therefore, elicits a response of disgust and repression. In opposition to Lacan's concept of the *objet petit a*, wherein an unattainable object of desire is seen in the other, Kristeva's abject is less concerned by the symbolic order, instead focusing on the instinctual and primal fears that are pre-linguistic (Felluga, 2011). In this way, the abject represents the most universal fears

and threats to the self, which appear to be instinctive responses to encountering otherness. Kristeva explores the notion of abjection in her 1982 work, *The Powers of Horror: An Essay on Abjection*. In describing the abject, Kristeva suggests,

> there looms, within abjection, one of those violent, dark re-volts of being, directed against a threat that seems to emanate from an exorbitant outside or inside, ejected beyond the scope of the possible, the tolerable, the thinkable. It lies there, quite close, but it cannot be assimilated. It beseeches, worries, and fascinates desire, which, nevertheless, does not let itself be seduced. Apprehensive, desire turns aside; sickened, it rejects (Kristeva, p.1).

The body is, therefore, regarded as the main site of the abject, as it is the physical space of the self. However, it is specifically waste matter that is expelled from the body that Kristeva considers as being abject, "such as feces, urine, vomit, tears, and saliva are repulsive because they test the notion of the self/other split upon which subjectivity depends" (Covino, 2014, p.17). Inside the body, these substances are part of the self, however, once they have been excreted they are no longer the self. The abject is the disgust and repulsion of the visceral other that was once the self but can no longer be recognised as such. Bodily fluids, hair, teeth and even limbs and internal organs can also be considered abject once they have been separated from the body. The skin is, therefore, the boundary of the self and beyond this boundary all else is other. It borders the self from that which is abject. Once the abject material is separated from the body, it is unclean, visceral and repulsive. Kristeva describes this as "loathing an item of food, a piece of filth, waste, or dung. The spasms and vomiting that protect me. The repugnance, the retching that thrusts me to the side and turns me away from defilement, sewage, and muck. The shame of compromise, of being in the middle of treachery. The fascinated start that leads me toward and separates me from them" (1982, p.2). According to Kristeva, the ultimate manifestation of this bodily conception of the abject is found in the physical body of the corpse. The corpse is the fundamental meeting point of the self and other, and the real and imaginary, as it forces a confrontation with the inevitable future of our own death and decay; in Kristeva's words, the corpse "is death infecting life" (1982, p.4).

The abject is not only confined to the biological material of the body, but also human behaviours. Many of these behaviours and acts do, however, still centre around the body and other bodies, as even in behaviour, the abject is the severance of the self and other to a point of alienation, and "religious abhorrence, incest, women's bodies, human sacrifice, bodily waste, death, cannibalism, murder, decay, and perversion are aspects of humanity that society considers abject" (Pentony, 1996, para.2). These acts are abject in both a practical sense that they cause repulsion or acts of violation against order and are simultaneously abject as they are manifestations of otherness, immorality and illegality. Violations of the social, biological and cultural orders can be seen as abject as they threaten the accepted order of meaning and the known and the understood.

Despite the abject being heavily associated with visceral, biological material, Kristeva highlights that the threat and repulsion are not due to a fear of contamination, and that "it is thus not lack of cleanliness or health that causes abjection but what disturbs identity, system, order. What does not respect borders, positions, rules. The in-between, the ambiguous, the composite" (Kristeva, 1982, p.4). Therefore, the abject other represents a threat to the self as it is a confrontation with alienation and threatens to absolve the self through this ambiguity and lack of order. The threat of the abject is not a threat caused by harm elicited by the other, but in the realisation of the self at risk of disappearance through the breakdown of the barrier between the self and the other. However, despite this threat, Kristeva suggests that while we are repulsed and reject the abject other in disgust, it simultaneously draws us in, thus, the confrontation is both captivating and alienating. In this way, the other is in many ways unavoidable, and sits as a reminder of what is not the self, therefore continuously troubling, disturbing and provoking a reassessment of the self.

2.3.4 Disgust and Art

The abject as an embodied response that rejects what is not the self, or a threat to the self is, therefore, evoked by disgust and repulsion of the visceral. Disgust "is an emotion that is visceral, reactive, and uncomfortable" (Korsmeyer, 2012, p.753). In this way the object of disgust affects the self physically as well as emotionally and prompts a response that causes us "to gag or recoil in the presence of its objects" (Carroll & Contesi, 2019, p.23). Objects of disgust are, consequently, similar to the stimuli of the abject which also elicits physical and emotional rejection of otherness, however, not all objects of disgust are abject. Where the abject threatens the boundaries of the self, such as bodily fluids or disembodied body parts, objects of disgust have a wider remit and in addition to bodily waste, infections and mutilations can include "the vermin that congregate to take care of these unseemly objects are also on the list of disgusting objects: swarms of insects, maggots, avidly chewing rats" (Korsmeyer, 2012, p.754). Furthermore, disgust can be evoked by moral and behavioural violations, including "filth, contamination, mutilation, and decay" (Korsmeyer, 2012, p.754). These objects of disgust are "often impure, or incomplete or unclean, excessive, categorically contradictory relative to a dominant cultural scheme, forbidden, freakish, particularly biologically. They are things to be hidden, shunned or avoided" (Carroll & Contesi, 2019, p.23). Yet, these objects, both materially and representationally, have found their way into the subject matter of contemporary art.

The power and affectivity of disgust as an emotional response has been "purposively aroused by art in ways that contribute substantially to the meaning of a work" (Korsmeyer, 2012, p.753). Disgust, therefore, can be a purposeful emotional provocation intended to not only repulse the viewer, but to offer new understandings or perspectives through this repulsion. Carolyn Korsmeyer explains that,

> artworks have always deployed disgust with images and descriptions of mutilations, rot, bodily wastes, and gore in the course of propelling plots or enhancing depictions, often

> to convey a sense of mortality, human frailty, or sin. Moreover, much art of the last decades includes many works that appear to be aimed at the arousal of disgust as the primary purpose or end of a creative work (2013, p.187).

The intentional evocation of disgust, therefore, serves a purpose to heighten the emotive affectivity of the work, which consequently provides a deeper understanding and engagement with the work. In art, the intentional provocation of disgust has manifested through "many varieties, including the humorous, the horrid and the tragic. The responses it elicits can be strong or subtle, but few are actually pleasant" (Korsmeyer, 2012, p.753). Disgust can, therefore, manifest in art through the inclusion of such visceral objects which have the capacity to affect the viewer. This disgust can emerge from the use of certain materials being used as art media; these include the visceral, abject objects of disgust which include bodily excretions, bodily materials such as skin, nails and sometimes hair, and discarded refuse. There are numerous examples of these materials and subjects being used in art, including Marc Quinn's portrait series, *Self* (1991-2011) [Figure 2.16], for which the artist cast a 3D portrait of his head made from his own frozen blood, Judy Chicago's *Menstruation Bathroom* (1971) [Figure 2.17] which featured a rubbish bin filled with used tampons and Andres Serrano's photographic series, *Shit* (2007) [Figure 2.18], which evokes disgust through numerous images of faecal matter of varied biological origins. These materials were once part of the body, and upon removal become objects of disgust. Their use as art materials, therefore, both repels the viewer as a result of their associations with contamination and uncleanliness, and simultaneously is an object of disgust through the realisation that these materials are detached parts of the self.

For bioart, disgust can be evoked by the viscerally confronting living material with its bare flesh and the exposed inner workings and substances of living tissues. These materials can be interpreted in the same trajectory of disgusting bodily materials as they are comprised of living flesh that is external to the body and exposes its visceral inner workings. Following Korsmeyer's suggestion that disgust is "purposively aroused by art in ways that contribute

substantially to the meaning of a work" (2012, p.753), the visceral, living materiality of bioart can, therefore, be understood as an intentional attempt to evoke emotive responses in the viewer that consequently assist in delivering the aims and critical understandings that bioartists intended. Furthermore, while bioart's materiality can be the subject of disgust, bioart can also then be understood as a site of abjection through the recontextualisation and objectification of the visceral living matter. This combination of disgust and abjection, enabled through materiality, demonstrates a practice that is concerned with affecting the viewer emotionally in an embodied and subjective way in order to explore our relationships with these materials.

Chapter Three: Living Bioengineered Art

Part One

The extent of bioart practices that use biological materials is dependent on how bioart is defined. Following on from the discussions in the first two chapters regarding the cultural context of bioart, the problems with defining the practice, this chapter will examine a number of artworks that use living materials as their media, biotechnologies as their tools. The range of works is vast, with many types of materials being used, including plants, bacteria, cells, tissues, animals and humans, using different biotechnologies for different purposes. Consequently, as set out in the beginning of this thesis, this research is predominantly concerned with the use and growth of human and animal cells and tissues and, therefore, this chapter will comprise of an examination of such artworks by several artists who are prominent practitioners in the field. These artists include Eduardo Kac, The Tissue Culture and Art Project, Guy Ben-Ary, Diemut Strebe, Gina Czarnecki and Amy Karle. These artists demonstrate a range of engagements with bioart, with some producing many works using living materials and others either singular or few works.

This first part of this chapter will describe a range of works from these artists in their construction and display, their processes and the artists' motivations in using these materials. The second part of the chapter will then analyse these works. While most of these artists' practices involve tissue culture and cells, Eduardo Kac's works do not engage in tissue culturing practices in the same way that most works in this chapter do, however, this chapter does begin with a brief insight into his work. This is due to the importance of Kac not only as the artist who coined the phrase bioart but for being one of the first artists to intentionally incorporate biotechnologies and living materials into his practice. Therefore, including a discussion of his practice assists in providing a contextual background for newer practices, for

both living biological materials and the genetic-level manipulation of them. Furthermore, it cannot be overlooked that Kac's practice is amongst the most well-known within bioart, and the consequential significant cultural discussions and ethical debates that arose from his works are important in understanding the wider context of bioart.

3.1 Eduardo Kac

Eduardo Kac began his career as a performance artist in the 1980s in Rio De Janeiro, Brazil. Kac's works have incorporated technologies, particularly communications technologies, robots and biological technologies. Thematically, Kac's practice explores notions "that range from the mythopoetics of online experience (*Uirapuru*) to the cultural impact of biotechnology (*Genesis*); from the changing condition of memory in the digital age (*Time Capsule*) to distributed collective agency (*Teleporting an Unknown State*)" (Kac, 2020a, para.1). In terms of Kac's involvement in bioart, he is responsible for coining the term 'bioart' in response to his 1997 work *Time Capsule*. Furthermore, Kac is also considered an originator of transgenic art with his 1998-99 installation, *Genesis*. Despite Kac's work differing from most of the other works discussed in this chapter from a material perspective, two of his most notable works, *Genesis* and *GFP Bunny*, will be discussed due to their importance in relation to the origins of bioart. These two works are fundamentally significant to both the initial development of bioart as being defined by its media and in terms of the critical responses to the use of these media for art purposes.

3.1.1 *Genesis*

Eduardo Kac's *Genesis* (1998-99) is one of the earliest examples of contemporary bioart. First exhibited in 1999 at the O.K. Center for Contemporary Art, Linz, Austria, and simultaneously online, the work was a transgenic interactive installation, comprising of a computer system, E.

coli bacteria, ultraviolet (UV) light and the Internet [Figure 3.1]. Through online audience participation, Kac drew on biblical scripture referring to the domination of humanity over nature and translated the DNA of E.coli into the biblical passage, and when prompted, asked the audience to either agree with the sentiment or destroy it by activating a remote UV light which would generate a mutation within the bacteria. The work demonstrates an engagement with early internet technologies, with genetic modification, and with the history of translation.

Drawing on the theme of humanistic control over nature, often found in contemporary bioengineering practices, Kac began the work using a passage from the book of *Genesis* (1:26) in the Old Testament of the Bible, which reads, "let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves on the earth" (Elwell, 2011, p.27). This passage selected by Kac was chosen for its overt implication of divinely appointed human supremacy over and above the rest of life that exists on the planet. Although taken from the Bible, this sentiment is not necessarily restricted to only a particular religion but demonstrates the debatable divinely sanctioned superiority of the human above other life forms that is present in many belief systems and not restricted to Christianity. Taken from the book of *Genesis*, this is in itself symbolically significant as it details the creation of the world and of people. Therefore, this can also be regarded as one of the foundation texts for demonstrating and asserting this hierarchical relationship of humanity over and separate from nature. In using this text, and this specific extract, Kac highlights the discord in morality suggesting that this statement is, or should be untrue, and sits juxtaposed to the contemporary reality of human superiority evidenced in practices such as deforestation and destruction of habitats for human benefit, animal testing and intensive farming.

The process of translating the passage from written language into the DNA base pairs of E. Coli involved the intermediary process of first translating it into Morse code.[14] Consequently, Morse code represents the beginning of long-distance and eventually global human communication technology, or the genesis of such communications, a trajectory that has culminated, for now, with the Internet. Morse code is a convenient tool for the process of recoding language into DNA, as it first converts the possible twenty-six letters of the English alphabet into more simplistic sequences of individual codes, which Kac did using "the following conversion principle: the dot in Morse code becomes a C; the line, a T; the word space, an A; the letter space, a G" (Andrews, 2007, p.132). Therefore, the initial sentence took three forms in three separate types of language: English, Morse code and genetic code.

After being translated into Morse code and then recoded into DNA base pairs, Kac subsequently integrated this coded DNA into the DNA of E. coli, which was then grown in a Petri dish. In doing this, the artist created a new gene which he named the 'artist's gene'. While the sentence underwent visible reinterpretations through multiple translations, when grown as genetic material the sentence was no longer visible or readable, instead, the sentiment resided as a living, growing lifeform. This meant that the biblical statement had been physically actualised as Kac had altered a living lifeform, and created a new genetic structure, therefore, the sentence existed as multiple living subjects rather than a static, lifeless sentence, offering a new perspective on how we think about and use language as communication.

Genesis was a performance work that relied on the participation of the audience and was both an online and a physical spatial installation at the O.K. Centre for Contemporary Art. During the performance, the Petri dish containing the E. coli biblical passage was placed under the UV light after which Kac shared the statement and asked participants to consider whether

[14] Established in the nineteenth century, Morse code developed as a method of encoded communication across long distances by translating letters into a coded series of individual combinations of dots and dashes. It was initially designed for transmitting messages using telegraph systems and later for early endeavours into radio communication.

they agreed that humans should have authority over other living forms or whether they thought we should not. If they disagreed, Kac asked them to destroy the sentence by activating the UV light above the petri dish, which accelerated the mutation rate of the DNA, thus altering and destroying the original sentence. The participants who disagreed complied with Kac's request and remotely activated the light in the gallery to destroy the bacteria. In this process, however, the participant's actions and beliefs become hypocritical as by disagreeing with the statement, they then take control over the growth process of the bacteria. Kac suggests that changing the bacteria and therefore the meaning of the sentence indicates that "it means that we do not accept its meaning in the form we inherited it, and that new meanings emerge as we seek to change it" (Kac, 2000a, para.5). Furthermore, it highlights the innate complicity present in the pervasive biotechnologies of the twenty-first century; whether we agree with harnessing and utilising power and control over other living lifeforms or not, it is almost impossible to avoid involvement.

After the work was performed, Kac translated the DNA of the mutated bacteria back into Morse code and then back into English as follows:

> **Mutated Genesis gene:**
> CTCCGCGTACTGCTGTCACCCCGCTGCCCTGCATCC
> GTTTGTTGCCGTCGCCGTTTGTCATTTGCCCTGCGCTCATGCCCCGCACCTC
> GCCGCCCGCCCCATTTCCTC
> ATGCCCCGCACCCGCGCTACTGTCGTCCATTTGCCCTGCGCTCATGCCCCGC
> ACCTCGTTTGCTTGCTCCAT
> TTGCCTCATGCCCCGCACTGCCGCTCACTGTCGTCCATTTGCCCTGCGCTCA
> CGCCCTGCGCTCGTCTTACT
> CCGCCGCCCTGCCGTCGTTCATGCCCCGCCGTCGTTCATGCCCCGCTGTACC
> GTTTGCCCTGCGCCCACCTG
> CTACGTTTGTCATGCCCCGCACGCTGCTCGTGCCCC
> **Translated to Morse code:**
> .-.. . -/.- .- -./.... .- ...- ./-.. --- -- .. -. .. --- -./--- ...-. .-./- .... ./..-. .. ../---..-./- .... ./... . .-/.- -. -../---...- . .-./- .... ./..-. --- .-- .-../--- ..-./- .... ./.- .. .-./.- -.-../--- ...- . .-./. ...- . .-. -.--/.-.. .. ...- .. -. --./- .... .. -.--./- .... .- -/.. --- ...- . .../..- .-/. --- -./- .... ./. .- .-. - ....
> **Translated back to English:**
> "LET AAN HAVE DOMINION OVER THE FISH OF THE SEA AND OVER THE FOWLOF THE AIR AND OVER EVERY LIVING THING THAT IOVES UA EON THE EARTH" (Kac, 2000a, para.1-3).

Consequently, the bacteria mutated as a result of the triggered UV light, thus transforming the sentence and therefore the meaning of the sentence. The participants' act of rejection of the sentiment and the subsequent recreation of the sentence suggests a metaphorical perspective on the processes of art in general, as well as human capacity for reinventing the ways in which we behave; evident in the three types of language used and how each demonstrates a reinvention of the same process and endeavour. However, the process of the work highlights the unavoidable duplicity present in bioengineering and complex moral ambiguities and hierarchies present in these practices.

Genesis emerged out of intentions to explore the intricacy of contemporary relationships between bioengineering, biological matter, religion, ethics, technology, global communication and the Internet, in addition to the ideas and values that inform our use of and relationships towards these technologies in current society. The layers of translation involved in the work mirror the relationship between the separate languages found on the Rosetta Stone (Kac, 2000a); where the Rosetta Stone allowed one language to be uncovered and translated into the other two, *Genesis* demonstrates a shared commonality between types of communication and communication technologies.[15] The original quote, Morse code and genetic sequence, along with the mutated versions, were later displayed on tablets in triadic configurations resembling the Rosetta Stone; named the *Encryption Stones* (2001) [Figure 3.2], the information was etched into two granite tablets using a laser, referencing both the beginnings of communication technologies and the multiple translations and adaptations these technologies have undergone since. Through the invention of the 'artist's gene', Kac suggests that it is the artist's innate propensity to connect, reconnect and reinterpret information, and through the actualised production of the living gene, *Genesis* demonstrates this through Kac's production of the

[15] The Rosetta Stone is an Egyptian stele with a decree inscribed in three languages, Ancient Egyptian hieroglyphics, Ancient Egyptian demotics and Ancient Greek; these multiple inscriptions of the same text is regarded as the key in deciphering and translating hieroglyphics.

artist's gene; that is an actualised living gene created through the transformation of living information, representing the ongoing sociocultural role of the artist in transforming knowledge and communicating new ideas.

3.1.2 *GFP Bunny*

GFP Bunny (2000) is an art project comprising of three components; a transgenic rabbit, the public response to the rabbit, and the rabbit's social integration. The albino rabbit named Alba was bred for the artist in collaboration with the National Institute of Agronomic Research in France in early 2000. With the assistance of scientists Louis Bec, Louis-Marie Houdebine and Patrick Prunet, Alba's DNA was altered using the green fluorescent protein (GFP) gene found in bioluminescent jellyfish, which causes them to express green fluorescence under specific light conditions. Consequently, when exposed to blue light, Alba's skin would glow green (Kac, 2000b). Alba's modification was publicly announced for the first time at the Planet Work conference in San Francisco, US, in May 2000; however, the rabbit was not present at the conference and instead was represented by a photograph showing her body glowing green [Figure 3.3], which resulted in international criticism. This critique was the second stage of the project. Kac claimed that the artwork would be complete when Alba would leave the laboratory to live with him and his family, however, the laboratory refused to release Alba and announced she had died in 2002.

The first stage of Kac's project centred around the genetic manipulation of a rabbit. The process of integrating genetic material of one species into the DNA of another produces a hybrid known as a transgenic organism; these organisms contain the genetic structures of more than one species. Alba was an albino rabbit and therefore had no pigmentation in her skin or fur, and under normal light conditions, she appeared to have white fur and red eyes. Following the mutation process, however, Alba's skin glowed green under blue light. Her fur did not glow

as only living tissue expresses characteristics of the GFP gene, and fur is comprised of non-living cells. Consequently, only Alba's inner ears and eyes would have glowed bright green, with her body perhaps emitting some light visible underneath her fur. Furthermore, Kac notes that the visual characteristics of the GFP gene increase in magnitude when implanted into mammals, therefore the rabbit would express the gene with greater intensity than the jellyfish in which it originated, thus creating an animal with a luminescent vibrancy that does not exist in nature. This concept of an unnatural or impossibly natural creation is at the heart of Kac's involvement in transgenic art. Transgenic refers to genetic material that has been combined with genetic material from one or more different species; in Alba's case, her DNA was composed of both rabbit and jellyfish genetic material. Kac suggests that while transgenic technology can be used to make "unique living beings", the crux of the artwork is that "this must be done with great care, with acknowledgement of the complex issues thus raised and, above all, with a commitment to respect, nurture, and love the life thus created" (Kac, 2011, p.61).

The final phase of the artwork, according to Kac, was to retrieve Alba from the laboratory and take her home to live with him, however, he encountered difficulties in realising this goal soon after launching the project as the photograph he released resulted in a disagreement with the laboratory. Houdebine claimed that Alba had never been specifically designed for Kac and that she was one of several rabbits genetically engineered at the same time, a claim that Kac has refuted (Philipkoski, 2002). Furthermore, the director of the laboratory where Houdebine worked refused to allow the animal to leave the lab. In response, Kac flew a flag featuring a green rabbit outside of his home in the US as a protest against Alba's forced captivity. In 2002, Houdebine announced that Alba had died aged four years old, the average lifespan for a laboratory rabbit and that her death was not caused by the genetic alteration she endured (Philipkoski, 2002). Kac contested this stating that at the time of the

announcement Alba was only two years old, having been born in 2000, not four as Houdebine had announced and that he did not believe she was dead. Instead, Kac suspected the announcement was intended to end the criticism Houdebine and the laboratory had continued to receive following Kac's public announcement of Alba's existence. Consequently, the final stage of Kac's project was never actualised and the transgenic animal remained confined to the laboratory until death.

3.2 The Tissue Culture & Art Project

Along with Eduardo Kac, The Tissue Culture and Art Project (TC&A) are among the first artists to intentionally and directly engage in living biological materials and biotechnologies as a focus of their practice. The TC&A is an ongoing artistic research project which aims to investigate the development and usage of tissue culture as an artistic medium. Established in 1996, the project was co-founded by Oron Catts, a tissue engineering artist, and Ionat Zurr, a wet biology art practitioner, and is primarily based out of SymbioticA, the artistic laboratory the project helped to establish at the University of Western Australia in Perth. The TC&A, however, does not function in isolation and since its establishment has collaborated with artists globally to develop and produce artworks made from living tissue culture. In summarising the aims and workings of the group, the following manifesto is posted on the research group's website, detailing their intentions as,

> The Tissue Culture & Art Project (TC&A) was set [up] to explore the use of tissue technologies as a medium for artistic expression. We are investigating our relationships with the different gradients of life through the construction/growth of a new class of object/being – that of the Semi-Living. These are parts of complex organisms which are sustained alive outside of the body and coerced to grow in predetermined shapes. These evocative objects are a tangible example that brings into question deep rooted perceptions of life and identity, concept of self, and the position of the human in regard to other living beings and the environment. We are interested in the new discourses and new ethics/epistemologies that surround issues of partial life and the contestable future scenarios they are offering us (The Tissue Culture & Art Project, 2021a, para.1).

As the world's first artistic laboratory, SymbioticA was established by Oron Catts, Miranda Grounds and Stuart Bunt in 2000. Following a four-year residency of the TC&A at the School of Anatomy and Human Biology at the University of Western Australia, Catts and Zurr set out on a funding quest to establish a base for artists to engage with biological sciences (Quaranta, 2014). Initially, SymbioticA performed at a small scale, and in the first year of its founding it acted as a studio hosting two residencies for local artists. However, Catts and Zurr were ambitious to develop the capabilities of SymbioticA and established a research programme, postgraduate courses, undergraduate papers and with more funding were able to increase the number of residencies, including an annual six-month residency for Australian artists funded by the Australia Council for Arts (Quaranta, 2014).

The development of SymbioticA emerged out of the lack of opportunities for artists to work with biotechnologies "because the resources needed are almost exclusively in academia and industry" (Zurr & Catts, 2014, p.201). Consequently, SymbioticA provides institutional access for artists through a workspace that is shared with bioscientists, ensuring that both materials and expertise are accessible to artists. Working alongside biotechnologists and technicians, artists are able to physically share space with scientists, increasing the flow of communication, ideas and collaborative opportunities between two spheres that are often separated both physically and intellectually. However, as the laboratory is located within the university, one of "the requirements of the University is that all projects, including those of SymbioticA, must receive ethical as well as health and safety clearances from appropriate committees" (Zurr & Catts, 2014, p.202). This is evidenced by Adam Zaretsky, an artist who completed a residency at SymbioticA, who states that "before using these tissues as a medium of art and science expression, I had cleared the artistic use of semi-living kitchen food preparation 'waste' with Sue Lewis, Manager, Research Ethics and Animal Care, The University of Western Australia" (2007, p.274).

The ethical assessment of art projects that use bioengineering processes has, however, been challenging, with Zurr and Catts stating that "on a few occasions the first response from the Human Research Ethics Committee (HREC), to a proposal from SymbioticA, was to state that the Committee did not consider the proposed work to be research, or (similarly) to request a statement explaining why the proposed project should be considered research" (2014, p.203). This difficulty in ensuring that bioart works are considered to be legitimate research projects is also reflected in the difficulties in assembling a committee to ethically assess these works in the first place, as "in the first major project conducted by the artists and their collaborators at the UWA [University of Western Australia] in the early 2000s, the ethical committee members were at a loss as to how to relate to a project with ends they were not set up to deal with, and deemed themselves unqualified to assess it" (Vaage, 2016, p.94).

Since its foundation, SymbioticA has hosted more than 90 residents from around the world including, Steve Kurtz of the Critical Art Ensemble, Orlan, Art Orienté Objet and Marta de Menezes (University of Western Australia, 2020). Furthermore, these residents all come from many different disciplines, thus producing widely different outcomes. Of these outcomes, one of the most specialised and unique features of SymbioticA, and of the TC&A in particular, is the growth of living tissue as material for art; these works are known as 'semi-living' art. The biological artworks made by the TC&A are unique not only in their intricate engagement in altering biological matter as material but in the way that they classify these works as being semi-living. Semi-living suggests partial life, an in-between state of living and non-living, or living and death. These works are made from living tissue, grown from immortalised cell lines or donated cells from living specimens, and are kept alive by means of nutritional and environmental support. Furthermore, despite the material used, these living organisms are unique and not able to independently exist in nature; they are distinctly artificial yet biological life forms engineered by artists. The artists describe the semi-livings as

> a new class of object/being in the continuum of life: the Semi-Living are sculpted from living and non-living materials, and are new entities located at the fuzzy border between the living/non-living, grown/constructed, born/manufactured, and object/subject. The Semi-Living relies on the vet/mechanic, the farmer/artist or the nurturer/constructor to care for them. They are a new class of object/being that is both similar and different from other human artefacts (human's extended phenotype) such as selectively bred domestic plants and animals. These entities consist of living biological systems that are artificially designed and need human and/or technological intervention for their survival and maintenance (Catts & Zurr, 2002, p.5).

The unique and ambiguous position of the semi-livings, challenging and disrupting the conventional binaries of the subject/object and living/non-living dualisms, has presented many practical, ethical and epistemological issues in the creation and display of such artworks, in addition to how we interact with them, care for them and dispose of them (Zurr & Catts, 2003). In this way, "bioartworks challenge Western cultural and bioscientific imaginaries of sealed, self-contained bodies and the accompanying firm distinction between life and non-life, natural and artificial, and human and non-human" (Radomska, 2017, p.378). Consequently, semi-living art sculptures are compelling and uncomfortable simultaneously, by bringing a new form of life into existence, the very existence of these works challenge our fundamental conceptions of life, sentience, and empathetic responsibilities to other life forms.

In creating the semi-livings, Catts and Zurr describe themselves as "scavengers" (2002, p.366), as they source their living materials from the waste or surplus products from scientific laboratories and the meat industry. Therefore, they do not directly contribute to harvesting living matter but work with material that has already been produced, extracted or removed from organisms, consequently creating life from discarded biological materials. These materials have so far been wide-ranging with grown materials including "epithelial (skin) tissue from rabbits, rats and mice, connective tissue from mice, rats and pigs, muscle tissue from rats, sheep and goldfish, bone and cartilage tissues from pigs, rats and sheep, mesenchymal cells (bone-marrow stem cells) from pigs, and neurons from goldfish" (Catts & Zurr, 2002, p.367). The processes behind the actual construction of these works are complex and similar in method to

in-vitro organ growing, however as they are grown for artistic purposes and do not need to take into account issues such as body compatibility, tissues can be merged between species and new and unnatural forms and substances can be made. Practically, semi-living works have extensive environmental and nutritional requirements in order for them to grow and survive, including temperature-controlled sterile conditions and routine feeding, which consequently requires these conditions to also be met in the gallery space if they are exhibited, thus forcing a re-creation of the traditional art space.

The creation and classification of the semi-livings as a new form of life, hierarchically positioned below humans and animals and produced to be living works of art has raised many ethical debates. These have included the issue of reducing life to the status of art (Stracey, 2009), the potential censorship of artistic experimentation by science committees, and the display challenges faced by art museums (Dumitriu, 2016). One of the most prevalent discussions beyond the ethics of their very existence is around the terminology of 'semi-living' and how the artists have defined this being due to the sculptures complete dependence on them for survival. This perspective that the works are only semi-living because they cannot survive without artificial assistance is problematic given the increasing capacities and human dependency on supportive and enhancement biotechnologies, such as incubators, pacemakers, prosthetic limbs and dialysis machines. However, this uncomfortable reality of there being little difference between the dependency of the artworks and the dependency of humans sits at the crux of semi-living sculptures as the artists present this unique dichotomy between living subject and art object to highlight cultural concerns stemming from contemporary bioengineering. Furthermore, this destabilises pre-held notions of human life, as if dependent sculptures are semi-living, this problematises how we perceive humans who require artificial support. These provocative issues are key to the works of the TC&A. Despite the number of opinions and positions surrounding these ethical debates, for now, they are mostly rhetorical

due to how new the semi-livings are and the ambiguity of where they fit into the established humanist hierarchy of living things.

3.2.1 *The Semi-Living Worry Dolls*

The Tissue Culture & Art Project's *Semi-Living Worry Dolls* were first exhibited in 2000 and are defined as being the first living tissue-engineered sculptures to have been exhibited in a gallery (Catts & Zurr, 2002). The work is comprised of seven doll-like sculptures, grown from PGA and P4HB degradable polymers, surgical sutures, and seeded with skin, bone and muscle cells, with each grown inside an individual custom-made bioreactor conditioned to act as a surrogate womb to support the growth of the sculptures [Figure 3.4]. The dolls are inspired by Guatemalan worry dolls; small wooden dolls wrapped in coloured wool akin to traditional Mayan clothing. Tradition states that the dolls are often given to children in the belief that in sharing their worries, the dolls will take their concerns away. The *Semi-Living Worry Dolls* skew this tradition, instead of being confidantes of childhood fears, they are designed to embody and listen to the fears and concerns people may have about bioengineering.

The dolls were grown using tissue culture, which refers to the growth of tissue from cells in vitro, therefore artificially cultivated outside of the organism the cells originally derived from. Plant and animal cells can both be grown using this method which sees isolated cells saturated in a growth medium inside a test tube or similar vessel, with this medium supporting the nutritional requirements of the cells and under the correct conditions allows them to multiply. Cells can either be primary cells purposefully extracted from a donor or immortalised cells which are mutated cells designed to reproduce indefinitely. The cells used to create the semi-living worry dolls were immortalised cells known as McCoy line cells, which are cells originally thought to be human in origin but were subsequently confirmed to have been extracted from a mouse (Fong, Yang-Feng & Lerner-Tung, 1994). These cells were cultured

in fetal bovine serum (FBS) and were incubated in sterile conditions at 37c for between 14 and 21 days (Catts & Zurr, 2002).[16]

Tissue culture can be grown two-dimensionally or grown using a scaffold to achieve a three-dimensional sculpture, it can also be 3D printed and these techniques have been used to grow organs in vitro. The dolls in this work were grown using scaffolds where the cultured cells were seeded onto degradable polymers in the shape of dolls; this meant that as the forms grew the scaffolds supporting them gradually decayed, leaving the structures self-supported in doll-like shapes. After the initial growth period, the sculptures were transferred from their incubator into individual glass bioreactors, designed to rotate to produce microgravitational conditions which assisted with growth stimulation of the three-dimensions of the structures. The artists have noted that the growth of the tissue is not a precise process that they were able to control entirely (Catts & Zurr, 2002), giving the dolls unique forms, each with a recognised similarity, but with individual localised tissue clumps in different shapes and sizes. Catts and Zurr recognised this differentiation stating that their "practice is in the realm of a dialogue with nature rather than control over it" (Catts & Zurr, 2002, p.368). Therefore, regardless of the extent to which these biotechnologies are used and able to control the growth of artificial organisms, the artists here do not claim to be able to control or to want to control nature, but to alter it, how it functions and our perceptions of nature in response to biotechnologies. In order to complete the visual appearance of the traditional Guatemalan worry dolls, surgical sutures were used to create face-like details on the structures, in addition to replicating the woven clothing wrapped around the torso area of the figures [Figure 3.5].

After the initial growth stage, the dolls measured 10mm by 7mm by 5mm and were exhibited in their individual bioreactors. Submerged in a transparent liquid medium, each of

[16] Fetal bovine serum (FBS) is produced from blood taken from unborn calves during the slaughter of pregnant cows and is the most widely used medium in growing tissue culture (Reynolds, 2018).

the dolls appears visually unique, reflecting the idiosyncratic individual growth of each cell-seeded structure. The material appears flesh-like and uneven in colour with a deep yellow tone towards the thicker parts of the tissue and more translucent towards the edges. Texturally the material is also uneven with irregular density and thicker clusters apparent across the figures. With their arms raised out to the side, the dolls mimic the traditional worry doll form of a crucifix, with no legs or other distinct anatomy, leading some to draw a comparison with Christian iconography (Senior, 2014).

In the Guatemalan tradition, small worry dolls made of wood are given to children so that they can pass on their concerns and the dolls will listen and take their worries away. In replacing the innocent childhood dolls with living tissue replicas, the TC&A recreate worry dolls for the age of experience where concerns are more complex and with less clear-cut solutions, resolutions or answers than in the past. In creating living dolls reflecting this tradition, the artists explain that

> if we are able to grow something as complex as a fully functioning organ, why not change this design to suit other tasks? And if we can keep a complex organ in vitro, why not design semi-living objects that can be sustained alive outside of the body for the duration of their use? The TC&A Project also asks: If this is possible, should we go down this path? (Catts & Zurr, 2002, p.365-366).

In this sense, the *Semi-Living Worry Dolls* demonstrate a self-reflexivity as they are derived from these concerns but in their creation they are actualisations of this posthuman attitude of utilising tissue culture and bioengineering for other uses and tasks. Therefore, the work presents the reflexive dichotomy of asking how we should use biotechnologies and whether we should use them for more purposes than biomedicine and then actually do so in creating the dolls.

Concerns regarding the appropriate applications and use of bioengineering and the possibilities that could potentially arise from misuse or as a result of unrestricted positivist attitudes are a growing issue as the increased proliferation of biotechnologies continue to be

developed. Reflecting these concerns, the artists attributed a worry to each of the seven dolls based on these contemporary issues. The dolls are named alphabetically from A to F, with each attributed an individual worry in response to contemporary bioengineering practices, with the artists suggesting that they could "find a worry for each letter of the language that made us what we are now" (Catts & Zurr, 2017, para.3). The dolls were named as follows:

> Doll A = stands for the worry from Absolute truths, and of the people who think they hold them.
> Doll B = represents the worry of Biotechnology, and the forces that drive it. (see doll C)
> Doll C = stands for Capitalism, Corporations
> Doll D = stands for Demagogy, and possible Destruction.
> Doll E = stands for Eugenics and the people who think that they are superior enough to practice it.
> Doll F = is the fear of Fear itself.
> G = is not a doll as the Genes are present in all semi-living dolls.
> Doll H = symbolises our fear of Hope… (Catts & Zurr, 2017, para.4).

These concerns highlight the other factors which have played a role in controlling the development and usage of biotechnologies, namely for-profit corporations and potential prejudices. Furthermore, in being aware of these external motivations present in biotechnologies, the artists suggest that it is not the technology itself that is a cause for concern but the human interests that inform its usage. In addition to these worries, the artists' added that the audience was welcome to rename the dolls, adding their own concerns and fears of bioengineering to the project. This invitation to the audience to participate acknowledges the wide-ranging views that are present across perspectives towards biotechnologies and the fluidity of these concerns to change and develop alongside the evolving landscape of bioengineering. In encountering the living embodiment of these fears, the dolls allow for an actualised context for these concerns to exist and to be validated or annulled.

As the dolls are made from living materials, they require ongoing care to ensure their survival. In highlighting that the art objects are also living subjects, the artists incorporated this care into a performance ritual during exhibitions. Technicians would dress in typical white

laboratory coats and feed the dolls with the fetal bovine serum required to sustain them (Johung, 2014). Not only does this ritual transform the art space into a laboratory, bringing the normally hidden implications of laboratory-grown life into the open, but it also makes it starkly apparent that these artworks are alive and dependent. In addition to the feeding ritual, in 2002 the artists added a killing ritual to mark the end of the exhibition at the Perth Institute of Contemporary Arts, Australia. This ritual involved removing the dolls from their sterile bioreactors and allowing the audience to touch them. The bacteria of the non-sterile environment quickly contaminated the dolls, eventually killing the tissue.

The killing ritual was repeated at a later exhibition, however, with the added performance aspect of a funeral and a condolence book for the audience to sign at the 2011 display at the Science Gallery in Dublin, Ireland, again stressing the living dynamics of the installation. In response to these performances, Catts "noted that [although] he had already killed far more living matter when he brushed his teeth that morning, there was still unease surrounding the killing of these dolls, which required the event to be marked, framed, and performed, and which called those who had previously grown, fed, or even just viewed these figures-in-growth to be present" (Johung, 2014, para.7). This discomfort is significant as it demonstrates the awareness of the audience that they are encountering life in an imbalanced exchange of an uncomfortable collapse of the self/other subject/object paradigms through the act of killing the dependent installation, the life of which was only brought into existence by human creation for this very purpose. Consequently, the act of killing draws attention to the necessity of this action as there are few alternatives to this due to the limitations in transporting living artworks that are unable to survive outside of specific sterile environments. Therefore, the inherent duplicity that inextricably links the act of creation to the responsibility of care and destruction of the living art subject is apparent and highlights the wider ethical responsibilities we have towards the things that we create.

3.2.2 *Victimless Leather*

Victimless Leather (2004) is a living prototype of a leather jacket grown inside of a custom-built perfusion chamber [Figure 3.6]. Like the *Semi-Living Worry Dolls*, the sculpture was grown around a supportive biodegradable polymer scaffold and was first exhibited in 2004 as part of *The Space Between* exhibition at the John Curtin Gallery in Perth, Australia (Bell, 2010). The sculpture has been recreated several times globally between 2004 and 2013, with all having been created in the same way, using the same materials and techniques. As with other biological artworks created by the TC&A, *Victimless Leather* is described as being semi-living in that it is grown from living cells yet is fully dependent on the artists for survival.

The jacket was grown using 3T3 mouse cells, an immortalised cell line of mouse embryonic fibroblast cells, established from a single mouse in the 1960s (Stracey, 2009). These cells were seeded onto a biodegradable polymer scaffold shaped in the form of a small jacket, as the cells grew across the surface a seamless, stitch-less jacket shape was achieved. In order to strengthen the material and to keep the shape supported after the scaffold would disintegrate, the mouse cells were combined with human bone cells (Jeffries, 2019), the source of which is unclear. This transgenic material required nutrition supplementation in order to survive, and therefore was grown inside of a sterile, custom-made perfusion chamber. The perfusion chamber, shaped like a bioreactor, was designed based on an organ perfusion pump which is designed to artificially maintain blood supplies during surgery by pumping blood through the heart. In this fashion, the chamber is designed to automatically drop necessary nutrients onto the jacket as it is required.

Measuring two inches in height and one and a half inches wide, the miniature jacket hangs suspended inside of the rounded glass bioreactor by a length of surgical sutures. The thread hangs from a ‘U’ shaped glass pipe which delivers the required FBS to the living tissue. A shallow pool of the pink-toned serum sits in the bottom of the glass, with a tube connected

to it in order to help drain excess liquid. The sculpture itself appears quite flat and angular in shape yet still takes the distinctive form of a jacket. As the work is made from bone and tissue cells, there is a visible density to the material which is an off-white colour tinged with pink demonstrating the fusion of the bone and tissue cells. Consequently, the living material of this work is visually different from the *Semi-Living Worry Dolls*, demonstrating the variation in visual effects depending on the materials used.

As with the *Semi-Living Worry Dolls*, the issue of responsibility for the life and death of the artwork is prevalent in the creation and destruction of *Victimless Leather.* During the work's display at New York's MoMA in 2008, an unexpected confrontation with this sense of responsibility occurred after it was found that the sculpture was growing too quickly and that it started to block the wires inside the bioreactor which supplies the required nutritional supplements. After discussions regarding how to overcome this issue, it was decided to let the work die as it could no longer be sustained in the chamber. Consequently, the wires were removed, killing the jacket. While the curator of the exhibition stated that she felt uncomfortable turning off the jacket's life support system, Oron Catts supported the decision, saying that it was important "to present the end of our projects in ways that remind people that these works are/were alive and that we have a responsibility towards the living systems that we engage in manipulating" (Schwartz, 2008, para.4).

The title of the work, *Victimless Leather*, engages in discourses of the moral and ethical responsibility and attitudes embedded within consumerism and consumption. The use of immortal 3T3 mouse cells is significant in this trajectory as they "are very common in scientific research centres around the globe [and] can be weighed in tons or even tens of tons and they all came from one mouse in the 1970s" (Wired, 2004, para.7). Therefore, the project proposes a sustainable method of leather production without the need for killing animals for the commercial value of their skins. However, there is a hidden duplicity present in the artwork,

as in contrast to the sustainability of the 3T3 mouse cells, the culture used to grow them contains FBS which requires the death of unborn calves in its acquisition. Consequently, the duplicity of the work is not victimless, however, this is not lost on the artists who reinforce that there is no real sense of being victimless irrespective of materiality used, especially from a posthumanist perspective.

3.2.3 *Disembodied Cuisine*

Among the many biological artworks created by the TC&A over the two decades of their work to date, *Disembodied Cuisine* stands uniquely aside from all other works by the fact that it was created to not only be killed but to be consumed. *Disembodied Cuisine* was an installation as part of the 2003 *L'Art Biotech* exhibition in Nantes, France, and was designed to critically challenge how we perceive what is edible and our feelings towards utilising animals for food (Catts & Zurr, 2013). The installation involved the in vitro growth of steaks using cells extracted from living frogs which were presented alongside the growing tissue [Figure 3.7]. The work culminated in the artists hosting a dinner party where the steaks were cooked and consumed.

Disembodied Cuisine is the companion piece of an earlier work by the TC&A named *Semi-Living Steak*, 2000 [Figure 3.8], which saw the artists grow steak from embryonic sheep cells, thus harvesting meat grown from the cells of an unborn lamb (Catts & Zurr, 2013). Of this earlier work, the artists state that "as there was a risk that the laboratory we worked with at the time might lose its license if we attempted to eat the results of our experiment, we realised that we could only taste our 'meat' in an alternative venue" (Catts & Zurr, 2004, para.5). Consequently, it was an important part in the creation of *Disembodied Cuisine* to be able to actually consume the grown products. Like the earlier work, *Disembodied Cuisine* engages with the inherent relationship present between humans, death and food, however, in this work,

frogs were used to source the cells needed in place of sheep cells. The specific use of frog cells over the previous choice of lamb tissue is a reflection of the French classification of frogs being considered a delicacy (Henley, 2009).

The installation comprised of a long dining table, covered in a white tablecloth and with three chairs lined up on each side. The table was set with plates, cutlery, glasses and wine, as the artists stated that it was their intention to present the food as nouvelle-cuisine in style (Catts & Zurr, 2013). This dining area was set up inside of a transparent plastic tent-like structure, which had a large yellow biohazard warning sign attached to the front. Simultaneously appearing like a scientific biohazard experiment and a crime scene, the space was divided as the enclosure was sealed and the dining space was only viewable from the outside. However, mediating the two spaces, on one side of the structure, splicing the transparent material being both inside and outside of it simultaneously, a glass tank half-filled with water contained the living frogs which had donated the tissue to grow the in vitro meat; in addition to containing water, the tank also replicated the frogs' natural environment with plants, flowers and rocks. Transparent on all sides, the frogs are able to view inside the dining area and outside into the exhibition space. Several glass jars sitting on top of the tank contained the growing frog steaks. The frog tissue was situated outside of the biohazard barrier, suggesting that it is not yet problematic as it is not yet food.

The frog steaks were grown from frog skeletal muscle which was extracted via a biopsy from four frogs rescued by the artists. Using tissue from a biopsy is presented as a viable alternative to produce 'victimless meat' as the animals are not killed, and the site of the biopsy is able to fully heal afterwards. The project arose from the idea of producing victimless meat wherein humans could still consume animal products without the need for slaughtering the animal. The artists comment that

> this piece deals with one of the most common zones of interaction between humans and other living systems and will probe the apparent uneasiness people feel when someone

> ‘messes’ with their food. Here the relationships with the semi-living are that of consumption and exploitation however, it is important to note that it is about “victimless” meat consumption (Tissue Culture & Art Project, 2008., para.4).

In harvesting meat from semi-living organisms, the artists explain that *Disembodied Cuisine* presents a new form of living creature, intentionally designed and created to be exploited for consumption, but that this can also be seen in the same vein as growing crops for harvest. However, the artists comment further that this presentation of a victimless source of meat consumption is only illusionary as the nutritional requirements for growing in vitro meat still requires animals to be killed, as discussed in the use of FBS. While this irony is present and noted in the work, it does speak to the growing research into establishing a victimless, laboratory-grown meat industry and the hidden costs still embedded in this quest. Beyond the need for killing animals for the blood plasma needed to support in vitro growth, Catts and Zurr add that these potential industries also have hidden costs in the carbon emissions released in the process of running such a laboratory, in addition to the semi-living still being a victim, albeit one that is removed from nature where “the animal is abstracted into fragments and mediated through technological apparatuses” (Catts & Zurr, 2013, p.107). On an ethical level, the project addressed the most common zone of interaction between humans and the living world and also probed the apparent uneasiness people feel when someone contaminates or changes their food. The project offered the illusion of ‘victimless’ meat consumption.

At the end of the installation, the artists held a dinner party, attended by themselves, the two curators of the exhibition, a chef designated to cook the steaks and six volunteers. The steaks were marinated in Calvados and cooked in garlic and honey, these ingredients were chosen for their inherent antibacterial properties, then covered in laboratory-grown herbs and served to each of the participants. Although the grown frog tissue resembled meat, the verdict after the tasting was that it lacked the expected texture associated with meat, instead having the texture of “jellied fabric” (Catts & Zurr, 2004, para. 6). While in part this is due to the lack

of being able to exercise the tissue which is naturally achieved when meat is taken from an animal that could exercise, Catts stated that this effect could be achieved in vitro through the use of culture, however, concluded that the three-month period of growth was not sufficiently long enough to achieve this. In terms of the responses of the participants, Catts commented that "four people spat it out. I was very pleased" (Catts & Zurr, 2013, p. 109). This suggests that in fact, the 'victimless' meat industry is not currently palatable, both in consumption but also in manufacture and in the ways in which we mediate relationships with new, non-human lifeforms. After the performance and the frog steaks had been consumed, the living frogs were released into the Nantes Botanical Gardens to be allowed to continue living even though their flesh had been extended outside of their bodies and eaten. The impact of this unique method of growing and harvesting meat has been significant as the corporate race to produce laboratory-grown meat for commercial availability has increased vastly since the work was first performed.

3.3 Guy Ben-Ary

Guy Ben-Ary is an artist closely associated with the TC&A, of which he was a member from 1999-2003, and SymbioticA, where he currently works (Kelley, 2016). Ben-Ary's works often "utilise motion, growth and big data to investigate technological aspects of today's culture and the re-use of biological materials and technologies" (Ben-Ary, 2014a, para.3). Like the previous two artists, many of Ben-Ary's works engage in biological and scientific practices. Ben-Ary's works explore the use of robotics, biotechnologies and biological materials using a range of different media; specifically, his works have engaged with the science of cryonics in *Snowflake* (2006-2015), robotics and sound in *Silent Barrage* (2008-2009) and induced pluripotent stem cell (iPS) technology in *In Potentia* (2012) and *cellF* (2015). Consequently, Ben-Ary's works demonstrate a vast number of interdisciplinary collaborations, which include

works that fall under the umbrella of bioart and others which explore more branches of science and technology.

3.3.1 *cellF*

cellF is a synthesiser operated by a neural network grown from the artist's own skin cells [Figure 3.9]. Over a four-year period, Guy Ben-Ary collaborated with scientists and engineers to realise the completion of the instrument, which was produced at SymbioticA in Western Australia. The work creates music alongside a human participant playing a drum kit; the vibrations of the drums stimulate the neural network, which then controls the synthesiser in response, creating an improvised arrangement. This neural network effectively functions as a second, external brain of the artist, which operates independently, despite sharing the same genetic material.

The neural 'brain' of *cellF* was constructed from skin cells retrieved by a biopsy from the artist's forearm. In conjunction with several artists, musicians and scientists, Nathan Thompson, Andrew Fitch, Darren Moore, Stuart Hodgetts, Michael Edel and Douglas Bakkum, the cells were converted into stem cells using iPS technology (Ben-Ary, 2014a). This process allows for the stem cells then to be converted to any other type of cell found in the body. Once converted, the cells were then fully differentiated into neural stem cells, which were then fitted over a multi-electrode array dish. These electrodes record the signals produced when music is played to the structure. When music is played, it is experienced by the work as stimulation through these electrodes (Ben-Ary, 2014a).

As a fusion of biology and technology, the immediate visual presence of *cellF* is an encounter with many interconnecting wires and electronic devices. The actual biological 'brain' of the work is positioned in the middle of these wires, and the neurons are contained within a Petri dish with wires running through it and is enclosed inside of an incubator [Figure

3.10]. While the biological component of *cellF* is small, the entire structure it sits within is large in scale, resembling a rectangular trumpet horn. The sound is transmitted through a set of 16 speakers, with *cellF's* spontaneous responses being generally low in tone and limited to a single note at a time. While the project is hosted by SymbioticA in Australia, the scale and complexity of the work has prevented it from being exhibited easily in other locations. For this reason, in overseas locations, the work has been presented in video format, accompanied by large scale microscopic prints of the neurons, coloured red against a black background.

Ben-Ary's practice frequently employs biological material as he states that it is his "interest in problematising new bio-technologies and contextualising them within an artistic framework" (Ben-Ary, 2014b, para.13). The artist explains that *cellF* "started with a new materialist question underpinned by the belief that artistic practice can act as a vector for thought: What is the potential for artworks using biological and robotic technologies to evoke responses in regards to shifting perceptions surrounding understandings of 'life' and the materiality of the human body" (Ben-Ary, 2014b, para.13). *cellF* challenges such perceptions of life by presenting a functioning second 'brain' outside of the artist's body and beyond his control. In this way, the work can also be seen as a self-portrait of the artist as it replicates the artist's physical self, which he confirms, stating that he was "inspired by an ultimately narcissistic desire to re-embody myself" (Ben-Ary, 2014b, para.4). However, in the creation of a living, visceral neural network, Ben-Ary has stated that through the work, he seeks "to open up the possibility to question how modern Western culture's institutionalisation and fetishisation of consciousness has significantly contributed to historically distinctive forms of being human" (Hudson, 2014, p.40).

cellF was not designed to be an isolated musical instrument, but to be an interactive participant to create and play music alongside human players. Participants are invited to play any kind of musical instrument alongside *cellF*, and the musical stimuli are then detected by

the synthesiser's neurons which in turn control the output and respond to the music with notes of its own. In this reflexive performance, the music created is both human and non-human, dependent upon conceptions of humanity and whether *cellF* is considered to be human or machine. In reality, *cellF* sits somewhere between the two, being both biological materials acquired from the artist and being a separate functioning machine, thus contributing to posthuman ideologies.

3.4 Diemut Strebe

Multimedia artist Diemut Strebe has engaged with many types of science in her practice, including biotechnologies, physics and artificial intelligence. Strebe's works intentionally engage in new technologies to explore the new questions and problems their existence creates, socially, ethically and philosophically. Strebe has completed the Ida Ely Rubin Artist in Residence at the Massachusetts Institute of Technology (MIT) Center for Art, Science & Technology, US, where she produced *The Redemption of Vanity* (2016); a 16-carat diamond that was covered in carbon nanotubes to create "the blackest black material on earth" (Arts at MIT, 2020, para.2). The work simultaneously explores applications of new technologies while challenging issues of materiality and its associated financial value. Strebe has worked with MIT scientists on a number of projects, including *Litmus* (2014), *The Origin of the Works of Art (*2017) and most notably on the 2014 living replica of Vincent van Gogh's missing left ear, *Sugababe*.

3.4.1 *Sugababe*

Sugababe is a living replica of Vincent van Gogh's infamously missing left ear, grown from bioprinted familial DNA [Figure 3.11]. Taking over three years to grow, Diemut Strebe worked with several faculty members at MIT, including Robert Langer and Noam Chomsky, to

produce the ear, which is presented inside of a transparent acrylic chamber and is fitted with a microphone and speaker system (Arts at MIT, 2020). The sculpted ear is made from cartilage grown using the DNA of one of van Gogh's decedents and engages in discourses of authenticity, originality and the nature of replicas, specifically in the context of a society that is now able to insert grown life and living objects into the pre-existing social order, and the implications and consequences of these new abilities. The life-sized ear is presented inside of a square tank which is filled with plasma, an off-white slightly golden-coloured liquid filled with small bubbles, designed to support the nutritional requirements of the work. The ear is mostly opaque and white in colour but appears more translucent in the parts where the cartilage is thinner. However, while it is living, it does not resemble a living ear entirely due to the absence of blood supply and skin which would provide a more life-like colouration. This lack of colour gives the structure an otherworldly, uncanny appearance of being living but not necessarily life-like.

The ear sculpture was grown using chondrocytes, cells that form cartilage, which were extracted from one of van Gogh's living decedents (Strebe, 2019). These living chondrocytes were then bioprinted into the shape of van Gogh's left ear. Bioprinting is a type of 3D printing, which combines biological materials such as cells, and then prints them layer by layer into the desired form. In order to grow the replica, Strebe required DNA from van Gogh and attempted to obtain a sample from a letter the artist had sent to Joseph Roulin, however, this was unsuccessful as she was not able to collect a large enough sample. Instead, Strebe contacted one of van Gogh's living relatives, Lieuwe van Gogh, the great-grandson of his brother Theo van Gogh, who consented to donate his DNA for the artwork and, consequently, two samples of cartilage from his own left ear were donated (Mafi, 2015). To add more authenticity to the work, Strebe also incorporated further DNA from a female living relative, Rosine Weenick, in addition to original DNA extracted from van Gogh's letter. Therefore, as most of the DNA

used was not directly obtained from van Gogh himself, the ear is not an entirely authentic replica, yet, both Vincent and Liuwe share one-sixteenth of the same DNA, including the same Y chromosome (The Guardian, 2014), clarifying the approximate level of similarity between the two individual's genetic matter.

As with other tissue sculptures, the ear is supported by a scaffold which was integrated into the chondrocytes during the bioprinting process. To achieve an authentic shape, the ear was digitally mapped out, reconstructed and then printed using a polymer culture substrate. The scaffold inside the printed sculpture allowed the ear to retain its shape and provide a template for the chondrocytes to grow around. After this process, the sculpture was placed in a bioreactor, where it continued to grow for a year until fully formed. *Sugababe* was first revealed at the ZKM Centre for Art and Media in Karlsruhe, Germany, following a lecture by Noam Chomsky; Chomsky was the first person to speak into the microphone in an attempt to try and communicate with the deceased artist (Blakemore, 2015).

The artist's concern with authenticity and the nature of the replica is evident in both the ambiguity raised by the distance in the DNA used and also in the title of the work. *Sugababe*, refers to the eponymous British pop group whose original members were all replaced (Guth, 2015); thus, the group was known by the same name, yet all of the original components had changed. Strebe compares the work to the paradox, The Ship of Theseus, which questions whether the ship of the Greek hero, Theseus, is the same ship if, after replacing all wooden planks and sails as they decay, is still the same vessel despite each original material aspect having been replaced. *Sugababe* parallels this paradox as the ear contains the original genetic material of van Gogh yet translated through generations, it has fundamentally been reconstructed; therefore, the work provokes a reassessment of what it means to be original or to be a replica in the age of pervasive biotechnologies.

3.5 Gina Czarnecki

Gina Czarnecki's practice has incorporated many different types of media since the beginning of her career in the 1980s, including video, drawing and sculpture. According to the artist, her work is "about human form and function, developments in biotechnology, the intertwining histories of medicine, myth, history and ethics" (Czarnecki, 2018, para.1). Czarnecki's interest in the use of science and technology in art has seen her act as an advisory source to a number of programmes and institutions, including the Science Gallery, London and the Casebooks Project at Cambridge University, UK. Czarnecki's best-known biological work is *Heirloom* (2014), her series of living portraits that uses both 3D printing and cultured cells.

3.5.1 *Heirloom*

Heirloom (2014) is a set of living portraits of the artist, Gina Czarnecki's two daughters, Lola and Saskia, grown from their own donated cells [Figure 3.12]. The portraits are three-dimensional masks grown from cells and remain living through their containment in sterile conditions and fed nutritional supplements. The masks are colourless and appear transparent as the layer of cells is as thin as tissue paper. Furthermore, the masks depict the girls with their eyes closed and a neutral facial expression, leading Jens Hauser to describe the portraits as "living mortuary masks" (Bureaud, 2016, para.16). When exhibited at the Medical Museion in Copenhagen, Denmark, in 2016, the portraits were displayed alongside the moulds used to cast the faces of the children, including those that were damaged or broken, and a video detailing the construction processes (Bureaud, 2016).

In order to grow the portraits, the DNA of the two girls was first needed. As Czarnecki's daughters were only 11 and 13 years old at the time the work was created, they were not able to consent to donate their own DNA. Instead, Czarnecki, as their parent, signed the consent forms required for the girls to donate cells which were taken from the inside of their mouths

using buccal swabs. In order to grow the portrait masks accurately, molds were taken of the girls' faces, which were then turned into glass masks. The cells were 3D printed into the shape of the faces and were incubated in culture serum. After growing the tissue, the thin cellular portraits were placed over the glass masks and then sealed in bioreactor cases [Figure 3.13]. The portraits live in a bath of nutritional liquid and are fed through a hose which is attached to the mouth of each portrait, an equally necessary and aesthetic decision which suggests "as if it were vital for breath" (Bureaud, 2016, para.16). The blurred boundaries between the masks being living and displayed as such through the hose being attached to the mouth area, yet simultaneously appearing as a contemporary form of death mask that will continue to live. However, that they will not portray the changing appearances of the girls as they age presents a dichotomy reflective of the living materials used in bioart; simultaneously, they are living but not fully alive. Similarly, they are living depictions of living individuals, however, in this process, the portraits become separate living objects.

The scientific production of the project was supported by John Hunt, a scientist at the Institute of Ageing and Chronic Disease at the University of Liverpool, UK; however, Czarnecki has stated that she faced many difficulties and obstacles in trying to find willing individuals and ethics committees that would assist and allow the work. Czarnecki comments that "it took years for me, bouncing around through various institutions and individuals, to receive ethical guidance in the use of tissue from living, consenting humans in artworks" (Czarnecki & Hunt, 2016, p.84). This issue of ethics appears to stem from Czarnecki's lack of affiliation with a licensed institution rather than the project or technologies used, however, this openness about the difficulties she faced in practicing bioart is a notable event of transparency in a genre which is often criticised for the opposite. In terms of specific materials used, however, there are many ambiguities in the descriptions of the construction process, with Czarnecki describing the growth solutions that were used as "cell nurturing cocktails"

(Czarnecki, 2018, para.2). This lack of specificity is problematic in trivialising the scientific aspect of the work while also potentially hiding the use of certain solutions that require the killing of animals, such as FBS.

In terms of the artist's motivation behind the project, the direct aim was to "investigate the idea of preserving her daughter's youthful appearances and offering them back to her daughters in the future as a kind of inheritance: an artist's heirloom" (Whiteley, Tybjerg & Pedersen, 2016, p.86). In a wider sense, Czarnecki explains that the work was inspired by her "interest in the complex philosophical and ethical questions that developmental biotechnologies raises, using the lens of art" (Czarnecki & Hunt, 2016, p.84). However, this interest also ties into the theme of 'heirloom' as Czarnecki comments that due to her "father surviving the Nazi camps and what I learned from visiting the Medjaneck concentration camp with him when I was seven years old has resounded through my life works" (Czarnecki & Hunt, 2016, p.84). In this way, the artist is not only demonstrating a passing on of genes through the portraits but a family history that has directly encountered the ethical and practical problems of biotechnologies, their uses and potential misuses.

In naming the work *Heirloom*, Czarnecki comments that "heirloom is something of value passed down through generations that parents might decide to leave for – and from – their children" (Czarnecki, 2018, para.3). The work reflects the meaning of the term heirloom in multiple ways, alluding to both the portrait tradition and genetic inheritance, rendering the title "both direct and poetic, with many layers" (Bureaud, 2016, para.4). According to the artist, the portraits "sit between representation and actuality, between the ontological and the evidential, weaving together principles between ideas, forms and understanding that ask us to consider our own materiality and values: where, between us and our cells, identity lies (Czarnecki & Hunt, 2016, p.84). Therefore, as a living heirloom, the artist has both preserved her children's youthful images, as well as creating new lifeforms in doing so; furthermore, by

looking to the future by anticipating the works as being heirlooms, Czarnecki has also formed living connections to her family's past.

3.6 Amy Karle

Amy Karle is a self-described bioartist who has undertaken several international residencies that encourage and facilitate art and science interaction, including at the Copernicus Science Centre, Warsaw, Poland, and Ars Electronica's AIxMUSIC, Linz, Austria (Karle, 2021a). Karle describes herself as a "provocateur and a futurist, opening future visions of how art, science, and technology could be utilised to support and enhance humanity while making advancements in the technology towards those goals in the process of making her artworks" (Karle, 2021a, para.1). Karle's work has engaged in both conceptual and material bioart, including drawings, performance, sound and 3D bioprinting in her practice.

3.6.1 *Regenerative Reliquary*

Amy Karle's 2016 3D bioprinted sculpture, *Regenerative Reliquary,* is unique amongst the works discussed in this thesis as it is not a living sculpture as of yet, but the artist intends it to be in the near future. However, it is included in this thesis due to the artist listing the work under the category of bioart on her website and the speculative addition of living cells being added to the work in the future; that is, the work is currently incomplete and is intended to be a living work of bioart when it is completed. At present, the work consists of a hand-shaped sculpture bioprinted using a biodegradable pegda hydrogel [Figure 3.14]. The work is not a completed biological hand but a scaffold that is designed to, in the future, support seeded stem cells from an adult human donor (Karle, 2021b). It is the artist's intention that the seeded stem cells will grow into tissue, which will subsequently be mineralised into bone. As the scaffold

is made from biodegradable material, it will gradually disintegrate, leaving behind a skeleton of a hand that is grown rather than being the remains of a corpse.

Regenerative Reliquary was produced in collaboration with the Computer-aided design (CAD) software company Autodesk, at the Pier 9 Residency programme in San Francisco, US (Capossela, 2016). The structure of the hand was first designed digitally using Autodesk, where the intricate scaffold structure was informed from scans of human bones the artist made (Capossela, 2016). These digital designs were then 3D printed using hydrogel. Visually, the work does resemble a human hand in shape and size, with four fingers, a thumb and joints all distinct through variations in the thickness of the gel. The hand appears yellow in colour but translucent, with geometrically shaped holes evident in the scaffold, allowing the viewer to see right through parts of the work. The sculpture is housed inside of a glass bioreactor and submerged in a protective preservation solution, however, the details of what the solution comprises of has not been noted. The work is pioneering from both an artistic perspective as well as within biotechnological practices as "this piece required new materials to be developed and made" (Karle, 2016, para.7), demonstrating an exploratory element of bioart practices in the new uses of existing technologies, as well as innovative ideas requiring new or alternative techniques or materials to be produced. Furthermore, at the time that the work was produced, it was the largest freestanding printed sculpture (Karle, 2016).

The use of bone resembles the many extant religious relics that claim to preserve bone fragments of dead saints (Ephanov, 2020). Furthermore, the work references the relic tradition through its presentation in a glass case, however, the glass case used in the work is a bioreactor, yet for the work and for religious relics, glass cases are necessary for the preservation of the objects, only they function in different ways and for different reasons. The contradicting idea of an artificially grown biological relic rather than an organic, historic relic is central to the work, with the artist suggesting that "instead of enshrining the inanimate remains left after

death as a memorial to the life that was once there, '*Regenerative Reliquary'* presents the opposite, depicting the possibility of life from an inanimate object" (Karle, 2016, para.4). Replacing the historic with the new, and the natural with the manufactured, the work deconstructs the ideas of preservation and the mythologies or beliefs attached to materiality, with preservation in this work revolving around a new, artificially grown limb which, like the stories attached to histories of relics, raises new speculations of what this technology could offer in the future.

Despite the conceptual relationship to relics, one of the motivations behind the work is also informed by the speculative practice of these technologies integrated into healthcare approaches, both for internal organ implantation and for prostheses. Karle explains that she "began envisioning a future factory where the same materials – just a few cells, could be used to grow organs, marrow, limbs and also create art and design objects, even technology for both inside and outside of our bodies" (Karle, 2021b, para.12). This vision of the future is growing closer to reality, with bioprinting suggesting possibilities of custom-designed organs that would not require transplantation from a deceased donor while also reducing the risks of organ rejection.

This work, in particular, demonstrates how artists using technologies can offer unseen advantages and new developments for science and technology as it is not until artists seek new materials and ways of using them that new challenges are unfolded, and in surmounting them, they reveal new knowledge under the realm of science. However, the incomplete nature of Karle's work is also an example of the barriers and difficulties of artists accessing the materials and expertise in order to create bioart works as she "is seeking scientific and biomedical partners to collaborate on cell culture and establish repeatable successful results for stem cell grown into bone in this or a similar method" (Material District, 2016, para.4). The creation

process of the work is therefore separated into stages, with Karle forming the first stage of the work separately from the ultimate biological components that will complete the work.

Chapter Three: Living Bioengineered Art

Part Two

The first part of this chapter described a number of bioart works that engage in living matter and biotechnologies. These works represent some of the most well-known, as well as some of the less-discussed examples of media-based bioart. While this included two of Eduardo Kac's works which used bacteria and living animals, most of these examples were tissue-based works grown from cells. Therefore, there are a number of shared qualities and characteristics present in these works, both in their materials and construction processes, as well as in a broader sense through the motivations of the artists, the aesthetic and the conceptual aspects of the works. The second part of this chapter examines these works together through visual analysis and reflects on the critical responses that these works have attracted. Together, this will assist in building a clearer picture of what bioart practices look like and what they have in common. Not only will these commonalities help to understand a more generalised grouping of bioart as a contemporary movement, but it will also help to position bioart in a sociocultural context through a deeper understanding of shared materials, characteristics and objectives.

3.7 Characteristics of Bioart

One of the most prominent issues raised around discussions of bioart is in relation to what the term actually encompasses and what the use of it is referring to. While this thesis has been clear about focusing on the materiality of works discussed, the lack of clarity around the use of the term bioart points to a lack of clarity around what unites such works and what features can be said to be specific or typical of bioart. By examining the key features, materials, processes, theoretical engagements and artist motivations that inform the works discussed, it is possible to begin to understand what is meant by bioart and what are the most significant unifying

features of these works. From this, it is then possible to understand critical responses and the cultural role of bioart, in addition to better understanding its context and importance in the history of art.

The characteristics that appear prevalent operate on both a visual and material level. Visually, many of the bioart works discussed appear to be based on or related to the human body. Materially, the majority of works use human or animal-derived cells aided by the use of growth serums. In terms of the motivation behind the artists' engagement with biotechnologies, there are varied aims detailed, yet all works appear to be purposeful and intentional explorations of human relationships with biotechnologies in the twenty-first century. Exposing the shared characteristics and distinct differences in works that have all been associated with the term bioart will allow for a more specific understanding of what is meant by the use of the term bioart.

3.7.1 Human-like Forms of bioart

There are many similarities and differences present in the bioart works discussed, however, an obvious and prominent similarity present in these works is that artists demonstrate an interest in mimicking or replicating the human body, its features and abilities. In this way, the many works appear to demonstrate either the isolated growth of a human body part; found in *Sugababe*, *Regenerative Reliquary*, *Heirloom* and functionally in *cellF,* which operates like a brain despite it not visually resembling one. The body parts created, grown and reimagined by bioartists include ears and limbs. In addition to Diemut Strebe's *Sugababe*, ears have been a popular choice for artists, with Sterlac's *Ear on Arm* being another notable example of an ear grown for art purposes, along with the Vacanti Mouse, grown by scientist Charles Vacanti in the mid-1990s (Catts & Zurr, 2016).[17] While the choice to grow an ear may stem from a

[17] The Vacanti Mouse was a mouse which had the shape of a human ear grown on its back using cartilage.

conceptual idea, such as the ear being symbolic of Vincent van Gogh and suggesting an interesting and novel method of exploring the artist the ear appears, however, to be one of the most accessible and researched biological forms that have been grown in bioengineering practices.

The doll-like forms of the TC&A's *Semi-Living Worry Dolls* is an interesting deviation from the authentic bodily representations of the aforementioned artworks. The choice of doll-like forms appears to be based on the concept of worry dolls embodying subjective fears attributed towards them, however, it is significant to note that a doll is also a non-living representation or stand-in for a human. As an inanimate representation of a body, historically, dolls have been used as children's toys and as part of religious or magical rituals (Bado-Fralick & Norris, 2010). However, in this artwork, the dolls are not toys or ritualistic but are constructions made of flesh as a product of contemporary abilities of bioscience. These dolls are a new type of doll and highlight "that new forms of visual culture change not only the way we approach images, but our understandings of bodily modalities and experiences" (Toffoletti, 2007, p.59). In this way, the *Semi-Living Worry Dolls* demonstrate the need for a new understanding of the changing human body in the age of biotechnologies.

In many contemporary cultures, dolls have taken on a new role, not only as toys but as objects that are deeply tied to capitalism; this is particularly true of dolls such as Barbie who is "indicative of endless transformations and eternal youth, manifested by the consumption of mechanisms of control such as plastic surgery" (Toffoletti, 2007, p. 61). However, the TC&A's dolls are not plastic, but flesh that is equally malleable, transformative and exists beyond symbolic representation. While manifesting the conceptual form of a vessel designed to carry childhood fears, as dolls, the *Semi-Living Worry Dolls* also stand in for our own bodies which are becoming more malleable and borderless due to biotechnologies. Furthermore, as highlighted by the concerns of Doll B and Doll C, which "worry about biotechnology, and the

forces that drive it [and] worry about capitalism and corporations" (Tissue Culture & Art Project, 2021b, para.3), there are a great number of potential problems that could arise out of the capitalisation of biotechnologies through the control of them by pharmaceutical companies. The connection between the dolls and the message that the TC&A are trying to convey, therefore, has many deeper levels than the dolls only being living replicas of objects designed to hold concerns.

Ben-Ary's construction of a functional 'brain' neural network, however, appears to focus more on function than form. The living neurons that were grown from stem cells do not resemble a human brain, and instead, the material appears to have no actual structure. Sitting in a Petri dish, the biological material appears to be a flesh-coloured jelly-like substance that is connected by wires to the electrical interface and only performs as a brain rather than physically resembling one. However, technology and machinery take a central role in the construction of *cellF*, thus demonstrating a fluidity of boundaries between the biological and the technological, with wires and other equipment connecting *cellF* to the musical machinery with which it interacts. This speaks to the transhumanist visions of a future in which the human body is enhanced and becomes one with technologies, therefore, redefining the human and the self.

The human form, therefore, appears to be an appealing reference point for bioartists. This could be linked to motivations that are driven by the influence of bioengineering technologies on the body through medicine and aesthetic augmentation. However, not all bioartists have followed this decision to directly engage in the human body, but instead many have appeared to resemble the body as a more conceptual reference. In this way, a number of bioart sculptures visually resemble objects that are intended to aid the body, protect the body and fulfil bodily needs. *Victimless Leather* imitates an item of clothing designed to cover and protect the body; *Disembodied Cuisine* presents the flesh of a dissected dead animal that

provides the human body with nourishment. This reference to bodily needs and the ways in which animals are used to meet these needs suggests connections between existing practices and new biotechnologies that propose new methods of growing living materials to offer solutions to the harm caused to living animals through consumerism; this includes clothing, cosmetic products, medicine and food. However, they both reveal the fallacies of claims of 'victimless' technologies, as even grown life requires ethical considerations. Therefore, by referencing such objects or needs, these forms draw attention to the wider scope of human impacts on living subjects and the costs of biotechnologies.

In a wider sense of works that are not discussed in this thesis but have been discussed under the umbrella of bioart, there appears to be a range of reference points, but many continue to engage with the body. This is apparent even when the biological material used is not tissue, such as Jun Takita's, *Light, Only Light* (2003) [Figure 3.15]; a brain-shaped sculpture covered with bioengineered bioluminescent moss. This suggests that due to a majority of bioartists seemingly engaging in bioengineering in order to explore, understand and critique its presence in contemporary society, the outcomes of such projects appear to reference the body and the effects of biotechnology on the body; a body that is being redefined and altered in the twenty-first century. However, it is significant to highlight that bioartists' engagement with the body is not necessarily a requirement of the materiality used or of bioart, as demonstrated by Andrew Krasnow's *Palette* (1992-99) [Figure 3.16] and Ezzam Rahman's *Here's What I Am, I Am What You See* (2015) [Figure 3.17] which both use human skin but take the form of a map and a flower respectively, yet these works do not appear to engage in the genre of bioart. What these works demonstrate, therefore, is that through materiality, bioartists are engaging in a more complex practice that concerns the social and cultural impacts of biotechnologies, and this is enabled through the effectivity of material engagement which sets bioart apart from other genres of art that use similar materials.

3.7.2 Living Cells and Growth Serums

Most of the works discussed in this thesis are constructed from living cells that are either donated or extracted from living organisms. The process of growing three-dimensional sculptures from cells requires a form for the cells to grow around. For this reason, most of the works created use either 3D bioprinting technologies or seed cells onto a constructed biodegradable scaffold. While the outcomes of these works are all vastly different, there are many shared aspects in the materials used and how they are processed into the final sculptures. However, with these materials, there are many ethical and practical considerations and potential problems with the use and acquisition of them.

Three of the works include human cells; Ben-Ary's work uses the artist's own cells, Czarnecki's work uses cells donated from her children, and Strebe's work uses both donated cells and historical DNA extracted from a letter. These three different methods of acquiring the genetic materials present three different challenges and associated ethical problems. The use of the artists' own cells is ethically ambiguous but consideration of the biopsy needed to extract materials from the artist is important as it could cause damage or harm; furthermore, the work *cellF* was designed to function as a second, separate brain. Therefore, questions of ownership, subjectivity and agency are raised by the work being both human and part of the artist, as well as being a mechanical artwork and separated from the artist. However, for Czarnecki's work, the most problematic issue with her use of living cells is that they were donated by her children, who, as minors, could not legally consent to the donation. Instead, as both the legal guardian and the artist, it was Czarnecki's consent that was given, which holds a bias as it was in her interest to consent for her work. Consequently, the use of human cells in this particular artwork suggests a difficulty between artistic access to biological materials and the rights of a parent to consent for DNA donation.

Strebe's work also uses donated cells, however, in this instance, Lewie van Gogh was a consenting adult and therefore the use of his cells is not as ethically problematic. What is somewhat problematic, however, is that his cells, combined with others, were intended to reproduce a replica of a deceased third party; Vincent van Gogh. Not only could van Gogh not consent to this act, nor the extraction of his cells from the letter, Strebe notes that not all of the van Gogh family did approve of her project, saying that

> the Van Gogh family now takes on two very different roles. On one end, you have the artists who are very creative and were eager to help with my project [Lieuwe van Gogh is an artist]. On the other side, there are those who handle the administrative duties of Van Gogh's brand. This part of the family wasn't nearly as receptive to the idea of creating a replica of Vincent's missing ear. It was very interesting to witness this division. I suppose ears don't continue to haunt without reason (Mafi, 2015, para. 5).

This elicits new concerns around the acquisition of DNA and the retrospective use of it for growing or cloning new life. While the ethical considerations of growing or cloning life are important, so too are considerations of ownership. If *Sugababe* is Strebe's work, but materially and genetically belongs to multiple individual members of the van Gogh family and is an object that is technically alive but dependent for care and survival, who can claim to be the owner of the work? Furthermore, how would these issues of ownership and consent translate into a medical context involving bespoke organs or limbs grown by corporations using an individual's own genetic materials? The lack of clear answers in light of these problems highlight the emergence of bioart as a platform to intentionally problematise and ask these questions.

In contrast to the concerns of consent in the use of living human materials, the use of animal-derived cells and matter elicits concerns associated with ethics and animal rights, together with the new concerns over life status and the agency of new life grown from animal products. The works of the TC&A all use animal-derived cells, however, the methods of acquisition of these materials vary. In the construction of *Victimless Leather*, the artists used McCoy cells which, while originating from a mouse, the cells come from an immortalised cell

line. This means that cells originally extracted from a single mouse in the 1970s have been manipulated so that they continue to multiply. Consequently, the cells can be acquired in bulk and do not require an animal to undergo a donor procedure. The cells used in *Disembodied Cuisine*, however, are frog cells extracted from a frog which was also displayed in the exhibit. Therefore, the frog was not killed for the work, but its materials were used to create a new mass of living matter which simultaneously existed externally from the animal. As such, this problematises notions of authenticity as well as the self and the other, but opens opportunities for minimising animal harm in acquiring and using biological materials.

In addition to the different types of living cells acquired by artists for their works, the growth of living cells requires nutrition which is provided through submersion in growth serums. Of all the artists' works discussed in this thesis, the TC&A are the most transparent about their use of growth serums, specifically the use of FBS, a growth serum that is collected from unborn calves in slaughterhouses (Reynolds, 2018). Part of the transparency from the TC&A about the use of FBS is a critical response to the claims of 'clean meat' companies that suggest a cruelty-free alternative to slaughtered meat, as the reality is that for meat to be grown outside of a body, FBS must be used, rendering such meat still problematic (Reynolds, 2018). Therefore "growing animal tissue in a laboratory is not a cruelty-free procedure" and while there are "hopes to develop a synthetic or plant based alternative for the calf serum in the future, but it is worth remembering that currently, laboratory-grown meat is not an 'innocent' product" (Radomska, 2017, p. 382). However, by offering more transparency around the construction details of their works than other artists, the TC&A also have the potential to attract more criticism than those who choose to omit the use of FBS from the details of their practice. However, this is an important aspect to address as not only does the production of FBS require the slaughter of cattle, the omission of its usage "keeps the victims (i.e. slaughtered cows and unborn calves) undisclosed" (Radomska, 2017, p.384).

Of the other artists' works discussed, Czarnecki mentions that the growth of her cell portraits involved "combining innovative new methods and cell nurturing cocktails" (Czarnekci, 2018, para.2), however, she omits the exacting solutions used; whether this is to simplify details, the process or to hide the use of specific materials is unknown. However, if the former option is the reason, the simplification of such biological processes is problematic as it fails to accurately discuss the processes and costs of bioengineering. Details of the growing process of Strebe's *Sugababe* are limited, with no direct reference being made to growth medium, and for Amy Karle, her work does not yet include biological material. Ben-Ary provides in-depth details regarding the process of extracting his own cells and reprogramming them to create functioning neural stem cells, including that the cells were grown in a tissue culture lab; while there is no exact reference to the use of FBS, the clarity of processes provided suggests an implied use of FBS that was not noted due to it being an expected part of the process. In comparison to many other accounts of artist's processes, Ben-Ary's account is the most specialised and detailed in terms of vernacular and scientific processes, further suggesting that the use of FBS is implied and not worthy of noting for the intended audience.

The materials used by the artists currently engaging in living bioart, therefore, share a number of similarities, as many are human or animal-derived cells which have been cultured into tissues. However, the acquisition of these materials appears to vary, with some posing greater ethical concerns than others, leading to further problems of consent and ownership, demonstrating the complexities present in bioart and in defining it as one shared genre of art. Furthermore, the processes of constructing living tissue sculptures from cells appear to be similar, with most artists culturing tissue with the assistance of scientists using either scaffolds or 3D bioprinting. By looking at the forms these sculptures take, it appears that bioart can be united by more than just materiality, but by the deeper engagements with the culture of biotechnology that these artworks suggest that is enabled through materiality. This becomes

even more apparent when examining the motivations that informed the construction of these works, of which many artists appear to be concerned with exploring and critiquing biotechnologies.

3.7.3 Exposing, Exploring and Critiquing Biotechnologies

The choice of using living matter as art materials by bioartists appears to have been informed by some shared sentiments, in addition to unique ambitions and concerns. A majority of bioartists have suggested that their engagement with biotechnologies stems from a desire to explore the presence and the role of bioengineering technologies in contemporary society. However, it is important to note that not all artists involved in bioart practices have explicitly referenced their rationale for using living materials which in itself poses a problem in assessing the claims that bioartists engagement in living materials is for shock value or superficial purposes (Stracey, 2009).

As with the transparency regarding materials used and processes involved in construction, the TC&A are the most transparent in detailing their motivations, together with having the largest collection of literature written by themselves about their practice. The group place their motivation fundamentally in exploring the "impact of tissue engineering on society" (Tissue Culture & Project, 2021, para.1), which focuses on life grown in a laboratory setting; the same life that they refer to as being semi-living. While individual works appear to focus on particular problems or aspects of bioengineering, such as food consumption or clothing consumerism, the "primary aim of the TC&A Project is to explore the philosophical, cultural and ethical implications of the semi-living and the contestable future scenarios they offer us" (Tissue Culture & Project, 2021, para.5). This suggests that the use of living matter is imperative to their practice as their purpose is to explore the implications of these materials, including how they are interpreted and perceived by critics. Furthermore, they are not unaware

of their engagement with biotechnology being perceived as hypocritical, as Oron Catts describes his practice in his Twitter biography as "culturally scrutinising Neolifism by actually doing it" (2021). This self-awareness is important for bioartists in order to dismiss the critical assertions of hypocrisy and self-indulgence of artists which have been used in criticism directed towards bioartists.

Similarly, the problem of critically exploring new biotechnology by applying them in art practices is apparent in the work and motivations of Gina Czarnecki in *Heirloom*. Czarnecki's work explores the ethical problems regarding the ownership of biological materials when they are donated for various medical or research practices, such as the donation of blood, organs or DNA. This issue is explored by the donation of DNA from the artist's two daughters to be able to create the works and their lack of ownership over the produced works. However, her work is equally concerned with the nature of heirlooms and the processes associated with them. By using living materials and biotechnologies, Czarnecki's practice combines the new and the old and anticipates the future in both the use of materials and the preservation of her daughters' youthfulness for them to reflect upon when they are older.

Like Czarnecki, Guy Ben-Ary's use of biotechnologies and the exploration of them through his art practice is also through a critical lens, with *cellF* "forcing viewers to look forward at possible future implications of technologies, as well as to look backwards in terms of how technologies have informed our belief in the givenness of categories, I create artworks that (I hope) critically question the practices through which distinctions and categories are materially and discursively produced" (Hudson, 2014, p.40). This interest in intentionally provoking critical reflection appears to be a central theme across bioartists, with such works physically embodying bioengineering technologies that question previous assumptions about ideas of life, materiality and how we mediate and understand them. However, for some artists, the draw of using living materials sits in line with the new possibilities it offers to art and design

practices for aesthetic and practical uses. For Amy Karle, her interest in biological materials is motivated by a wider interest in the future of technologies and their potential impacts, stating that she is "a provocateur and a futurist, opening future visions of how art, science, and technology could be utilized to support and enhance humanity while making advancements in the technology towards those goals in the process of making her artworks" (Karle, 2021, para.1). *Regenerative Reliquary* appears to support this aim as it is not a completed work but one which looks to the future and anticipates new ways for technologies to enhance humanity through applications in art.

Similarly, Diemut Strebe "has said she is interested in bringing cutting-edge technologies like these to the art world 'because science has so much creativity and inspiring processes, which I love to involve in my work'" (Osberg, 2015, para.3). While the work, *Sugababe* appears to have been specifically influenced by exploring the paradox, The Ship of Theseus, this can also be linked to the concerns of biotechnologies in society, as the work explores concepts of originality and authenticity through genetics. Furthermore, Strebe has commented that her work is asking questions about these new technologies and that they are important questions to ask in contemporary society, saying, "we don't live in Disneyland. We live in a time when these questions are important to ask" (Guth, 2015, para.9). In this way, Strebe's work appears to be provocative in her use of living technologies, using them to open dialogue rather than assert knowledge or answers.

The uses of living materials as art media appear to be, therefore, for reasons predominantly concerned with the problems that new technologies pose for concepts and uses of living matter. The consideration of these issues by artists demonstrates an intentionality and sincerity of bioart works, moving beyond accusations of an insincere disregard for living materials or producing such works simply because it is possible to do so. By actualising their concerns materially, bioartists seem to invite curiosity and discussions around these materials

and our relationship with them. However, in doing this, it appears that many opponents to bioart require artists to provide justifications for their use of living matter. This requirement for justification of artists' use of living materials once again demonstrates a cultural set of expectations that appear to divide art from science and creates boundaries that are subjective and appear to align with moral expectations rather than ethical guidelines. However, in using these materials and processes, it appears that bioart is helping to produce discourse around these expectations, allowing audiences to reflect on and address them.

3.8 Responses to Bioart

The responses to works of living bioart, by both audiences and critics, has varied widely. While there is a growing field of literature on critical and scholarly responses to bioart, there is limited documentation or research on the individual responses of exhibition visitors. The responses to bioart can be found in a number of sources, with most appearing in academic journals, books and mainstream media, with notable authors including Eduardo Kac, Anna Dumitriu, Oron Catts and Ionat Zurr, Lindsay Kelley, Robert Mitchell, William Myers, Nora Vaage, Charissa Terranova and Frances Stracey. Furthermore, there are a number of theses and dissertations that have explored different aspects of bioart, including Marietta Radomska's *Uncontainable Life: A Biophilosophy of Bioart* (2016), Marianne Cloutier's *Bioart as a Space for Identity Conceptualisation: Figuring the Human Body under the Scope of Biotechnologies* [French] (2017), Svenja Kratz's *Artscience in Practice* (2013), and Howard Boland's *Art from Synthetic Biology* (2013). Of these numerous sources, a majority of works tend to deal with the construction of artworks, artist's perspectives and the ethical implications of bioart, with limited insight on bioart from the viewers perspective. However, it is possible that this limitation is a reflection of the limited opportunities for bioart to be exhibited and viewed and the restrictions on artists accessing the materials to create these works. Consequently, there is

limited literature which provides insight into understanding how bioart is experienced and the reasons for these embodied experiences. However, despite these limitations, the controversial nature of bioart means that the literature that does exist is often transparent in expressing where it is situated in either the praise or criticisms of bioart.

The criticisms of bioart can primarily be categorised into two related themes; that bioart appears to present a transgression of the expectations of art and artists, and the ethical implications that these transgressions present. Given the range of living materials used in the different works that have been included in discussions of bioart, it is possible that the materials used and explicit knowledge of these materials is contingent on the response as some artworks appear to have attracted stronger responses than others. Therefore, many of the responses, both positive and negative, appear to be based on perceptions and understandings of materiality and their suitability for art media and as something that can be manipulated and used by humanity for our own purposes. This importance of materiality appears to be a deciding and divisive aspect of bioart and consequently is at the forefront of responses to these artworks, not only as a confronting new media for art, but as a source of deeper sociocultural concerns around bioengineering.

3.8.1 Expectations of Art

The expectations of art, that is, perceptions of what art should be and do, have influenced the reception of bioart works. Firstly, it is clear from the nature of bioart being included under this name, and most often discussed in an art context, that these works are intended to be considered artworks; however, it is also apparent that they intersect the traditional categories of both art and science, consequently embodying both simultaneously. This affect of bioart being both art and something that exceeds the traditional notions of art is a possible cause of discomfort and one which evokes responses of bioart being an act of transgression that disrupts the cultural

expectations of art and artists. These expectations are not necessarily clear cut but become apparent in the provocative acts that bioartists partake in by using life as art materials. As one of the originators of the bioart genre, Eduardo Kac comments that,

> while specialized publications showed greater appreciation for "GFP K-9", the response in the general media covered the whole gamut, from forthright rejection to consideration of multiple implications to unmistakable support. The shock generated by the proposal curiously caused one critic to declare "the end of art". As I see it, there's no reason to see the beginning of a new art as the end of anything (Kac, 2011, p.3).

This reveals that responses to Kac's proposed work differed depending upon the knowledge base and interest of the audience. While there is no clarification of the nature of the specialised publications that offered a more optimistic response, this claim suggests that a greater understanding of the context and processes of the proposal allows for a more positive experience with it. The varied response of more generalised media indicates, however, that responses are subjective and dependent on a wide range of factors. The suggestion of bioart representing an end to art, however, is an interesting and important comment, especially in the context of the history of art. Bioart appears to be based around the introduction of new materials into art practices, a process which has happened many times in art history, for example, the introduction of new media in contemporary art since the 1980s, as discussed in Chapter One. The rejection of bioart, even as a proposed work here in Kac's case, as being art reveals the challenging nature of the media of bioart, and what a change in the use of this media reveals about our own prejudice and expectations about life outside of ourselves as being the cause of these rejections, yet is simultaneously one of the most compelling and important features of the practice. Art, therefore, enables an encounter with both the fears and the possibilities of the very same biotechnologies that are being developed and used at present. However, some discomfort may stem from a lack of familiarity with these technologies as they are often not publicised until end products are announced. Therefore the first encounter with some of these

technologies may be through bioart, and consequently, this contextual shift along with new technologies can provoke a negative response.

The simultaneous criticism and curiosity towards actualised works of bioart have continued to emerge, with the critical lens being the more dominant response. The reasons for criticism appear to be linked to the ethical problem of living materiality becoming art media. Frances Stracey summarises the range of responses to bioart as follows:

> responses to more recent and controversial forms of bio-art, such as the creation of transgenic mammals, have gone beyond judgements of beauty in favour of more sublime and apocalyptic assessments. These range from accusations of promoting a new 'artful' eugenic movement, to cries of aesthetic indulgence in "carnivalesque sadism", to condemnation of the artists as naive or unwitting pawns in a market-driven public relations game on behalf of bio-tech industries, using the allure of culture to sell controversial science to a wider audience (Stracey, 2009, p,497).

Stracey's remarks touch on two key issues regarding the reception of artists using living media and biotechnologies in their practice; the first is the problem of the works being interpreted as hollow or exploitative uses of living materials just because artists can, and the second being the perception of the relationship between the artist and the scientist or the art and the technology (Stracey, 2009). For the first issue, this is perhaps one of the biggest obstacles for artists to overcome. Despite transparency around critical engagement with bioengineering on a theoretical as well as a practical level, there appears to be a prevalent perception that an artist's use of scientific materials is frivolous and has an inherently lower value or importance than the very same processes and materials have when they are a product of science. This consequently prompts a reconsideration of how materials and processes are divided by cultural forces into one of two categories wherein it seems that one group of individuals are given privilege to overcome ethical concerns and negate the same criticisms as the other group. These roles attributed to the scientist and the artist are conflated through the production of bioart works, through the development of the artistic laboratory, and through the direct engagement with living art objects. Furthermore, the accusation "of the artists as naive or unwitting pawns

in a market-driven public relations game on behalf of bio-tech industries, using the allure of culture to sell controversial science to a wider audience" (Stracey, 2009, p.497) suggests not only are artists and scientists perceived differently but that artists are naïve participants in bioengineering practices, rejecting their agency and intentionality in their involvement.

Although there is little documented about the response of bioart exhibition audiences, with the notable exception of Wolfgang Kerbe and Markus Schmidt's 2015 paper, *Splicing Boundaries: The Experiences of Bioart Exhibition Visitors,* which will be discussed in the next chapter as it considers the bioart encounter, the TC&A have made responses to their works part of the exhibition experience. On the display of the *Semi-Living Worry Dolls*, Deborah Dixon states that "audience members were invited to tell their worries to these dolls and reflect upon the worries expressed by others. They are, therefore, very much evocative objects. But, these are also prompts towards critical thinking; that is, they are intended to change an audience's perception of what art itself is" (2009, p.417). This suggests that not only did this work facilitate an encounter with living products of bioengineering but also actively encouraged the audience to express their subjective feelings of the encounter. In the 2019 display of the *Semi-Living Worry Dolls* at the *Future and the Arts* exhibition at the Mori Museum in Tokyo, the artists similarly provided a notebook and pens for visitors to write down their feelings towards the sculptures. In this way, whether the responses are critically engaged with and considered or not, it allows for a process of active engagement with the living works and prompts the audience to think about how the objects make them feel.

As Dixon suggests, however, the presence of these works prompts a realisation that the art the audience is engaging with is alive and perhaps not art as they have encountered it previously. A change in the perception of art mediated through bioart, therefore, prompts a similar challenge in perceptions of science and biotechnology. This is further evidenced by Ionat Zurr's statement that "one of the most common and somewhat surprising comments we

heard was that people were disturbed by our ethics of using living cells to grow living fabric, while the use of leather obtained from animals seems to be accepted without any concern for the well-being of the animals from which the skin has been removed" (Wired, 2004, para.9). This attitude demonstrates the precarious ambiguity of the semi-living as a life form, as in encountering it, the audience feel compelled to acknowledge its agency, even over the lives and agencies of consumer livestock, as those practices are often hidden from view.

Furthermore, Ben-Ary suggests that the viewer is not alone in their discomfort when encountering bioart, but that it is present for the artist too, saying that "philosophically, I feel a sense of discomfort in working with dissociated neurons, or bits of brains as I am constantly confronted by ethical questions regarding past, present and future understandings of consciousness, intelligence and sentience" (Hudson, 2014, p.40). Therefore, the ways in which bioart provokes critical responses through the disruption of expectations of both the artist and the art appears to be situated in the materials used and the discomfort these materials provoke. Works of bioart are not static, but they are living objects made from living materials which are malleable and mouldable like traditional art materials. Through this reconfiguration and recontextualisation of visceral, living matter, emotional and embodied discomforts appear to emerge, along with the ethical concerns that this presents, therefore, exposing new, unprecedented concerns for artists and art practices.

3.8.2 Ethical and Practical Concerns

The ethical concerns of bioart are a prevalent issue that has emerged as a focus of the practice in the literature surrounding it. Through these discussions, it is apparent that it is difficult to separate the practices of tissue manipulation in art from tissue manipulation in bioengineering as they are fundamentally the same processes, with the outcome or conceptual processes being different. Therefore, to critique bioart is to critique bioengineering which is a reflexive process

that appears to be a central role of bioart. However, this has not prevented bioart from creating a platform to generate uncomfortable discussions around ethics.

Furthermore, there are a number of practical issues that have emerged from using living materials as art media, which have also been discussed in the literature. One such example is the TC&A's 2008 iteration of *Victimless Leather* which, as previously discussed, was killed during its display at MoMA, which provides an example of the unexpected concerns that arise from using and displaying living materials as art. Gillian Terzis comments that "the artwork was designed as a critique of the type of research that goes on behind closed laboratory doors, but its 'death' triggered unease. What are the ethics of manipulating biology? And does it matter if it's for the sake of art, rather than the sake of medicine?" (Terzis, 2015, para.1). This comment highlights that the realities of bioengineering are often off-limits to the public and that the ethical considerations required for practicing tissue engineering appear to be insufficiently well-defined to encompass a range of uses and applications. *Victimless Leather's* uncontrollable growth and subsequent public demise exposes a practice that exists but is not commonly seen. It demonstrates a lack of control over nature in a practice where control is often exercised and is necessary for growing specific, functional products that may one day be implanted into human bodies. However, here, *Victimless Leather* grew independently, demonstrating that it existed beyond being an art object, but a living subject, and that despite attempts to control nature, we still cannot exercise complete control over a subjective, living entity. This unexpected growth highlights the work as being a living being and, therefore, its death is more pronounced than if its growth had not been visible or if it was killed out of sight. The spectacle made of its death is a significant reminder of the limitations of bioengineering and the unpredictability of using new materials as art media, especially living ones.

For some critics, however, the TC&A are not sufficiently political in their provocations of drawing attention to the practices and ethical considerations of tissue engineering. Deborah

Dixon states that "they [TC&A] argued, an 'aesthetics of care' demands that the status afforded lab-born, Semi-Living Objects be placed under critical scrutiny, such that the commercial, legal and regulatory frameworks that shape form and feature, but also their diffusion TC&A is insufficiently political in their endeavours" (Dixon, 2009, p.420). The lack of substantial political engagement appears to be in relation to the perceived hypocritical nature of critiquing a practice while partaking in it, evident in "for example, while TC&A may express compassion for the other, their position is necessarily and 'absurdly' compromised by the fact that they manipulate tissues as if they were mere objects" (Dixon, 2009, p.420). This implies that despite attempting to highlight concerns evident in the use and manipulation of living subjects through bioengineering, their participation in the same practice can be perceived to undermine expressions of concern or care that may have been the initial motivation in engaging with the subject matter.

This accusation of bioart practices being hypocritical and lacking in accountability is not an isolated concern, with further critiques stemming from how this hypocrisy does not sit well with bioartists who use posthumanist and anti-anthropocentric rhetoric in justifying their practice. Steve Baker and Carol Gigliotti refute the critical works of bioart, stating that they do "not see these works as 'opening up new perspectives', but immersed in existing perspectives, which I, among others, have already found to be not only troublesome, but also disastrous, not just for animals, but for the planet at large" (2006, p.38). This suggests that bioart practices are extensions of extant anthropocentric bioengineering practices and rather than existing as a critical opposition to them, bioart is complicit in the damaging behaviours and rhetorics they produce. In this way, no matter how critical bioartists are of these technologies, by using them, they implicitly are part of the problem. This is emphasised by Dixon, who says that for "such critics, there is no apprehension of irony in the documentation of TC&A, but rather confusion and hypocrisy, while their parody merely serves to replicate regressive practices" (Dixon,

2009, p.420). Consequently, the actions of bioartists can be seen as not only transgressive but problematic, creating new problems through being a new practice entrenched in the problems that already exist.

However, Catts and Zurr of the TC&A have rejected these claims that their work lacks political validity, stating that

> for the non-scientist, the 'wet' experience in the laboratory involving some degree of life manipulation can be seen not only as an ethical conduct but also as a political act. A political act that goes beyond the democratization of the technology, to the act of breaking down dominant discourses, dogmas and metaphors to reveal new understandings of life and the power structure it operates within (Catts and Zurr 2008, p.140)

For Catts and Zurr, then, the act of using and manipulating living matter is an intrinsically political act. By engaging in bioengineering and using life as art media, from their perspective, this practice is an important contribution to enabling conversations to move on from the anthropocentrism of current bioengineering practices. Furthermore, not only does their work reveal new discourses, but highlights and exposes the practices that are problematic, along with their political, economic and philosophical implications. Radomska suggests that "TC&A uses irony as their artistic strategy in order to problematise and ridicule transhumanist dreams" and does this "not with the aim of finding new technological solutions but, instead, to disclose the logic of the 'governing of life' prevalent in the field of biodesign" (2017, p.385). Therefore, the disputes and lack of consensus around where bioart sits on this political and philosophical spectrum between critical or implicit engagement with bioengineering is a prominent issue that is yet to be determined as there is no clear answer. Instead, bioart intentionally problematises bioengineering and our perspectives of these practices, purposefully provoking questions rather than answering them.

Chapter Four: Encountering Living Bioart

The use of biological materials and bioengineering technologies for art has presented a number of new and unprecedented situations, problems and phenomenological experiences. As demonstrated by a majority of the artworks discussed in Chapter Three, bioart, as art, is intended to be displayed and has been so across a number of institutions globally. The viewing experience of living materials is, therefore, an important aspect of bioart, as is understanding its importance and impact. However, there are a number of unanswered questions regarding the viewership of bioart; if artists have gone to the difficulties of accessing and using these materials and processes, what is the resulting experience for the viewer, and is this experience something that is intended or an unexpected result of the materiality? This chapter will, therefore, consider the ways in which bioart is displayed and how the viewing experience of bioart is mediated through the encounter. This will include examination of how the physical spatial experience is constructed both to care for these works and to guide the viewer's encounter, as well as considering the locations chosen for bioart display. Furthermore, this chapter will explore the viewer's relationship with bioart, the phenomenological and psychological implications of encountering these living artworks, and the consequential outcomes of these experiences and perceptions of the works in a wider socio-cultural context.

4.1 The Display of Bioart

Given that the emergence of bioart is primarily situated in the twenty-first century, there is little precedent for negotiating the issues that arise from the display of living materials. The field of living media-based bioart is vast and diverse in respect of the materials used and, therefore, the idiosyncratic nature of each individual work of bioart as living art objects is best understood through the subjective experience of encountering individual works in person.

While there is little precedent for engaging with bioart, there are other cultural experiences that can offer some insight into the ethical considerations of encountering life. These include zoos, circuses and 'freak shows', which are experiences that provide different forms of encounters with living subjects, and consequently present different ethical concerns and considerations for viewing.[18] However, a critical difference between these examples and bioart exhibitions is that most often, bioart works are laboratory-grown living materials rather than pre-existing subjects, such as animals or people.

Through sensory and environmental observations and feelings, the ways in which bioart works are displayed dictates how they are encountered and consequently how they are perceived. This, therefore, highlights the importance of where bioart works are displayed, the curatorial decisions in their display, and the additional practical requirements in the exhibition space. Furthermore, given the range of living substances being used as art materials, it is clear that there are new and unprecedented obstacles in the display as well as the production of living bioart works (Kallergi, 2008). These complications include strict licensing over the possession of human-derived materials such as tissue and organs and potential breaches of bioethical regulations for the display and possession of biohazardous materials. These issues, first and foremost, however, dictate the spaces in which living bioart works can be presented and viewed, which subsequently affects who the audience is and the environment in which they can experience bioart.

Legal requirements for the display of biological materials, such as licensing, is not universal, as discussed in Chapter One, and where it does exist, it is usually for specific materials. For tissue-based works, some jurisdictions have laws regarding the possession of human tissues, such as the UK's Human Tissue License and, therefore, "galleries looking to

[18] These types of exhibits express a varied range of ethical problems as they can include both animals and humans. As discussed in Chapter One, the exhibition of living humans has been witnessed throughout history, whereby indiviudals often with anatomical abnormalities have either been trafficked or coerced into appearing in 'freak shows', providing entertainment in the form of novel value, such as the case of Sarah Bartmann in the nineteenth century (Buikema, 2009).

display bioart also need to take into consideration the fact that they may need a Human Tissue License, should they be using any pieces made using human cells" (Solon, 2011, para.17). As of 2009, Frances Stracey commented that only one independent UK gallery held such a license, then in 2011, Olivia Solon clarified that GV Gallery in London "is the only private gallery in the United Kingdom that has one of these licenses – sharing the certificate with the likes of the Wellcome Trust, Hunterian, Science Museum and the Natural History Museum" (2011, para.19). With regard to obtaining the license, and the purposes for holding it, the gallery's director, Robert Devcic states that "it regulates and maintains confidence and makes people work ethically. It took me nine months to get a license. They don't regulate tissue that's from outside the EU, but nevertheless I'm keen to keep those standards" (Solon, 2011, para.19). Following approval for the Human Tissue License, GV Gallery hosted an exhibition of Andrew Krasnow's works made from human skin in 2009, noting that prior to this the artist's works had only been accessible in the UK by private appointment (Johnson, 2011).

Licensing for possession of biological materials, as well as care of them, is an established practice within museums, particularly regarding the possession and display of human remains (Clegg, 2020). These regulations dictate the care of biological materials that are of a significant age and exist within museum collections, such as preserved human bodies and body parts. As these objects are not living, this care refers to preservation and treating the remains with respect and dignity. These policies and regulations have, however, changed over time as understandings of holding certain objects has changed (Clegg, 2020). The changing and precarious dynamics of holding and displaying biological materials, specifically human remains, is demonstrated in the collection and policies of the Wellcome Collection. Based in London, the Wellcome Collection is a medical and scientific collection established by Henry Wellcome in the late nineteenth century, displaying some artefacts in their own museum, with others loaned to the Science Museum, London, UK. The Wellcome collection holds more than

500 human remains ranging from prehistoric humans to the last century, including bodies, body parts, bone fragments, organs and teeth (Biers, 2020).

Providing transparency around the possession and display of these items, the Wellcome Collection has published its *Care of Human Remains* policy (2018), which acknowledges that these artefacts are of a sensitive nature, however, they have a great and necessary educational value which is why they continue to be kept and displayed. Furthermore, in this policy, the collection clarifies that it holds a Human Tissue License and will honour ongoing requests for repatriation of remains to communities and cultures who make such requests. This commitment was demonstrated in 2013 when three items identified as being Māori in origin, two toi moko and a skull fragment were repatriated to New Zealand at the request of Te Papa Tongarewa (Wellcome Collection, 2020). Furthermore, as well as committing to ongoing repatriation requests, the museum states that its policy is subject to review and able to change to accommodate new or additional needs or requirements. However, the possession of these artefacts and the ongoing changes of attitudes in collecting and displaying human remains demonstrates both the ongoing fascination with, and simultaneous repulsion of, ancestors being transformed from subjects to objects; a phenomenon that appears to occupy a middle ground between education and the sanctity of the body. Nonetheless, it is evident that there is a purpose to these displays, one which has a different function and response to models or artificial human replicas as it provides a direct, material-based connection to our past and ourselves.

It is, however, important to note that the Human Tissue License is not a retrospective legislative order and does not apply to ancient or historical artefacts that are more than 100 years old (Biers, 2020). Instead, "the license is mostly required by academic institutions (such as medical schools), research departments, mortuaries and museums. It requires organisations to ensure that the human donors of tissue collected after 2006 have consented for use in public display (as opposed to just medical research)" (Solon, 2011, para.18). The implications of this

suggest that bioart made using human tissue must always follow these new regulations, however, institutions which hold and display older artefacts do not necessarily have the same legislative restrictions, therefore making bioart more difficult to display than scientific exhibitions and collections.

While most scientific collections, including the Wellcome Collection, comprise of historic artefacts, not all exhibitions of human remains have been historic. In contrast, the preservation techniques of Gunther von Hagens have been subject to global interest and criticism (Singh, 2003), in addition to raising many unprecedented concerns around the display and importation of his works. Von Hagens, a German anatomist, developed his own unique method of bodily preservation in the 1970s which is known as plastination. The technique involves replacing the fluids and fat from a dead body with plastics such as silicone and epoxy, which preserve the internal organs and cause the soft tissues to harden. Many of the bodies used have been donated to be plastinated on request of the individuals, however, there has been some controversy around von Hagens obtaining bodies of individuals who did not consent to being plastinated before death (Harding, 2004).

One of the primary criticisms of von Hagen's work is that the acquired bodies have since been modelled in various poses, most with their plastinated organs exposed and displayed globally in various exhibitions (Singh, 2003). Each body is modelled in a different way, with many styled in the historic écorché anatomical style, semi-dissected showing both the individual's skin, muscle, bone and organs [Figure 4.1]. Many of von Hagens's exhibitions also include a large number of plastinated, dissected organs, removed from the body, often to demonstrate the visual effects of different diseases or health conditions. Due to this anatomical style, von Hagens' plastinates are often considered to have an educational or didactic function in their display (Burns, 2007). This educational aspect of von Hagens work is emphasised by the sponsorship of the New Zealand display of von Hagens' exhibition, *Body Worlds* in 2018

in Auckland, by a health insurance company. Not only was the exhibition advertised as being educational for promoting healthy lifestyles, but at the end of the exhibition, viewers were asked as to whether witnessing the bodies and organs of both healthy and unhealthy plastinates would change their lifestyle or dietary habits, such as stopping smoking, exercising more frequently or losing weight. This suggests a focus on a didactic experience rather than provoking criticism through controversial means for the sake of spectacle.

While some bodies were donated to von Hagens with consent, in 2004, it was reported that he had acquired the bodies of several executed prisoners from China (Harding, 2004); this is one of many accusations of obtaining and trafficking bodies and human remains without consent of the deceased that von Hagens has faced. However, issues of consent are variable by country and therefore have proved difficult to prove or dispute. Von Hagens' work has received further criticism from religious groups believing his work is offensive to the sanctity of life, criticism for his techniques lessening the supply of organs for donation as all organs or bodies donated are completely plasticised rather than being able to be transplanted into another person in need, and criticism for his commercial practices of selling the plasticised corpses (James, 2010). One of the most significant elements of von Hagen's work is the discussions it has brought to legislative issues, in particular the ambiguities regarding biological materials, especially of human origin, being used as objects of display. As discussed, licensing for possession or display of bodies or human remains in the UK is clear and derives from medical malpractice, however, in the US, many states have proposed laws based on von Hagen's exhibitions, including Florida and Hawaii, in order to prevent trafficking of dead bodies and ensuring consent was given for bodies to be plastinated and displayed (Gonser, 2009; Crist, 2007).

While the critical debates of von Hagen's works are a useful background for bioart in understanding and negotiating legal issues and consent, living tissue artworks are not donated

corpses, nor are they considered to be independent living subjects. Therefore, issues of consent do not apply, with the exception of human materials in jurisdictions that require a license. Furthermore, while not fully living, they are not dead either, nor are they historical remains and, therefore, traditional museum policies do not necessarily include the protection, care and regulation of bioart works. Instead, living tissue bioart works present new challenges in negotiating laws of display in order to both exhibit such works, but also to ensure that the protection and care for these living subjects is fulfilled and regulated to avoid unethical practices. However, such legislative issues are largely unclear and not widely discussed, particularly with respect to tissue being used for artistic purposes. Furthermore, "these artworks are provocative and raise a wide range of technological, logistical and, crucially, ethical issues. So knotty is the area that very few galleries even show these works, and those that do tend to be large scientific institutions" (Solon, 2011, para.12). This is significant as it suggests that it is the scientific community that possess the legislative powers, the means to obtain appropriate legislative documents and support to hold and display these biological materials, which has consequential impacts on viewership and democratisation of these technologies and materials. These issues demonstrate, however, the emergent nature of the genre and the normalisation of tissue culture being isolated to scientific uses, therefore demonstrating the lack of familiarity the general public has with visceral encounters with actual tissue culture, especially through art.

The issues around licensing, therefore, prove problematic and limiting for the display of biological materials, and consequently limit the capabilities for certain institutions or venues to hold or display such works as "one can easily acknowledge that, practically and spatially, the (art) museum is not the optimal space for accommodating living organisms" (Kallergi, 2008, p.3). These obstacles are multifaceted, however, and extend beyond ethical issues as after obtaining legal permission there are a number of logistical measures which may be limited

by space, equipment and policies. Furthermore, the financial impacts of meeting the spatial and environmental conditions for artworks are also important to consider as this further impacts whether institutions are able to display living works. However, due to the unprecedented nature of many of the works, their individual needs and requirements cannot always be predicted or anticipated until the processes of display are underway.

Collaboratively, these issues demonstrate that living artworks prove inherently problematic for art museums, not only in terms of practicality but also philosophically and culturally, as "according to Gessert, the problem with exhibiting artworks that employ some sort of life form is not only practical but also philosophical. He argues that the museum architecture embodies the deeply rooted throughout art history and art theory idea of separation between art and nature" (Kallergi, 2008, p.3). This suggests that by displaying living objects, bioart ruptures traditional viewership not only by reconfiguring what can be used as media for art but by challenging expectations of the traditional art space by exhibiting these works. Furthermore, by the nature of bioart disrupting categorisation of art and science, this is consequently translated into problems of display, with it being unclear whether bioart should be displayed in science museums where facilities and legal requirements may be more accessible, or art institutions as they are primarily works of art. This liminal cultural positioning of bioart is an important element in the wider attitudes and perspectives towards bioengineering and consequently has a wider impact than just the responses to bioart, but also how and where people can engage with these works.

4.1.1 Locations of Bioart Display

Given the limitations of legal and bioethical legislation, the practical requirements of space, facilities and equipment, and the financial cost of these requirements are also obstacles institutions face when displaying bioart. It is, therefore, for these reasons that many bioart

exhibitions appear to be held in scientific institutions, suggesting that they have greater access to these facilities. However, the location of display for these artworks has a consequential effect on viewership and the audience of the works; while the location may alter the demographics of the audience, the location can also carry coded connotations and impact how works are viewed. The effect of location on viewership and audience is therefore significant when considering the phenomenological experiences of encountering artworks which are living objects. While there has been a steady trajectory of bioart exhibitions throughout the twenty-first century, they are not always mainstream exhibitions and do not occur with routine frequency. Therefore, to understand the physical presence of bioart within contemporary culture, it is important to consider the locations that have been used to display living bioart in the past. Furthermore, in addition to the physical location of display, how works are displayed within these institutions is a further consideration that is significant in understanding how we encounter living bioengineered materials and consequently provides an insight into the critical responses towards bioart. These considerations are also important in understanding the aims of inciting critical awareness and debate of bioengineering in contemporary culture, as the processes of viewing can impact how works are perceived.

There have been several recent major exhibitions globally that have either centred around or included bioart, including *Spare Parts: Rethinking Human Repair* (2019) at the Science Museum in London, UK, *Art's Work in the Age of Biotechnology: Shaping our Genetic Futures* (2019) at the Gregg Museum of Art and Design in Raleigh, US, and *Future and the Arts* (2019) at the Mori Museum in Tokyo, Japan. Each of these exhibitions focused on different aspects of bioart, but all showcased the biological works of international artists. However, each of these major demonstrations of the genre was held in a different type of institution, demonstrating the diversity and simultaneous ambiguity of bioart; one being a science museum in the UK where a license is required for human materials, one being a

university-based gallery in the US, and one an art museum in Japan. However, in addition to current bioart exhibitions, it is important to consider the exhibition venues for the tissue works discussed in-depth in Chapter Three that are central to this thesis. These works differ vastly in materiality, with most having been displayed at least once, with several having been displayed many times in different locations. Looking at the locations of where these works have been displayed offers an insight into the types of institutions that have successfully held tissue culture exhibitions, while highlighting the range in institutions that both demonstrate an interest in showcasing bioart and the consequential audiences of each of the works.

The works of the TC&A have been exhibited in a range of institutions, including art museums, science museums and other alternative venues. Of the works discussed, *Victimless Leather* appears to have been exhibited more times than any of the other works, having been displayed in more than ten locations, including the Ontario Science Centre in 2006, New York's MOMA in 2008, the Science Gallery in Dublin in 2008, the Casino Luxembourg in 2009, and the Mori Museum in Tokyo in 2010. In addition to the art galleries and science museums the work has been displayed in, it has also been exhibited in more obscure venues, including The National Glass Museum in The Netherlands in 2008.

The many iterations of the TC&A's *Semi-Living Worry Dolls* have also been displayed a number of times, including at Austria's Ars Electronica in 2000, then at the Natural History Museum of Vienna in 2011, Dublin's Science Gallery also in 2011, the Laznia Centre of Contemporary Art in Gdansk in 2012, the Copernicus Science Centre in Warsaw in 2012, and the Mori Museum in Tokyo in 2019. In the latest exhibition in Tokyo, however, the dolls were not presented living, but instead a showcase of 59 preserved dolls that had previously been living but no longer were. Despite this, the exhibition did display other tissue works that were living, in addition to multiple works made of living bacteria; therefore, even though this specific iteration of the work was not living, the museum still hosted living works. The range

of institutions which have displayed the *Semi-Living Worry Dolls*, therefore, include both science venues and art institutions, in addition to the Science Gallery, Dublin, which is a purpose-built institution designed to promote the merging of art and science.

As for the other works discussed in Chapter Three, the TC&A's *Disembodied cuisine* was only performed once at the Lieu Unique in Nantes, France, a Centre for contemporary culture, which hosts exhibitions, performances, symposiums and more. The venue was used for both the exhibition which featured the growth of the in vitro meat and the performance aspect, which involved the cooking of the meat and a dinner party in which participants consumed the grown food. Dietmut Strebe's *Sugababe* has been displayed multiple times in different iterations of the same work. These iterations have been exhibited at the ZKM Centre for Art and Media in Germany in 2014, the Ronald Feldman Gallery in New York in 2015 and the Mori Museum in Tokyo in 2019. *Regenerative Reliquary* by Amy Karle has been exhibited at Ars Electronica in Linz, Austria, in 2016 and again in 2017. As a centre for media art, Ars Electronica has played an important role in displaying works of bioart, having also displayed Eduardo Kac's *Genesis* (1999).

4.1.2 Art/Science Venues

Following the rise of connectivity between art and science in the twenty-first century, there has been a similar development of institutions, both for research and display, specifically aimed at promoting and supporting this connectivity, often enabling an interdisciplinary exploration of art, technology and science. While some of these institutions have a specific focus on bioart, others include a wider science focus, with some institutions having a foundation in practices such as biohacking but also include the capacity for artistic exploration of biological materials. These collaborative institutions have emerged globally and include Science Gallery (Republic of Ireland), ArtScience Museum (Singapore), Bioart Laboratories (Netherlands), BioClub

(Japan), Bio Art Lab (US), WAAG (Netherlands), Arts Catalyst (UK), (Art)Science BLR (India), Incubator Art Lab (Canada) and Coalesce Centre for Biological Art (US). Many of these places include both the laboratory setting and facilities for producing works but also spaces for display and engagement.

The Science Gallery, Dublin, has hosted a number of the works discussed in this thesis, and was established by Trinity College Dublin in 2008 and is part of the Global Science Gallery Network, which has further presences in the USA, UK, Australia, India, the Netherlands and Italy. With the aim of highlighting the importance of STEAM education and direct engagement with contemporary art and science as united experiences, the Science Gallery focuses on the importance of new ideas, new knowledge and the importance of these in society and for the future, stating that,[19]

> bringing science, art, technology and design together, Science Gallery ignites a passion in young people for new ideas and areas of study that can help to guide their career and educational choice, equipping them with resilience, empathy and ethical understanding to thrive in the knowledge economy (Science Gallery, 2020, para.1).

While not solely designed for display, SymbioticA, founded by members of the TC&A, as discussed in Chapter Three, is the first intentionally designed and constructed artistic laboratory. Designed to enable collaborative work between artists and scientists in a shared laboratory setting, SymbioticA has been key in enabling many bioartists to actualise their works, with more than 100 artists having taken up a residency at SymbioticA and who have collaborated with the TC&A in their practice to date (SymbioticA, 2020).

The cultural importance of institutions that support bioart and wider collaborative practices is apparent in their global presence and concurrent emergence, with most having been established following the turn of the twenty-first century. Furthermore, the number of institutions and the growing rate of new venues demonstrates a cultural need and desire for

[19] STEAM refers to science, technology, engineering, art and mathematics; it is an educational approach aimed at increasing creativity and innovation through transdisciplinary engagement (Liao, 2016).

greater connectivity beyond the restrictive categorisation of art or science. These institutions are, therefore, as equally important for artists, scientists, creators and curators in being able to display and share challenging and unconventional works, as they are for audiences to experience an unmuted, unlimited view of a subject or theme without being limited to a specific kind of art or a specific kind of science.

In addition to collaborative institutions which assist in the creation and display of bioart, there are a number of bioart groups that have been established to connect artists and scientists in order to build a network of individuals who seek to collaborate. Similarly, the number of groups continues to grow and currently include Bioart.tw (Taiwan), BioArt Society (Finland) and Hackteria (online). Again, these networking groups provide support for bioart and a context and community for expansion and growth amongst the genre. This is particularly important for facilitating connections between scientists and artists that enable bioart practices to occur, as many artists have stated that this process has often been long and complicated, as bioartist Gina Czarnecki has stated that "it took years for me, bouncing around through various institutions and individuals, to receive ethical guidance in the use of tissue from living, consenting humans in artworks" (Czarnecki & Hunt, 2017, p.84). Therefore, providing a community for bio-artists and bioart, critical networks can enable future projects to occur.

The dynamic interactions between the art and science communities, supported and enabled by these networks and institutions are, therefore, imperative to both the construction and consumption of bioart. The development and growth of institutions as well as local and globalised communities demonstrates the relevancy of bioart to contemporary cultures, as this new media is now embedded in the structures of contemporary life. The globalised emergence of these communities suggests that a connection between contemporary arts and sciences is both a natural occurrence but also pertinent to contemporary global issues. In enabling, connecting and displaying works of bioart, as well as other forms of art and science

collaborations, these communities can then disseminate bioart works to a global audience, prompting a wider network for critical engagement in current science and technologies.

4.1.3 Audience and Viewership

A further consideration in understanding the bioart encounter is the audience. As the genre merges together contemporary art and contemporary biotechnology, it is likely that individuals with an interest in science would be interested in these exhibitions, as well as those who have an interest in art. However, it is not only the breakdown of categorisation that is a key issue but that, as discussed, the location of these displays has the capacity to influence who might view such works. As such, these locations have the potential to expose bioart to new audiences that might not otherwise engage with this genre were an exhibition to be held in a traditional art setting. The nature of bioart in resisting categorisation, therefore, appears to simultaneously invite a wider audience of those interested in both arts and science, while also potentially alienating them through its ambiguities. Furthermore, when works are displayed in non-traditional art settings, the audience may not be limited to a traditional art audience, therefore, expanding the potential interpretation and responses to bioart and its associated biotechnologies through new audiences. This is an element demonstrated at the 2019-2020 *Future and the Arts* exhibition at the Mori Museum in Tokyo, where automatic admission was provided to the art museum with the purchase of a ticket to the Tokyo City View, an observation deck 250 metres above sea level providing panoramic views of the city. Therefore, the exhibition was accessible to viewers who may not have necessarily chosen to visit, thus creating opportunities for new and unexpected encounters.

While there is limited literature examining the exhibiting process and audience responses to bioart exhibitions, Wolfgang Kerbe and Markus Schmidt (2015) produced a study of the "experiences of bioart exhibition visitors" (p.129). The study used semi-structured

interviews to understand how visitors experienced the *Synth-ethic* exhibition at the Museum of Natural History in Vienna in 2011. In total, 119 visitors were interviewed over the two-month period the exhibition was in situ; these visitors were selected to be interviewed as they had been observed viewing the exhibits for more than five minutes. *Synth-ethic* featured both living and non-living works by 11 artists, including Joe Davis, Paul Vanouse, Art Orienté Objet, and the Tissue Culture & Art Project. The data collected revealed that more than half of the attendees were male (54.6%), and the average age of all participants was 36.1 years, with a range of 13-67 years (Kerbe & Schmidt, 2015). Kerbe and Schmidt (2015) state that "participants were also asked to rate their interest in art and science on a scale from 0 to 7" and found that "interviewed visitors were slightly more interested in science than in art" (p.131). Furthermore, the study revealed that "the interviewees had on average a high formal education and included many students and academics" (Kerbe & Schmidt, 2015, p.131). These basic statistics recorded offer an insight into the demographics of bioart visitors; however, it is also significant to highlight that this exhibition was held at a science museum and, therefore, the data tentatively supports that the audience is likely to be slightly more science-focused.

Although only one such study appears to have been published at this time, this data provides an insight into the audience demographics and consequently their experiences and expectations when encountering bioart. While it cannot be assumed that all bioart exhibitions would have a similar audience, this data reveals that visitors had a higher interest in science than art when this exhibit was held in a science museum. This is significant when thinking about where bioart is displayed, who the intended audience is, and the expectations of the viewer. The fundamental concern with the audience of bioart, therefore, reflects back to the aims of bio-artists who suggest they seek to raise discussion, critique and reassessment of biotechnologies in contemporary culture through their works.

The effect of location of display of bioart on the viewer, therefore, has the ability to influence the response towards the art through the potential demographic of the audience which is influenced by the venue. However, the ways in which works are displayed and exhibitions are organised and designed within these settings can also affect how audiences engage with living bioart, including the use of coded cultural symbols and objects, specific environmental conditions and sensory, participatory or immersive experiences. While some of these features are practical elements required for the works, others are aesthetic decisions, creating an experience for the viewer. These design features can dictate how works are engaged with and the consequent phenomenological experiences and critical responses of the viewer.

4.1.4 How Bioart is Displayed

The multifaceted considerations required for displaying bioart reflects the unique nature of each individual living work. Each work, the location it is created in, the materials it is made of, any specific environmental specifications it requires, and the exhibition itself all pose individual considerations and unprecedented challenges. For this reason, it appears that while there are legal and financial limitations to display, there are few guidelines specifically designed to guide the display of bioart in part due to its recent emergence, but also its complex ambiguities and the diverse range of living works created. However, it is evident that in addition to the legislative requirements for displaying living bioart, there are further supplemental considerations surrounding the care and maintenance of living materials. These special considerations are not ones routinely required in the display of art, but vary depending on the materials used. The extent of these requirements is dependent upon the living structures, as some materials require more invasive, ongoing care, whereas others need less maintenance and only require certain atmospheric conditions such as light or temperature considerations, to ensure the survival of the materials as,

> works that employ some sort of life form require particular conditions or arrangements during an exhibition. Kathy High's transgenic rats need to be fed (the artist will report a high level of attachment between her rats and the museum guards feeding them) and Gessert's hybrid irises need access to direct sunlight. Less complex life forms may still require a repetitive feeding procedure and/or particular light or temperature conditions. As for organisms whose natural residence seems to be the laboratory space, they may require specialized lab equipment and/or sterile conditions in order to survive (as e.g. Oron Catts and Ionat Zurr's 'Semi-living worry dolls') (Kallergi, 2008, p.3).

Therefore, for works which involve the use of living animals, such as Marta de Menezes *Nature?* (2000) [Figure 4.2], the requirements and responsibilities of care are more obvious, as the butterflies require space to fly, plants to eat and water to drink; these being some of the fundamental needs for living things.[20] [21] Microorganisms also require specific conditions that are well understood, with individual types of microbes having specific sets of requirements such as being temperature or light sensitive. However, with living tissue sculptures, the requirements of care are more complex and may be different and unique for each individual work dependent upon the exact materials used. While some artists might fail to make these requirements clear, the TC&A have been transparent in detailing the needs of their living works, such as requiring ongoing feeding with FBS and sterile growing conditions (Catts & Zurr, 2008). Therefore, "to facilitate a living exhibit, the hosting institute often needs to undergo spatial modifications and incorporate new routines and procedures in its normal practices. A dedicated environment may be necessary to host, facilitate and possibly restrict the life form in presence" (Kallergi, 2008, p.3). This, therefore, suggests a substantial spatial and organisational impact on host institutions and a disruption and reconstruction of the exhibition space.

[20] These needs have also been noted outside of bioart, such as during Damien Hirst's *In and Out of Love* (1991) [Figure 4.3] which saw a room filled with butterfly pupae, and included sugar water, fruit and flowers for the hatched butterflies to eat and drink. However, the care of the butterflies was a concern for some viewers despite their fundamental needs being met, with one viewer saying that "I'm totally concerned. I'm wondering if this one is suffering" (Barkham, 2012, para.8).
[21] In *Nature?*, de Menezes altered the wing patterns of living butterflies using cauterising tools on butterfly chrysalises. These patterns existed only temporarily in the living butterflies and were not passed onto their offspring as no genetic mutation was made.

Aside from the logistical requirements for scientific apparatus for providing care of living artworks, some artists and curators have incorporated laboratory apparatus into the exhibition design for visual effect. This is evident in multiple works by the TC&A, most notably in the display of *Disembodied Cuisine* and *Victimless Leather*. Both artworks demonstrate the incorporation of scientific equipment and its associated coded meanings into the art space, therefore affecting how the viewer interacts with and interprets the works. In the display of *Disembodied Cuisine*, the installation was stylised as a biohazard containment area, complete with plastic sheeting enclosing the artwork, with biohazard warning tape sectioning the work off from the rest of the gallery space. Furthermore, the work included a domestic dining table scene within the biohazard warning apparatus, further conflating the ideas of science and danger alongside scenes from everyday lives. This display, therefore, highlights what the technology entails; technology which is currently being developed for mainstream consumption and marketed as a potential beneficial asset as a means of environmental protection. The inclusion of these features emphasises the potentially hazardous aspect of the technologies used and bioengineering practices in general which are infiltrating everyday mainstream culture. Visually, the transposition of scientific equipment, especially that which alludes to a potential danger, into the art display is an important dynamic as it has potential to affect how the viewer interprets the artwork and, consequently, biotechnologies.

For the display of *Victimless Leather,* the TC&A built scientific procedures and instruments into a performance known as the 'feeding ritual' which simultaneously fulfilled the nutritional supplementation of the sculpture (Kelley, 2016). This saw gallery staff dress in white laboratory coats, protective gloves and glasses, and feed the sculpture with growth medium through a tube that dripped the solution onto the tissue. The 'feeding ritual' was conducted routinely in front of the gallery audience, therefore directly demonstrating that the work was alive and, as such, immersing the audience in a process that reveals the living works'

vulnerability and dependence, but simultaneously its distinctive lack of humanity and conscious otherness. Furthermore, as previously discussed, the iteration of the work presented at MoMA in 2008 included a killing ritual due to the uncontrollable growth of the sculpture, which invited the audience to participate. Unlike the observational aspect of the feeding ritual, the audience were directly invited to be involved in actually killing the work by touching it, infecting it with bacteria. In addition to using the affectivity of the visual presence of scientific instruments and apparatus, this performance highlights that the work is, in fact, a living subject which requires care, feeding and the emotional empathy of both creators and the viewer in order to survive. Simultaneously, it demonstrates the precarious nature of these living objects and their vulnerability to human care as to whether they live or die.

Despite advances in biotechnological capabilities, the limited control that humans have over natural procedures is evident in the TC&A's display of the S*emi-Living Worry Dolls* at the *Future and the Arts* exhibition at the Mori Museum in 2019. Instead of a new iteration of living dolls, this version of the work showcased a collection of 59 dolls from previous iterations, each in different stages of preservation and decay. While some still retained a doll-like shape, the shapes of others appeared ambiguous, either having grown in different forms or had collapsed [Figure 4.4]. This demonstrates that despite using the same technologies, the dolls did not always grow uniformly according to the wills and desires of the artists, therefore, highlighting the inconsistencies of human control over growing life. While it is possible to grow living materials, it is not an exacting practice that has yet been perfected. Instead, this shows that life and growth are unpredictable and this exhibition publicly displays the processes of trial and error, failing and the dead matter that are usually confined to laboratories and subsequently disposed of there.

The use and incorporation of laboratory equipment into the display of bioart works appears both to serve a practical purpose in the care of the works but also to highlight and

showcase the technical, visceral, living part of the works. It draws attention to processes and development of tissue-growing technologies which are still mostly confined to biomedical laboratories where their potential uses continue to be uncovered. Such inclusions, through bringing coded equipment from the laboratory to the exhibition gallery is an important consideration in communicating the core aspects of these works as a means to explore biotechnologies through art. Fundamentally, the display of these works and the complex decisions made, incorporating both practical and philosophical components, dictate how the works are encountered and is fundamental to the phenomenology of experiencing them as living objects. However, as living tissue, cells or semi-living lifeforms, these objects are not always visibly alive; therefore, the ways in which we perceive them as being alive falls to the method, acts and contexts of display in which the artists and curators show them to us. As such, this allows us to perceptibly understand the intrinsic vitality of the living materiality on display. In this way, Jane Bennett's ideas of vital materialism can be understood through the ambiguities of bioart being both living and non-living, yet their affectivity is highlighted and enhanced through the ways in which they are displayed.

4.1.5 Encountering Living Artworks

In creating living artworks, especially semi-living tissue sculptures, the very point that underscores the reason for the work existing is that it is alive, and the living material becomes media for art. However, therein lies a fundamental problem with tissue and bacterial artworks in that although they are alive, and the audience is informed that they are alive, the works often appear static and inanimate, thus making it difficult to actually experience and understand the works as living beings. It, therefore, seems problematic for artists to go through the difficulties and complexities in time, ethics and legislation to present living works for them to not to be interpreted as such. Consequently, it appears that the quality of being alive must be

communicated in other ways through bioart exhibitions. Through subjective phenomenologies and specific exhibiting styles selected by the artists, unique encounters with new lifeforms are created, thus enhancing the critical capacity of the audience to engage with new biotechnologies.

The state of being alive is a complex set of characteristics and a state that is still undergoing definition, as what we define as expressing the qualities of life itself is still evolving (Oliver & Perry, 2006), as demonstrated by laboratory-grown tissue cultures. Despite this ongoing issue of definition, "most biologists agree that life forms should fulfil the following criteria: (1) the entity has a body; (2) it metabolises; (3) it reproduces; (4) it is capable of movement. Yet what counts as life and how we account for life forms that do not fulfil the above-mentioned criteria are two questions that are still being discussed" Radomska, 2017, p.388). This is particularly important when considering living bioart, as artworks made from artificially grown tissue may or may not express all characteristics or may express them only on a cellular level rather than as an entire organism. Therefore, when expressing fundamental characteristics of life, they may not be visible to the viewer or difficult to detect and this consequently increases the difficulty in separating living bioart from traditional media or inanimate new media such as plastic; the latter of which is further problematised by the prevalence of imitation life in contemporary cultures such as AI and robots. Simplistically, the characteristics of tissue and semi-living materials render them alive, but when works do not necessarily move, verbally communicate, visibly eat or show apparent signs of living, it is important to understand how the audience experiences them as living and how this affects their subjective phenomenologies of the encounter. Instead, it appears that the understanding of these bioart works as living derives from instinctual, psychological processes as a result of visual clues from both the materiality and the methods of display used.

4.2 The Effects of Materiality

The effects of materiality of new media art are wide-ranging given the diversity of materials used which, therefore, evoke unique responses. Within examples of bioart, as we have seen, materials also vary widely dependent on where the biological matter is sourced from, therefore, the effect of individual works is dependent on the unique materials used. The effects of bioart are, however, evident in the critical responses bioart has attracted which, as previously discussed, tends to focus on the materiality. To fully understand the effects of bioart in a cultural context as well as a posthuman context, it is imperative to understand the ways in which different materials act on the subjective phenomenologies of the viewers and the intent of the artists. Fundamentally, it is the purpose of material based bioart to utilise and emphasise new biological materials and processes, however, these can only be fully understood and experienced through the physical encounter. The physical, face-to-face encounter deconstructs the boundaries between the self and other through the sharing of physical space and through social, communal, reciprocal relationships that form social contracts of morality and ethical behaviour. This social contract enabled through the face-to-face encounter, is described by Edward S. Casey, who recounts,

> I encounter a woman on a plane that is flying between Chengdu, China, and Lhasa, Tibet. She is in an advanced state of a crippling disease, perhaps multiple sclerosis. Her twisted body moves only with great difficulty, but she insists on moving herself. She walks down the aisle, resting heavily on a cane at each step. Her glance engages mine, and in that brief moment (which I have never forgotten) I perceive her distress: her need for support from others, yet her proud defiance of this same support as long as she can walk on her own. In this case, there is nothing I can do except look back sympathetically and realize that I have been put on ethical notice: I have grasped human frailty and mortality, mine as well as my fellow passenger's, and I have been reminded of the fact that, at some point in life, each of us will require the concrete assistance of others (Casey, 2006, p.77).

This sense of ethical responsibility for the other is enacted through the physical space that is shared and is, therefore, the basis for social engagements between individuals. For bioart, and living art in general, there appears to be a similar social contract despite these works not having

a human face or gaze. Therefore, in place of the glance between two subjects, we can recognise the human glance through the materiality of these objects being living tissues or cells like parts of our own bodies. Through this physical encounter the materiality of bioart can be fully understood and experienced, "since a majority of bioart works (and artists) strongly value and utilise the notion of material presence as embodied in (tangible) displays" (Kallergi, 2008, p.5).

The responses, both the subjective experiences of the viewer and critical responses of theorists, towards living works of bioart are simultaneously dependent upon the materiality as well as how the materiality is experienced. As living bioart is defined by its medium, the media is central to the concept of the work as it is to the subjective experience of encountering it. Tissue, as a medium, is both complex and ambiguous due to the liminal nature of its life status and categorisation. Therefore, in addressing how audiences respond to these living works and how they feel towards them in terms of affinity is difficult to measure because they are new life forms, only experienced during specialised bioart exhibitions, which are infrequently held niche events. These works are a new form of life, an 'other' form of life and, therefore, understanding encounters with this new type of life is important for posthuman understanding and critical engagement with new biotechnologies from which they are created.

As previously discussed, there are limited investigations into the experiences of viewers in encountering bioart and how individuals perceive and feel about living artworks; while there is a growing amount of criticism and cultural commentary around the greater practice of bioart and the ethical and philosophical issues the practice can provoke, this does not necessarily mirror the experiences of viewership. However, Kerbe and Schmidt's 2015 study, as discussed, reveals the differing levels of affinity and moral concern between the participants and the artworks based on materiality. The exhibition, *Synth-ethic*, featured 11 artworks exploring the theme of synthetic biology. Of these 11 works, seven involved the use of organisms as materials; these works were: Art Orienté Objet's *Que le Cheval Vive en Moi!* (2011), a

performance including human and horse materials and a living horse, Revital Choen and Tuur van Balen's, *Pigeon d'Or* (2010), which used pigeons and bacteria, Tissue Culture & Art Project's, *Semi-Living Worry Dolls* (2011), made of McCoy cells of mouse origin, Andy Gracie's, *Autoinducer_Ph-1* (2006), made of rice plant, azolla plant and cyanobacteria, Paul Vanouse's, *Latent Figure Protocol* (2007-2009), made using a DNA sample from the artist's own cells, Joe Davis', *Bacterial Radio* (2011), made from transgenic bacteria, and Sonja Bäumel's, *Cartography of the Human Body* (2010), made using bacteria (Kerbe & Schmidt, 2015).

In the study, participants who had viewed the exhibition were asked about the potential ethical problems posed with the use of living organisms in the artworks viewed, and "for a majority of the visitors, the use of bacteria and simple organisms does not pose an ethical problem, whereas the integration of higher animals (e.g. pigeons/horses), let alone humans, into the artwork is much less well accepted" (Kerbe & Schmidt, 2015, p. 132). Furthermore, the responses documents are clear in demonstrating the difference in the number of ethical concerns raised; Art Orienté Objet's *Que le cheval vive en moi!,* which contained both human and horse materials received ten comments relating to ethics or morals. Cohen & Van Balen's *Pigeon d'Or*, made from both pigeon and bacteria, followed with eight comments pertaining to ethical concerns; with the TC&A's *Semi-living Worry Dolls*, made from mouse cells, then receiving two comments about the work concerning ethics. It is, therefore, apparent that the works containing human and animal materials are perceived as being the most problematic in terms of ethics, while the works containing bacteria did not appear to evoke ethical concerns in the same way. Yet, the tissue-based work by the TC&A evoked more responses of ethical concern than the bacterial works, but less than the works containing human and animal materials. Furthermore, the work also received the second highest number of comments in

general, following Art Orienté Objet's work; this suggests that the work was memorable and piqued the interest of the viewers, yet its ethical positioning is ambiguous.

The data from Kerbe & Schmidt's study suggests, therefore, that the level of ethical concern increases as the size and perceived sentience of the organism used increases; thus, a need to exercise ethical responsibility is contingent on perceived importance, size and our relationship to other animals, with humans sitting at the top of this hierarchy. However, where tissue-based sculptures are concerned, they are not animals or bacteria, they are unnatural forms that are artificially made, yet made from organic, biotic matter, usually retrieved from humans and animals. Therefore, their place within this hierarchy is ambiguous, and consequently, so is their ethical and moral status. This suggests that while tissue culture can provoke discussions around ethical issues relating to bioengineering, it is more subtle and nuanced than the overt discomfort that arises from the explicit use of animals or humans. Given the ambiguous and equivocal nature of the relationship between us and grown tissue culture, irrespective of its origin, there appears to be a lapse in recognition of tissue as being equivalent of a 'natural' animal. The study suggests that where there is tension in using products or parts of an animal, there is less, but not an absence of, tension in the use of animal cells to grow new life forms.

One of the fundamental differences between explicit animal material and grown tissue is that the tissue objects have been grown, sculpted and manipulated into different forms. While the material is alive, the objects are not natural forms, nor have they been born or are they recognised as living subjects. The dichotomy between them being alive but not possessing any of these characteristics creates a conflict. One of the potential causes of this conflict that makes it difficult to define its ethical status is the simultaneous ambiguity in recognising the tissue culture as being a living substance. Although appearing like flesh, cartilage or skin, most sculptures do not move, or breathe or show signs of being alive. Instead, they are alive on a

cellular level where the characteristics of life take place, but we do not see a moving, responsive, sentient being. This renders it more difficult to experience and understand the works as being alive as we cannot see the signs of life, yet they are living and able to evoke unique affects through their living materiality.

A further element that dictates responses towards living works of bioart are the forms chosen by the artists. Given the dynamic and flexible capacities of tissue culture to be grown into a multitude of shapes, achieved through seeding the material over sculpted scaffolds and then fed nutrients in order to stimulate growth, the range of forms able to be achieved is vast. However, as discussed in Chapter Three, many of the sculptures that have been grown appear to reference the human body, and in the case of the *Semi-Living Worry Dolls*, mimic the human body. Dolls, as discussed in Chapter Two, are innately uncanny by their appearance in imitating humans, but are not alive. Yet, here the doll-like sculptures are alive and made from living mammalian flesh. However, sculptures which take the form of body parts such as an ear or a hand are not inherently uncanny, as they are expected parts of the human body with which we are familiar and are viewed as being necessary for everyday activities. However, these sculptures become unnatural in their apparent detachment from a body; and moreover, they were never attached in the first place but grown outside of a body.

The issues, therefore, of affinity, empathy and concerns of ethical treatment towards the other is dependent on appearance and familiarity as much as embedded cultural attitudes towards them; for example, it is commonplace that rats are used for testing in laboratories, however, there is a greater level of unease over larger domestic animals such as dogs or large primates that are biologically close to humans being similarly used for testing (Ormandy & Schuppli, 2014). Therefore, in terms of the living works of bioart, they are simultaneously not necessarily recognisable as being living entities, however, in realising that they are living tissue derived from living creatures, this is when concerns about the usage of such materials for art

becomes ambiguous and problematic. Detached from normative contexts of encountering these bodily forms, they become strange, and the use of living tissue renders them uncomfortable.[22] In seeing these human-like forms grown from living materials, there is a conflation of the self and the other, the human and the nonhuman, however, as Radomska states, "human bodies are always already nonhuman" (2016, p.44). Referring to the microcosm of bacteria, viruses and other microorganisms that not only live in our bodies but "without which our organisms would not be able to perform their basic functions or even to survive" (Radomska, 2016, p.37), this nonhuman or not-fully-human aspect of the human is juxtaposed alongside the self/other conflation of bioart's materiality; consequently, the position of ourselves in our relationship to these artworks is both ambiguous and unsettling.

The ambiguity in affinity between the viewer and tissue bioart is contrasted by the more explicit and definite relationships exhibited between the viewer and other living media used in bioart, as outlined by Kerbe & Schmidt (2015). It is clear that microbial media is less problematic from an ethical standpoint, however, in terms of affinity, materials could be uncomfortable for the viewer if they were potential biohazards, such as contagious pathogens. Similarly, the use of animal materials prompted a strong critical response in the study, suggesting a high level of affinity between the participants and the materials used. For tissue-based media, there are a number of contributing factors present leading to the liminal mix of apathy and ethical concern, which then results in ambiguity. Along with form and movement, awareness of where the materials have derived from is a contributing factor in ascertaining feelings towards living media this, therefore, depends on the information being displayed on exhibition labels. During display, the TC&A's *Semi-Living Worry Dolls* list the materials of

[22] As discussed in Chapter One, this contextual shift that causes discomfort or uncanniness can be found in art history predating bioart, most notably in surrealism, exemplified by Méret Oppenheim's *Object (Le Déjeuner en Fourrure)* (1936) [Figure 4.5]; the work comprises of a teacup and saucer covered in fur, which is a familiar object made strange by the materiality. While fur is a natural material and one that is considered to be a luxury consumer material, the inclusion of it on an object that is concerned with drinking evokes a sense of discomfort.

the work as ‘McCoy cell line, biodegradable/bioabsorbable polymer, surgical suture’ [Figure 4.6], however, this does not specify the origin of the McCoy cells, therefore the viewer might not be aware that these cells originated in mice.

The relationship between the viewer and the living artwork is, therefore, mediated by and contingent on the media used and knowing where this material is from. In encountering living tissue, removed from medical contexts and artificially grown and housed inside bioreactors, the works are confronting in their materiality, yet are not known previously encountered living creatures that the viewer has a pre-established moral and ethical standpoint towards. This ambiguity transmitted through the media of these works, therefore, allows for criticism of the technologies. By not having a high level of affinity with the material combined with the uncanny forms often used by the artists, the effect of this is that it allows the viewer to be critical of the technologies through the forms. It is not as highly emotionally charged as Eduardo Kac’s *GFP Bunny,* where the welfare of the rabbit is central to the critical responses, yet they demand a higher level of engagement and moral responsibility than microbial works. This ambiguous middle ground, between overt ethical boundaries being crossed and impartialism allows, therefore, a medium which invites critique by highlighting the plethora of ambiguities present in contemporary biotechnologies.

4.2.1 The Separation of Art and Science

In encountering living bioart, audiences become directly and implicitly engaged in the ongoing debates of the uses and ethical implications of bioengineering technologies that pervade contemporary life. This process of coming face-to-face with living art raises many potential issues in both challenging the audience’s perspective on ethical debates, but also with the ethical implications placed upon the viewer through the very act of viewing. The most frequent debates instigated by living bioart works involve the ethical problems of the use of

bioengineering technologies in art and by artists. Most significantly, living bioart often "raises awkward (and unaddressed) ethical questions: what are the rights of a living creature that has been reduced to art?" (Stracey, 2009, p.498). Therefore, it is not only the ethical implications of growing living materials using biotechnologies that is central to bioart criticism, but it is the use of them for artistic means. These concerns call into question how we categorise, divide and value art and science, in addition to our expectations of which fields should create, use and engage in certain materials and processes. Fundamentally, these concerns contribute to the cultural separation of art and science and apply constraints to both fields, limiting creative freedom and new possibilities. However, it is art that sees the constraints applied most restrictively as the concept of bioart explicitly critiques the usage of scientific tools through art. In this ethical problem of justifying the use of biotechnologies in contemporary art, Annick Bureaud (2018) states,

> ethical rules in research and medicine are a delicate balance between risk (for humans) and the abuse of, pain inflicted on, or fatal damage to the creatures used (non-human and human) in regard to the potential benefits (usually the health and well-being of humans). Could 'aesthetic interest' be considered a criterion for 'reasonable risk- or damage-necessity'? Experts judge art projects daily for grants and programs of all sorts, and it seems to me no less or no more (ir)rational or subjective than the criteria used in science and medicine (p.85).

This demonstrates the different cultural expectations for science and art, not by each field independently, but by subjective feelings and opinions which arise from culture itself, and the cultural norms and expectations of art and science. It suggests that it is a transgression of accepted ethical norms for artists to utilise biological materials for purposes that sit outside of biomedicine and that

> by exhibiting our very contradictions—that under certain circumstances you are allowed to do what is otherwise considered immoral—art is not only questioning the ethics of (bio)science but is contributing to the larger debate: redefining where we put the limits of what is acceptable—or not—and setting new, crossed hybrid hierarchies among the living on which we are collectively elaborating (Bureaud, 2018, p.85-86).

This exploration into our ethical positioning is enabled through the art encounter, as Bureaud suggests, "by exhibiting our very contradictions" (2018, p.85) and creating a new and unique forum for a direct engagement with these technologies; however, this encounter re-presents and re-purposes the technologies in new ways, challenging our expectations. Through the physical encounter with living bioart, a direct confrontation is actualised by witnessing and living with living biotechnologies where it becomes apparent that they are visceral, living works of art and new lives that we do not know how to categorise or understand yet. Being on display, existing as art objects for voyeurism and aesthetic spectacle, these lifeforms do not offer cures for ailments, nor are they participants of clinical trials for new drugs to benefit humanity; instead, they exist to provoke our emotions and our conscience in regards to our hierarchical treatment and classification of other lifeforms, particularly the marginalised lifeforms that have been artificially manufactured. This uncomfortable juxtaposition of equating lower levels of life with commodities used for our own gain and benefit is revealed through this method of explicitly exhibiting our double standards and the implicit reaction of discomfort and ethical and moral unease of such exhibitions.

Alongside the discomfort suggested by the merging or blurring of boundaries separating and controlling the use of biotechnologies, further criticism and unease is prompted in the concern that bioart demonstrates uncontrolled usage of technologies. The fears of uncontrolled use are not specifically confined to art but are more generalised fears over the potential detrimental impacts of technologies, such as threats of bioterrorism. This discomfort is not without justification, however, given the misuse of experimentation in the past which led to the establishment of bioethical regulations, particularly within Europe as,

> practical ethics in biotech and biomedical research laboratories, as well as legislation, form a blurry landscape with varied rules and regulations that seem to be in constant flux, without a shared homogeneity among the EU countries. Here and there the weight of local history, sometimes tied to medical scandals, can be witnessed—not to mention the moral and mental scars left by World War II (Bureaud, 2018, p.85)

The issue with bioart lies in the ambiguities that inform its ethical position; when it is on display, despite most works being created in authorised laboratories alongside bio-scientists following strict codes of conduct, this is not reiterated in the exhibition space. Instead, bioart sculptures exist often without context, suggesting fears of the uncontrolled artist overtaking the cultural image of the uncontrolled scientist. The transition of biotechnologies into the exhibition space, therefore, appears as a transgressive act through the reconstruction of the purpose and the consequent meaning of these materials. By publicly displaying actualisations of contemporary bioscience, bioart prompts us to question our ethical standards and whether these lifeforms should be protected or even created in the first instance, whether in the name of art or science. It is, however, important to highlight that while bioart has gained significant criticism, bioartists have only used the tools and techniques created by scientists that already exist and are also being used behind closed laboratory doors. Therefore, the ethical dilemma of bioart is not only concerned with living media so much as it is an issue of what we perceive to be legitimate and justifiable uses of these technologies. Through the visceral, physical presence of these technologies, bioart draws upon our fears of unchecked usage, and represents a reflection on our ethical limits, however, the monstrosity of bioart is not located in the artworks, but within cultural hypocrisy over what we accept as reasonable or appropriate use of living biotechnologies.

4.2.2 The Objectification of the Art Other

In addition to prompting reflection on issues of ethical guidelines and appropriate usage of biotechnologies, living bioart has also provoked contemplation on how we treat other forms of life. Specifically, in encountering living bioart, not only are our subjective embodied feelings affected, but through the encounter with the living other, our responses to a dependent, purposefully created other that does not and could not exist outside of its display are brought

into question. It is this posthuman perspective that many artists seek to intentionally reflect and explore, particularly in regard to issues of responsibility towards new types of life as biotechnologies force a reconfiguration of how we think about and classify what is living and what is natural. Stracey (2009) highlights this perspective, stating that "it has been argued that this work emphasises our ethical responsibility towards 'other humans, part-humans, posthumans and non-humans with whom we cohabit and ... seek to perfect and control'" (p.499).

This responsibility to other life forms outside of traditional anthropocentric humanist perspectives is one of the primary elements of posthuman thought, as discussed in Chapter Two, and in displaying and encountering living bioart, the audience is affronted by new life inhabiting the same spatial environment, therefore forcing the viewer to consider the new life and how to respond to it. By being vulnerable, dependent and reduced to performing as a work of art rather than afforded its own agency and freedom to exist as the lifeform that it is, living bioart, especially manufactured tissue bioart, causes unease by forcing this objectification through the act of viewing. Through exhibiting these works, audiences have no choice but to be the spectator. There is no option for equality, as the very act of viewing is voyeuristic and in turn, objectifies the art subject further. It is this dichotomy, the unclear distinction as to whether the living work is, in fact, an object or subject, that intensifies the discomfort of living artworks and forces the reconsideration of how we define life and our relationship with other living things. Instead of the bioart itself being uncomfortable, it is what it reveals, which "more importantly, it is our conceptions and beliefs about life and the living that are currently shaken and have become unstable. That is the very issue of the redefinition of ethics and the basis of our attitudes toward and relations to our fellow humans and other living creatures with whom we are sharing the planet" (Bureaud, 2018, p.85). Consequently, the need for reassessment of

ethical practices and processes is important in respect of new understandings of life and life's materials enabled through biotechnologies.

4.2.3 Ethical Responsibilities: Creation, Display and Viewership

There are many aspects of living bioart that incite criticism of ethical care and considerations towards living matter, however, this is dependent on the audience being acutely aware of the materials works are made from. Knowledge of the types of living matter used and the original source of the materials have the potential to impact ethical or moral opinions on the art created and biotechnologies in general. However, knowing how the works are cared for is a further concern that presents a new challenge for artists, curators and the audience. The Tissue Culture & Art Project are transparent regarding both aspects of care for their works and the implications and problems caused by creating them, such as the responsibility towards their death as well as life (Vaage, 2016). This is evident in the feeding ritual being included as a performance in the display of the *Semi-Living Worry Dolls*, and the killing ritual publicly enacted in the display of *Victimless Leather*. However, this emphasis on responsibility and transparency is not evident across all bioart practices. In particular, Stracey references Eduardo Kac's *GFP Bunny* and states that "what Kac and his supporters fail to discuss, however, is that GFP and other fluorescent molecules used in imaging can cause cell damage. The fluorescent proteins in Alba (and in Kac's other organisms) might be toxic, if not fatal" (2009, p.499). Although the particular gene that was implanted into the rabbit was named, Kac failed to highlight the possible side effects of the process which could have potentially harmed the animal. This lack of transparency in bioart, particularly in respect to the possible harm processes could cause the living materials, is problematic and simultaneously prevents a balanced ethical perspective by concealing information, but also potentially increases ethical concerns by the lack of information available.

In addition to ethical anxieties, concerns regarding responsibility are also central to bioart debates (Vaage, 2016); this includes who is responsible for the living works created and how this responsibility can be applied ethically and appropriately. Part of the complexities around the ethics of responsibility lies in the collaborative foundation of bioart practices, with artists, scientists, laboratory technicians, ethics committees and more involved in the practice. There is no one specific individual responsible for the creation of bioart works, but instead they are the result of many individuals suggesting, therefore, that the role of responsibility is shared. While the fundamental burden of responsibility is often placed on the artist, "what happens when, or if, it is released into the wild? And who benefits from this life-sculpting process?" (Stracey, 2009, p.498). These are issues that again change the dimensions of responsibility and question the very act of bringing new life into existence, particularly when its' position in the world is unclear.

Furthermore, in the process of exhibiting and subsequently viewing bioart, the issue of responsibility becomes even more complex as it is "less discussed when dealing with ethics, the artist and the audience are the other recipients on whom responsibility is placed" (Bureaud, 2018, p.86). This issue of the implied or projected responsibility of living works onto the viewer is a complex and ambiguous one, which places the viewer in an uncomfortable position of both needing to consent to viewing these works, but simultaneously has no real opportunity to disagree. Bureaud compares this problematic encounter with performance art, asking, "can the audience have a say during a performance? But who would dare to interrupt a performance that is explicitly 'at the edge'? Isn't the artist responsible for him or herself? Where is the line drawn? As long as it is 'made public', isn't an artwork considered 'safe' for both the performer and his or her audience?" (2018, p.86). This provides an important perspective on works of living bioart as by displaying them, artists and curators are implicitly implying that the works are 'safe', however, the very point of bioart is often to disrupt expectations and challenge the

accepted norms, uses and ethics of bioengineering. This is exemplified in the experience of the TC&A in 2003 when attempting to display a collaborative project with Stelarc, they

> received correspondence from the exhibiting venue stating that there was no policy on presenting living tissues in their gallery and requesting a statement from us that the work did not raise ethical issues in general and in particular in the bio-medical community. We could not give this assurance to the gallery as we see the primary aim of our work as providing tangible examples of issues that need further ethical scrutiny (Zurr & Catts, 2014, p.208) .

Consequently, along with issues such as lack of transparency around the impact bioengineering can have on such lives, these works are not necessarily 'safe'.[23] Furthermore, the ethical implications of bioart works are not only fundamental to bioart practices in critiquing contemporary bioengineering, but are inherently engrained in these scientific practices and therefore cannot be avoided.

While bioart is often created to invite discussion and criticism of bioengineering from audiences, there are few ways for audiences to actively voice their critique. The audience cannot stop the display, free the living work or intervene in the processes. While this mirrors the pervasive nature of biotechnologies, such as the prevalence of genetically modified food, it places responsibility on the audience, without consent, to act responsibly towards the work and to consider other life forms. However, importantly, for galleries and institutions in the UK which hold a Human Tissue License, "the license has to be on display at all times during exhibitions including human tissue, and visitors need to consent to viewing and not damaging the works" (Solon, 2011, para.19). This, therefore, requires the viewer to consent to viewing, but also to act responsibly towards the living works. Fundamentally, ethical issues found in the creation of bioart are reflected in the experiences of viewing and participating in the

[23] This is also present in performance works, particularly where there is involvement of danger, injury or harm as the audience is implicitly bound into a social contract with the artist through the process of viewing as they "not only watch but also share the experience. They are communicated to and communed with, they 'bea[r] witness' to the ordeal" (Bennett, 2017, p.26).

objectification of living works of art. For living bioart, “ethics is a dual issue of power and responsibility” (Bureaud, 2018, p.86). The power in creating life produces a contract of responsibility, however behind these actions sits the problematic issue of ethics and the difficulty in establishing an appropriate ethical guideline for bioengineering technologies and answering the ethical concerns that these works produce.

It is clear that in encountering living bioart, the viewer is encountering a new form of life as well as a new form of art. This art object is simultaneously a living subject which collapses the traditional subject/object-based encounter, therefore, forcing a new type of encounter. While ethical concerns have been raised towards the living materials used, there must also be considerations for the psychological, physical and phenomenological effects this engagement has upon the viewer. Through immersive, face-to-face encounters with living tissue sculptures, criticism and new perspectives can emerge through the subjective, emotive and psychological responses of the individual. This is enabled through the visual and physical presence of these works and the embodied experience which is not replicable through representation.

From an immediate, visual perspective, many works of bioart are visceral and raw confrontations with living tissue that have not been previously encountered. While we are also made from cells and tissues present in the works, the sculptures often lack skin, fur or hair that normally act as boundaries separating the inner parts of the body and the outside world. The exposure of vulnerable materials, removed from the body and reproduced in a context where they are voyeuristic objects and reliant on their creators and viewers for ethical care, exposes the uncomfortable reality of biotechnologies and the exploitation of other forms of life for human gain. Consequently, the living matter provokes an abject response, distancing the viewer emotionally and physically from it. This abjection is located in the living matter, as well as in the conflations between the works as occupying both object and subject categories and

living and non-living categories. There is an immediate confusion regarding the life status of these works as the knowledge that they are living and are made from tissue and cells, juxtaposed with encountering a static sculpture in a gallery setting creates a new and unprecedented encounter. Not fitting into any pre-existing category of life known, living bioart is abject through its otherness and its liminal positioning between prior learned categories of living entities and the unknown, experienced through the visceral, face-to-face encounter with the media.

As the forms of many tissue-based works imitate the human body, often in the shape of limbs or organs, they conflate the self and other through sharing the same materiality, breaking down this self/other distinction and therefore become abject. However, despite this abjection, there appears to be enough vulnerability and intrigue present in the living bioart sculptures that is sufficiently compelling to incite care for it, but also to be critical of the technologies, as evidenced in the responses given in Kerbe and Schmidt's (2015) study. The materiality, therefore, both ethically compels us to care for the works and orders us to do so by virtue of sharing the same physical space as it. However, the materials become other by occupying a liminal space between categories leaving a feeling of uncertainty and renders the living sculptures as other.

4.3 Materiality and the Uncanny Valley

Masahiro Mori's uncanny valley is an idea that is fundamentally based on the aesthetic properties of objects which appear human-like and the consequential psychological responses they elicit. Mori's initial paper, published in 1970, focused specifically on the appearance of robots that performed assistance functions such as working in factories, therefore, robots designed to automate human processes. This aspect of performing human tasks appears important to the theory as it focuses on the relationship between the human and the non-human,

yet these non-humans take human-like appearances while fulfilling human tasks. Mori's work highlights the ongoing human fascination with creating life as "one of the long-term dreams and fears of humans has been the ability to construct life from scratch" (Beloff, 2017, p.1), and the ambiguity of different types of 'life', such as machines, that exist outside of natural biological reproduction. Gray and Wegner (2012) state that "people have long been fascinated with the idea of creating humans" (p.125), from folklore to Mary Shelley's *Frankenstein* (1818), to "more recently, books and movies have imagined a time when computers and robots will be fully human— our friends and enemies, our lovers and therapists" (p.125). It is this ongoing diversity of new life infiltrating and pervading many social and emotional aspects of human lives, which we increasingly are becoming dependent on as they can enrich our lives, however, "there is a commonality underlying many of them, an undercurrent of apprehension or unease—the uncanniness of the inanimate made living" (Gray & Wegner, 2012, p.125). Furthermore, the idea of artificially creating life in Shelley's Frankenstein "produces an uncanny effect in us as it blurs the boundaries between fantasy and reality and the figure of Frankenstein brings forth a range of feelings in us – from amazement to revulsion" (Beloff, 2017, p.1). However, as these ideas have spread beyond the realm of literature and fantasy into actualised practices, so too have the uncanny feelings they evoke.

Mori's theory speculates that the more human-like new life forms become, the more positively people will respond to them and the more liked and accepted they will be. However, this affinity will only occur until a speculated, undefined point in which perceptions of objects appearing or becoming too humanlike causes a sudden dislike, inciting feelings of creepiness or unease. Mori demonstrates this using a linear graph, and the sudden dislike is shown in a deep curve in a loss of affinity, which is the uncanny valley. For Mori, this decline in likability is problematic if robots and androids need to assimilate into society to assist with tasks and therefore warned roboticists to take this into account when producing their designs.

The effect of the uncanny valley has, however, had a wider spread than just robotics, despite Mori's theory only focusing on robot design. One of the major sources for stimuli being cited as uncanny is digital animation, found in both film and video game production, as discussed in Chapter Two. With the advancement of animation technologies, including the ability to digitise people using motion capture technologies and CGI, higher levels of realism have been realised in these media, therefore, increasing the human-likeness of animated characters (Wolchover, 2011). This subsequently increases the likelihood of the uncanny valley effect, as it becomes more difficult to distinguish between reality and animation. This effect has been witnessed in cultural responses to certain films or games, which demonstrate this high level of realism, with criticism of characters for being creepy or strange. It is this cultural effect that has seen the uncanny valley to have "already attained a dogmatic status" (Burleigh, Schoenherr & Lacroix, 2013, p.2), despite the relatively recent uptake in research into the effect.

The uncanny valley has pervaded many forms of media, and despite its negative effects, examples of it continue to emerge in popular culture; as previously discussed, animated films including *Sonic the Hedgehog* (2020) and *Cats* (2019), in addition to *The Polar Express* (2004) have all been cited as examples of the uncanny valley and prompted negative critical responses, despite predominantly being aimed at children, as "no one would expect a holiday children's movie to generate such reactions. It is particularly interesting then when such a movie, *The Polar Express*, can be cited as an example of incidental horror" (Burleigh, Schoenherr & Lacroix, 2013, p.1). Through the use of animated characters, it has been "suggested that the near-perfect human likeness of the animation was responsible for people's negative reaction to it" (Burleigh, Schoenherr & Lacroix, 2013, p.1). The pervasiveness of the uncanny valley effect in both human and non-human characters has led to the development of suggested guidelines for animators and designers to assist with preventing characters from falling into the uncanny

valley; with suggestions to prevent this, including avoiding strong deviations from normal or expected features when rendering realistic figures, incorporating childlike and appealing features such as large eyes and healthy skin tones, and conversely, amplifying uncanny valley characteristics for villainous characters to draw contrast and promote a negative relationship (Schwind, Wolf & Henze, 2018).

It is this presence of the uncanny valley in mainstream cinema, as well as video games, that has led to an acceptance of Mori's theory, however, only recently has there been much research and experimentation into the validity of the theory and what specifically is behind the cause of these responses. This research is necessary as despite the prevalence of uncanny characters, and guidelines for animators in trying to avoid the effect, Mori's initial paper "does not, however, offer a causal explanation of eeriness; it does not explain why stimuli that are nearly perfectly human are perceived as eerie" (Burleigh, Schoenherr & Lacroix, 2013, p.2). This, therefore, suggests that phenomena such as animation guidelines are directly informed by experience and cultural response rather than any known underlying psychological mechanisms that might specifically cause the effect.

Although Mori does not offer a causal explanation for the uncanny effect, he does highlight a key indication into what could affect the response by plotting two separate curves on the linear graph which demonstrates the uncanny valley. Mori's initial work plotted the suggested correlative affinity between people and objects that resemble humans using two separate curves on a linear graph; one curve representing static objects and the other representing moving objects. Along both curves, Mori gives examples of objects and their apparent likeability based on their appearance. The static curve begins with a stuffed animal, which is also the peak of affinity along this curve, which then descends into the uncanny valley with a corpse, and then regains some affinity, but still in the valley with a prosthetic hand. The prosthetic hand is plotted on both curves and appears at the same point in the uncanny valley

on both curves, suggesting that whether static or moving, prosthetic limbs are always uncanny. Along the curve of moving objects, Mori begins with industrial robots, which are plotted closest to the baseline than any other object on either curve. Humanoid robots appear just before the highest peak of the curve, before the curve descends into the uncanny valley, where zombies sit at the very bottom of the dip. As the curve begins to recover, prosthetic hands sit near the top of the valley, and as the curve rapidly ascends back into positive affinity, bunraku puppets sit just before a healthy, living person.[24]

Moving objects that resemble humans demonstrate both a greater increase in positive affinity at a certain level of aesthetic resemblance, around the point of a humanoid robot, but similarly demonstrates a greater dip into the uncanny valley, around the point of zombies. In a practical sense, this demonstrates the threat that arises from movement as a static agent is less likely to present a threat to the self than a moving one. This strengthening of the response with the element of movement potentially ties into the suggested evolutionary reasoning for the uncanny valley, which is linked to theories of danger avoidance, mortality salience and pathogen avoidance (Moosa & Ud-Dean, 2010). Danger avoidance theory locates the response of eeriness to humanlike forms as an instinctive response to otherness and outsiders and the threat they could present to the self. In this way, a corpse may be uncanny and evoke fear as an evolutionary response to avoid potential pathogens or disease. Death is often cited as being a source for the uncanny, with Moosa and Ud-Dean (2010) ordering the responses to death according to how the strength of the uncanny feeling increases as follows:

1. Dead insect – as a matter of fact, many of us kill insects (mosquitoes, cockroaches, etc.) without even having the feeling of regret
2. Decomposing insect body
3. Dead small animal
4. Decomposing small animal
5. Dead large animal
6. Decomposing large animal
7. Human corpse

[24] Bunraku puppets are traditional Japanese puppets, almost life-sized and carved from wood, they have been used in puppet theatres since the seventeenth century.

8. Decomposing/freshly dead mutilated corpse
9. Freshly dead mutilated corpse with sudden movements (p.13).

Therefore, not only is it the most humanlike that is the most uncanny, but it is the most humanlike that is not presented as it should be. Where a dead body is uncanny, a mutilated corpse is more uncanny as the body is violated and the rotting state of the body demonstrates the change from life to death, self to other, existing to not existing; thus, it is a visual threat to the self, as it demonstrates the body decomposing and becoming other. However, in respect of movement and how movement increases the effect, a moving 'other' poses more threat than one that cannot move. In this scale of negative affinity, a moving corpse presents the strongest feelings as it is unnatural for the dead to move, thus sudden movements by the dead poses a threat to the natural order. From an evolutionary perspective, movement is strongly linked to moving threats or even predators and, therefore, moving humanlike figures that are not the self are likely to pose a threat.

In exploring the concept of danger avoidance to explain the uncanny valley phenomenon, it has been suggested that categorisation based danger avoidance is a more accurate or defined method of understanding the danger posed; that is, an avoidance of stimuli which is difficult or impossible to file into known categories, such as human or not human. This approach was first researched using "morphed images of real, stuffed, and cartoon human faces as stimuli and measured both a likability score and categorisation latency to classify each image into a given categorization class. They found that the likability score was lowest when the categorization latency was highest" (Kawabe, Sasaki, Ihaya & Yamada, 2017, p.129). Therefore, a delay in recognising and subsequently categorising different types of human faces, directly correlated with low levels of likeability, thus rendering the resulting stimulus to be more likely within the uncanny valley. What this categorisation latency means is that "an object with such an improbable appearance is not categorized into already acquired classes of objects,

is probably judged as a stranger to be avoided, and, consequently, has a low likability score" (Kawabe, Sasaki, Ihaya & Yamada, 2017, p.129). Therefore, categorisation based stranger avoidance explains the phenomenon of the uncanny valley as a psychological barrier in being able to quickly and accurately identify an object into a set of objects that has already been learned, such as a human face or the face of a known animal; instead of identifying the object, the individual cannot categorise it due to ambiguities in its appearance and therefore arouses feelings of uncertainty or eeriness which results in the uncanny valley.

In identifying what specifically causes the uncanny valley and which objects may prompt the response, it appears that "the uncanny valley likely depends on extensions of pre-potent responses to stimuli via general learning mechanisms" (Schoenherr & Burleigh, 2015, p.1) which includes abilities to recognise faces and, therefore, "negative responses are the result of a lack of familiarity" (Schoenherr & Burleigh, 2015, p.1). Mori's initial paper and most of the current literature tends to focus on the effects of human likeness in causing the uncanny valley "when human likeness is operationalized as a merger of human and non-human categories, or when a human likeness continuum is paired with one or more atypical features" (Burleigh, Schoenherr & Lacroix, 2013, p.2). However, the element of familiarity being important suggests that there is no universal uncanny valley, but rather that it is culturally dependent based on norms and exposures within these cultures. Therefore, where one object may have high affinity within one cultural context, it could potentially be perceived as uncanny in a different one. The uncanny valley, therefore,

> emphasizes the deviation of an object's appearance from a human one as the decisive factor causing eeriness in the uncanny valley phenomenon. It thus focuses on human likeness in the stimulus continuum from non-human to human. On the other hand, the categorization-based explanation does not always focus on human likeness. It thus assumes a more general cognitive function to emotionally evaluate an object on the basis of categorization (Kawabe, Sasaki, Ihaya & Yamada, 2017, p.131).

In terms of understanding the mechanisms of danger avoidance stemming from conflict in categorisation, Schoenherr and Burleigh (2015) suggest that "a particularly compelling source of evidence for the uncanny valley comes from research into folktaxonomies" (p.1). As opposed to the technical categorisation of scientific taxonomy, folk taxonomy refers to less precise, vernacular categorisation of organisms, such as 'insect', as opposed to specific species of insects. Schoenherr and Burleigh (2015) explain that "when we encounter an organism, our knowledge of folkbiological categories can cause us to classify stimuli in terms of a species (e.g., "fish") or an ecological niche (e.g., "aquatic habitat") that is available within a folktaxonomic structure" and that "while the preferred level of categorization within these taxonomies differs between cultures and expertise such taxonomies form the basis for all judgements of category membership" (Schoenherr & Burleigh, 2015, p.1). However, in respect of how categorising objects can affect the uncanny response, they "suggest that cognitive anthropological research on folktaxonomies has revealed uncanny valley-like phenomena in the form of 'covert categories'– categories that cannot be readily placed into a taxonomical structure" (Schoenherr & Burleigh, 2015, p.1). This suggests that visual ambiguities which disrupt recognition and subsequent categorisation could cause an uncomfortable response, such as a robot with a human face. This lack of ability to categorise, therefore, suggests an innate predisposition to avoid that which cannot be recognised or assimilated.

This recognition and categorisation using folk taxonomies is not only limited to objects with a human-likeness, but also when two distinct objects are merged, distorting the ability to categorise them such as "hybrids and monsters, [as] such entities tend to combine features from disparate categories; ranging from the addition of a single feature, such as unicorns which are horses with a horn" (Schoenherr & Burleigh, 2015, p.2). This strengthens the idea behind categorisation based stranger avoidance, which places emphasis on the known, whereas hybrids are often visually and categorically ambiguous. This effect was demonstrated by

Kawabe, Sasaki, Ihaya & Yamada (2017), who ran a study "using morphed images of a tomato and a strawberry as stimuli" (p.130). Using the two fruits as an example, this study found that with low categorisation ability of the image, participants reacted with a low desire to consume the morphed fruit, however, when the fruits were distinguishable and categorised easily, there was an increased desire to eat the known fruits. This is significant as it demonstrates the safety and likeability of the known and the unease that comes with the collapse of the known, even when the hybrid is a result of two known objects.

In addition to the visual hybridisation of food, such as the aforementioned hybrid representation of a tomato and a strawberry, Schoenherr and Burleigh (2015) suggest that "the uncanny valley could also have implications for recall that facilitates the cultural transmission of knowledge. As in the case of food taboos, such a negative valence might reduce our willingness to interact with features of our environment, thereby further reducing our exposure to a range of stimuli" (p.2). This suggests that cultural knowledge and values and the ways they are communicated has the potential to impact future relationships with stimuli. Furthermore, in the age of pervasive biotechnologies, sources of the uncanny continue to become less visually distinct, with the uncanny valley "also evidenced in genetically modified organisms that antagonist interest groups have labelled 'Frankenfoods,' such as the transgenic tomato" (Schoenherr & Burleigh, 2015, p.2). As a consequence of these new biotechnologies, ideas of what is natural and what is artificial collide and create new problems for categorisation which are beyond the visual confusion of likeness, but instead are more theoretical and abstract, questioning our own methods of categorisation.

Given the range of stimuli cited as being uncanny, it is suggested that "the uncanny valley might reflect a primary response to unfamiliar or covert categories" (Schoenherr & Burleigh, 2015, p.3). This suggests a strange feeling of eeriness or unease can emerge when encountering something unexpected such as a robot with a human appearance, or an animated

character that appears to look real. However, the uncanny valley emerges as a response when realising that while resembling a living human, there is something detectably 'off' about these figures, which is due to a delay in being able to identify the figure being human or not. It is this delay in recognition or categorisation that prompts an inherent feeling of discomfort or unease. Therefore, "in the absence of having prior knowledge of an individual or group, the relative distinctiveness of a category, due to a lower frequency of exposure, will produce negative affect" (Schoenherr & Burleigh, 2015, p.3). This means that using Mori's example of robots, it is the sudden, jarring realisation that robots with human-like appearances are robots, not humans, the recognisable category for human-looking stimuli that causes the uncanny valley effect. Robots are still emerging technologies and, therefore, it is the double-take that the human-like objects produce that triggers a misrecognition and difficulty in categorisation that causes the uncanny valley. Therefore, not only can the uncanny valley be culturally or historically dependent, but is suggestive of a future ability to change, for example, if human-like robots become more commonplace, would the effect still occur, or would something new begin to inhabit the uncanny valley?

The categorisation issue is a direct result of our experience of objects rather than the inherent aesthetic qualities of them. It is the process of experiencing them which causes the lapse in categorisation abilities. For Mori's theorisation, machinery with a high level of human likeness are not practically different from ones which do not look human-like, furthermore, they are both fundamentally robots, instead, it is the human perception of the robots when we see them functioning and performing human tasks. In this way, the human-looking robot is more difficult to categorise than the machine looking robot as "humanlike robots are not only unnerving, but are so because their appearance prompts attributions of mind. In particular, we suggest that machines become unnerving when people ascribe to them experience (the capacity

to feel and sense), rather than agency (the capacity to act and do)" (Gray & Wegner, 2012, p.125).

In understanding the critical responses towards bioart, the same categorisation based danger-avoidance that is used to explain the uncanny valley can offer an explanation for the discomfort that bioart works appear to elicit. The uncanny valley occurs when non-human objects appear to become too humanlike and therefore become difficult to categorise, consequently producing a negative response. However, when looking at bioart made from living tissue, the atypical features that problematise categorisation are not only aesthetic but contingent on materiality and life status that are simultaneously human-like, but not human; this is because "an uncanny sense of nature is currently emerging around us, which is caused by the fact that today, increasing amounts of biological organisms are based on man-made design" (Beloff, 2017, p.2). While the flesh-like materials visually appear similar to the materials of our bodies, the similarity extends beyond a visual similarity; instead, it is the knowledge that these artworks are alive and produced from cells taken from living animals or people that provokes a difficulty in categorising them into known fields. Furthermore, living bioart presents not only the conflation of two categories, but multiple categorical conflicts simultaneously, occupying the categories of human and non-human, living and non-living, art and science, subject and object, and yet not precisely fitting into any of these categories. Therefore, the complexity of their creation and socio-cultural-philosophical positionality makes categorising these works difficult, if not impossible.

Moving beyond only aesthetic stimuli as a source of the uncanny valley, there appears to be many contributing factors to evoking sensations of the uncanny, including movement, as initially demonstrated by Mori, that are important in affecting the strength of the uncanny effect. The increased intensity of response appears to be linked to the more humanlike a being is, the more this has a negative impact. For bioart, the materiality, being both living and

humanlike, therefore, poses a similar threat and consequently a similar effect. Being constructed from living matter but being a recognisable animal, or even fully living, it is clear that bioart suggests a strong uncanny effect through its materiality. Hence, it is not only the aesthetic profile of an object that might cause the uncanny valley, but a collaborative effect of human-like features that prompts a greater response of unease and a greater dip into the uncanny valley.

4.3.1 The Uncanny Valley of Bioart

The notion of the uncanny valley, where affinity with an object is contingent on specific aesthetic features, where the strength of the effect can increase based on additional characteristics such as movement, offers a compelling and dynamic insight into both the critical intentions and critical responses towards living material-based bioart. According to Laura Beloff, "where Mori was investigating robots and their human-likeness in relation to human sensations, the author points towards comparable sensations and experience when concerning biological organisms that are either manipulated or designed by humans" (2017, p.2). Therefore, following Mori's analysis of the relationships between humans and human-like robots and objects with human-like appearances, it is possible to see parallels between the psychological processes which produce the uncanny response in the materiality of bioart. The process of categorisation based danger avoidance functions through psychological processes of categorising learned stimuli into known categories, for example, a person or a cat. However, one of the key features with robots or objects with a high level of realism in their human-like appearance is that viewers struggle to immediately categorise them as either human or robot as they appear to occupy both categories and neither simultaneously; they seem to be something else, something which has not yet been encountered and therefore does not have a learned category for it to fit into.

In the context of bioart, the number of conflictive categories is high and subject to change based on both aesthetic appearance and dependent on knowing the materials that are used; for example, an artwork which includes human material may evoke a categorisation issue where the viewer is aware of this material inclusion compared to if it is used and the viewer is unaware. This is apparent in the exhibition label for the TC&A's *Semi-Living Worry Dolls,* which, as previously discussed, lists the materials as being McCoy line cells without explicit reference to what these cells are or where they came from. Therefore, the work may evoke a different response if the materials were more explicitly detailed. Furthermore, works which visibly resemble hybrids by highlighting the humanity and the lack of being fully human may also evoke categorisation difficulties. This is evident in Czarnecki's *Heirloom,* where the sculptures are portraits intended to represent the appearances of the artist's daughters. However, with this work, the most immediate categorisation difficulty is not only the materiality but also the conflict between the portraits as appearing as a hybrid between both living and dead. This is because although the portraits are made from living genetic materials of the individuals they portray, they appear like "living mortuary masks" (Bureaud, 2016, para.16). The juxtaposition of living materials resembling death masks, therefore, evokes a conflict and produces a jarring momentary inability to recognise the works as being living or not; that is, depicting the living or the dead. The work, in fact, however, is simultaneously both living and non-living, therefore this inability to correctly categorise the work is because there is no single category for it to belong to, as with all living bioart works discussed in this thesis. The materiality evoking a sense of uncanniness is because these "artistic works no longer simulate nor create representations of the world. They deal with the actual real" (Beloff, 2017, p.4). Therefore, moving beyond representation of biotechnologies to using and presenting actualised real materials suggests an effect evoked by the vitality of the media used.

A dominant feature present among a majority of these works, in addition to their materiality, is the ways in which they resemble parts of the human form. Unlike the purposeful human-like resemblance of *Heirloom*, the *Semi-Living Worry Dolls* are suggestive of the uncanny valley through their close proximity to known forms of imitating human appearance, that is, the figure of the doll. Where the uncanny valley arises from a conflation of the too-human-like with the non-human, it appears on the surface that the lack of sophistication in the rendering of worry dolls would not cause a strong reaction. However, the living materiality of the dolls adds a dimension of unfamiliarity and discomfort as it produces a living, almost-human but distinctly not-human figure. Similarly, the living reproduction of an ear using human genetic materials, as in Strebe's *Sugababe,* elicits a duality of the human, but not fully human. Severed limbs and prosthetics have previously been cited as being uncanny as per Mori's initial graph, however, here the artwork invites further layers of familiarity and unfamiliarity as the ear is an independent living object, not an artificial ear or a severed dead ear. Strebe's ear is, therefore, not a known or previously encountered form of limb but one that is new and occupies a liminal space between natural and manufactured.

This categorisation conflict is also present in Karle's *Regenerative Reliquary,* which although does not yet contain living materials, resembles a human body part but exists separately to a body. In addition to this, there are the conflicting categories present in many of these bioart works, of art/science, art object/living subject, living/non-living, human/non-human and self/other which are inherently present in the fundamental process of bioart creation. These categories are learned, pre-established categories that bioart, by its nature of being a hybridised transdisciplinary practice, does not fit neatly into. Therefore, when bioart is encountered, it is a new form of imaginative, critical exploration that is difficult to comprehend as an art practice that has been encountered before, or as a form of biotechnology that is often encountered indirectly or subconsciously.

As an emergent form of creativity and cultural criticism, bioart has demonstrated new relationships between the viewer and the art. This has occurred through merging two previously culturally separate fields of art and science, bringing the hidden processes of biotechnology into visible public realms, and displacing the traditional viewing arrangement of viewer/object with a subject/subject encounter. Furthermore, this subject/subject encounter is not as clear cut as perhaps viewing an animal in a zoo whereby both parties are active individual agents, albeit the animals are not consenting to captivity, yet here instead the viewer has agency and autonomy, and the living artwork is vulnerable and dependent on the viewer as well as its creator for care and ethical treatment. Together with criticism and concern regarding bioart posing as a potential misuse of scientific materials and processes, which appears to be somewhat ironic and part of the point of bioart to highlight our ethical boundaries in general, bioart has and continues to provoke strong emotive reactions from audiences and critics alike.

Criticisms of bioart, together with the general reception towards living bioart works, suggests a relationship with the viewer is contingent on multiple related facets of materiality. The effects of materiality appear to parallel Mori's configuration of the uncanny valley in robotics, humanoid machines and objects, however with human-like materiality replacing human-like appearance. This consequently suggests an impact on levels of positive affinity or a negative response are subject to the materials used, which is supported by Kerbe and Schmidt's (2015) study, which found that bioart works which used human matter generated the highest levels of ethical concern while microorganisms garnered very little concern by contrast. However, artificially grown tissue culture, being a new form of life, appears ambiguous in eliciting some level of ethical concern, but less than living animals.

Mirroring Mori's graph of the uncanny valley, there is a steady level of increasing discomfort that rises from bioart that changes through materiality. The uncanny valley of bioart plunges into a similar irrecoverable dip when the materiality becomes too human-like until it

becomes fully, unaltered human. However, works that use human materials, that are either non-living or bodily fluids, such as Andres Serrano's *Piss Christ* (1987) [Figure 4.7], which uses a photograph of the artist's own urine, and Andrew Krasnow's *Palette* (1992-1999), which uses donated human skin, that do not necessarily fit the definition of bioart that this thesis focuses on, still do not have high levels of affinity despite using human materials.[25] These works demonstrate an effect that is abject as the materials used have been directly removed from the body, whereas tissue bioart has an additional effect of uncanniness by being a living subject created through artificial methods.

Therefore, using Mori's proposed relationship between a human-like appearance and affinity, it would appear that the more human-like a work is through its materiality, the greater the level of concern and consequential criticism it incites. However, with tissue art, these works are living, but not living subjects that have been encountered before that occur naturally outside of human intervention. They simultaneously appear human-like and non-human, which manifests through new uses of living materiality and the objectification of the living matter through the use of it as art media. These works consequently "tamper with expectations of how things used to be. These kind of experimental artworks present us moments when the boundary between fantasy and reality is broken and we are faced with the reality of something that we have until now considered imaginary" (Beloff, 2017, p.4). If, therefore, it is the aim of bioartists in using living media to explore and critique contemporary biotechnologies by partaking in the same processes, it appears that innate human psychological functions assist in this endeavour through evolutionary responses to the unknown, the uncategorisable and the other. This is because, "to put the point perhaps over-simply: we are more shocked by bio-art than by abstract debate, because bio-art utilizes, in culturally compelling ways, the technologies we may want

[25] Although not human material, Wim Delvoye's *Art Farm*, established in China in 2004 would also be applicable here, where the artist tattooed living pigs with a range of designs. Although pigs are not human, tattooing is recognised as a human behaviour and practice.

to interrogate" (Simoniti, 2017, p.125). Bioart, therefore, "both observes and explores the possibilities of the uncanny nature – a nature or reality that used to be familiar but which has been modified in a laboratory, extended with various agencies and components, which all together form a hybrid ecology" (Beloff, 2017, p.4).

By using, exposing and forcing an encounter with biotechnologies, bioart is a confrontation with the other which cannot be categorised into known categories due to its new and unknown nature. This, therefore, evokes responses of alienation which consequently allows for a more objective scrutinisation of both the technologies and materials used, as well as bioethics in general. Therefore, it appears that the aims of artists are assisted by our evolutionary responses to otherness, which is achieved by removing bioengineering from its original context, breaking down boundaries and categorisation of what is art or what is science, and reimagining these technologies to explore our hopes, fears and questions over our future. Through innate responses to unknown or new stimuli, that is, bioart, our subjective experiences through the encounter allows for a greater level of understanding and critical judgement of biotechnologies, together with our ethical and moral obligations towards other forms of life, and our complex relationships towards them as the creator of them, the users of them for new products, and critics of them.

Chapter Five: Bioart as a Product and Reflection of the Anthropocene

The materiality of bioart is a central feature of the genre that affects, problematises and alters traditional expectations of art and science, in addition to traditional viewership and embodied art encounters. Bioart has attracted both criticism and intrigue for its ethically ambiguous positioning between contemporary art and living bioengineered materials, which has resulted in complex debates as to whether it is an acceptable use of living materials, that is to reduce them to the status of an art object. However, when considering these ethical issues in a wider context, they reveal deeper socio-cultural concerns that infiltrate contemporary science. The use of living animals in scientific experiments and research is a well-documented practice, and one which is culturally sensitive and has prompted many well-publicised critiques and arguments (Ormandy & Schuppli, 2014); it is a known practice, and despite moral discomfort, it continues to be a common practice that is often mandated by law in that many drugs, medical procedures and cosmetics must be tested on animals before they can be used by humans (Archibald, Coleman & Drake, 2019). A key difference between the established practice of animal testing and grown tissue culture is largely concerned with the ambiguity of the ethical status of the tissue, which is a reflection of its uncertain life status. Bioengineering is rapidly infiltrating many aspects of society, such as food production and medicine, and, therefore, these uncertainties must be discussed in order to be better understood. Through bioart practices wider debates about the uses and processes of these new technologies can be explored as a cultural turn and not only as a response to art.

The introduction of new biotechnologies has often resulted in fear and anxieties regarding the impact of such technologies, including our relationship with the natural world, as well as concerns over potential misuse, for example, fears of bioterrorism or compulsory microchipping as previously discussed. Since the middle of the twentieth century, the

expansion of biotechnological capabilities has accelerated, altering life through the increased abilities of manipulating and editing living structures at a microscopic level, as discussed in Chapter One. However, synthetic lifeforms, grown from cells into larger tissue forms, are still an emerging technology and, therefore, their position within contemporary culture remains unclear. The emergence of bioart as an artform that explores biotechnologies by using them as its media suggests a pervasive interest in these technologies as they have become the media of contemporary life. Both the use of living materials and the use of life editing and altering technologies have become important tools trialed in attempts to alter and design human genomics; through this, biotechnologies have demonstrated the potential to improve human health from gene editing to eliminate diseases, to artificially growing organs for transplantation. As such, this in turn suggests a future where humans can live longer, healthier lives, however, the ethical implications of changing the fundamental structures of the human body are complex and remain unanswered. The responses to bioart artworks has, however, been to challenge the ethical considerations of the use of living materials as suitable and ethical media for art. Conversely, as a deliberate attempt to reflect on the ethics and morality of biotechnological capabilities, bioartists have exposed the hypocritical double standards attached to ethical conduct towards other forms of life. The criticisms aimed at bioart works are not the same criticisms directed towards the same biotechnologies used in medicine, agriculture and biosciences. They are aimed at the appropriation of scientific media by artists which suggests that artists do not share the same benefits that allows for ethical problems to be accepted or suppressed for human gain.

In considering the confrontational otherness of bioart, it is easy to overlook the fact that these ‘other’ lifeforms are, in fact, the product of human enquiry and construction. Furthermore, the liminality and abjection of these same life forms are the product of ethical approval by institutional ethics committees, moral views and subjective value systems. This is

evident in the marginalisation and criticisms of bioart, which is not replicated by the products of the same technologies through medicine, with artist Adam Zaretsky stating that "because I am an artist, I am not shielded by the rhetoric of moral sanctity implicit in the public face of scientific rationalisation" (2007, p.275). In many ways, bioart is a reflection of contemporary humanity, current scientific and artistic interests and concerns, and of the current socio-cultural positioning at the very beginnings of manipulating life to suit subjective, humancentric needs and desires. As a mirror, encountering bioart allows us to encounter and be confronted by these self-reflexive concerns. Exploring the role of bioart as a reflection of contemporary concerns and practices that enables a critique of technologies with greater objectivity ties into the objectives of many bioartists in inviting discussion and debate around the use of biotechnologies. However, in doing this, artists must acknowledge the hypocritical nature of their usage of biotechnologies in order to incite these debates. Consequently, separating this conscious and deliberate act of hypocrisy from artists who do not acknowledge the hypocrisy is problematic, yet, this reflects the true complexities present in our relationship with biotechnologies and other life forms in the twenty-first century.

5.1 The Function of Abjection

Abjection, as an embodied reactionary response to otherness in relation to aspects of the body, is a warning of the transgression of boundaries as the abject sits in opposition to object and consequently is a place "where meaning collapses" (Kristeva, 1982, p.2), as previously discussed in Chapter Two. As evident in the perceptions of living bioart, the abject arises from the lack of distinction between the self and the other, which manifests through the living materiality. The living or semi-living bioart sculpture appears to occupy a space that is equidistant between the living body and the corpse, which is a source of abjection as it represents "cesspool and death. Without makeup or masks, refuse and corpses show me what

I permanently thrust aside in order to live. Such wastes drop so that I might live, until, from loss to loss, nothing remains in me and my entire body falls beyond the limit-cadaver" (Kristeva, 1982, p.4). This liminal space of bioart, between life and death, presents a crisis of the self and its borders as the "abject never ceases to haunt the borders of identity; it constantly threatens to dissolve the unity of the subject" (Ross, 1997, p.149), which manifests in bioart as its materiality simultaneously occupies the position of the self and the other, sometimes through the vitality of the materiality, and sometimes even genetically. The mechanism of abjection is triggered by materiality in the visceral, physical sense of encounter, but also through the additional knowledge of exactly what the material is made of and the fact that it is alive. Abjection is a warning from the body of an outside threat from the self when part of the self is cast off and becomes other. It is a crisis of identity in response to the body and bodily functions that become othered or discarded. By inhabiting human forms and being made from living materiality, occupying the roles of both subject and object, self and other, bioart threatens the identity of the human body. By inciting an innate response of rejection, bioart presents a threat to current boundaries of the body and to the understanding of what it is to be human and to be a living subject.

In understanding whether the effect of abjection is an intended aspect of bioart or an unexpected but instinctual reaction to bodily otherness, it is useful to look at the role of abjection in a wider context where it is often addressed in response to the female body or bodies that are in some way 'other'. Addressing this use of abjection, Caroline Ross asks, "is the use of revulsion and disgust a shock strategy elaborated in response to a cybernetic age where the body is threatened with disappearance into virtual reality?" (Ross, 1997, p.149). Bioart, as a body of otherness, presents an encounter with the future of the human body as biotechnology continues to inform medical practices. This, therefore, represents both a promise and a threat to the body but is manifested in feelings of shock and repulsion through the living materiality.

However, Ross (1997) suggests that "the contemporary use of the abject is indeed a 'return to the body,' but one that produces an excessivity that problematises the absence/presence duality and opens up new cybernetic definitions of subjectivity" (Ross, 1997, p.149). Looking at the abjection of bioart as a return to the body suggests that the confronting otherness that it presents, offers a reimagining of the body as a new conception of humanity. In embracing the fusion of the body and technology, the abject can reveal a new framework for the body and our relationship to it. The instinctual nature of recognising otherness in living materiality, and the ways in which it threatens the identity boundaries of the self and the other, is not limited to bioart but can also be found in the public responses to new processes and products of bioengineering. This is because bioart is only a repurposing of the materials and tools of bioengineering, suggesting that it is the fundamental act of artificially altering life which provokes abjection. However, instead of responses to bioengineering products being specifically abject, these responses are referred to as producing the 'yuck factor'.

5.1.1 The Yuck Factor

The abject response provoked by the visceral materiality of bioart sculptures is mirrored in similar public responses to products and outcomes of biotechnology, in particular those with medical and environmental functions. Known as the 'wisdom of repugnance' or the 'yuck factor', the effect has been used to describe the responses of visceral or graphic processes or uses of biotechnologies and refers to the effect in the self rather than the stimuli that prompts the response. The yuck factor describes "the influence of instinctive responses against new technology" and is a "catchall phrase to describe techphobic sentiments that vary by what triggers them" (Schmidt, 2008, p.525). In terms of what produces the effect, the yuck factor has been observed in response to a wider range of technologies, including cloning of animals, genetically modified crops, and the consumption of recycled wastewater. As a response to

technologies, the yuck factor reveals "that violating moral codes relating to divinity and sanctity can provoke reactions of disgust. Studies that involve creating and destroying human embryos have elicited such reactions" (Schmidt, 2008, p.526). Morality as a signifier of the yuck factor is a marked difference from ethical practices. Practices such as destroying human embryos are legal practices that have therefore been permitted by ethics committees, so long as they are given permission to destroy them by the parents (Douglas & Savulescu, 2009). However, morality does not equate to ethics, as morality refers to personal, or culturally specific perspectives, whereas ethics aim for objective, logical perspectives that consequently contribute to legislation and decision making; this difference is described by Deleuze as,

> the difference is that morality presents us with a set of constraining rules of a special sort, ones that judge actions and intentions by considering them in relation to transcendent values (this is good, that's bad…); ethics is a set of optional rules that assess what we do, what we say, in relation to the ways of existing involved (Deleuze, 1997, p.100).

The difference here is that where ethics is a deliberate set of rules that are designed to judge actions and behaviours that we are not ordained to follow, morality is both more constraining and more ambiguous as it is based on values that are more difficult to determine. When dealing with biotechnologies, therefore, there is a greater span of moral concerns due to the number of subjectivities present within society and the ways different people perceive good or bad. Morality is dependent on many subjective factors and not necessarily based on fact or evidence, but on feelings of how one should behave in relation to others, such as whether behaviours are or should be altruistic or just (Joyce, 2006). Feelings of morality may vary within cultures and, therefore, are difficult for scientists to navigate in communicating new technologies. This is a complex issue that is imperative for the success of new technologies that offer beneficial use to humans, but simultaneously keeps the positivism of science in check and held to account.

In relation to the technologies used by artworks in this thesis, the prospective benefits of bioprinting as a technology to increase the supply of human organs for donation could be "an attractive alternative as it avoids the 'yuck' factor" which is present in the

contemporaneous technology of “chimaera pigs, used to incubate human organs created through the implantation of iPSCs, can be an ethical source of immunocompatible organs” (Vermeulen, Haddow, Seymour, Faulkner-Jones & Shu, 2017, p.620). While it is ethically viable to practice both processes of growing transplantable human organs outside of the body, the morality of the practices differs. The yuck factor emerges through the discomfort of combining human and pig genetic material and the consequential harvesting of organs for transplantation between species. It is a gut response to a change in order that elicits a transgression of morality. Similarly, the yuck factor has been found in public responses to technologies which filter and recycle wastewater into drinking water (Leong & Lebel, 2020).

These examples of the consumption of reused wastewater and organs harvested from chimeric pigs being sources of the yuck factor, demonstrate that the response stems from a perception of contamination and redefinition of what is clean, natural and the boundaries of these concepts. The yuck factor is, therefore, “linked to ideas about ‘Pollution behaviour’ the reaction which condemns any object or idea likely to confuse or contradict cherished classifications’ as out-of-place” (Vermeulen et al., 2017, p.620). This suggests that stimuli classified as being ‘yuck’ challenges our ideas of the natural and the boundaries of the self/other. While the consumption of cleaned wastewater poses no detrimental impact on health, nor is it distinguishable from other clean sources of water, it is the knowledge that it was once waste that is problematic.

The yuck factor poses an interesting insight into responses towards living tissue bioart as it has a similar effect to that of the abject which, in bioart, can be linked to the uncanny valley. Reflecting on ‘yuck’ as being a psychological safety response, it is clear to see how bioart could also fall into being perceived as eliciting feelings of ‘yuck’. As such, this is potentially a consequence of the concept of ‘yuck’ originating in scientific literature, which has not engaged in bioart debates on a large scale, and it not being a frequently used term within

art discourse. This, however, does not suggest that it is not 'yuck', but instead that there is a shared response to certain stimuli across disciplines; that is, materiality and categorisation. One of the explanations for the yuck factor is a lapse in effective communication between scientists and the public, suggesting that a lack of education regarding new technologies renders them as things to be feared or repulsed by. Through educating members of the public and providing them with more information of the processes and benefits of such technologies, formally problematic technologies such as recycled water subsequently improves levels of acceptance (Leong & Lebel, 2020, p.2). This suggests once again that it is not the technologies that are inherently problematic, but how they are perceived which depends on knowledge through information being openly accessible and understandable.

Active engagement with science, however, relies on the scientific community and disseminating corporations to provide direct, honest engagement with the public, and not necessarily expect the public to actively seek more information or a greater understanding themselves. This, therefore, renders the methods of communication and dissemination to be important. However, scientific literature has stated that information "can be enhanced or framed to improve public response" (Leong & Lebel, 2020, p.2). Framing is often used in science communication and can be understood as

> a set of simple elements that organise the perception of a given situation. Framing is how those elements tune the interpretation of a phenomenon. In other words, framing constantly answers the question "what is going on here?" in any activity. From the science communication literature we know that frames embedded in texts affects the interpretation of scientific research (Davis & Russ, 2015, p.223).

Therefore, through the framing of technologies in literature and communication, public perceptions of specific products or processes can be affected or changed; for example, research has demonstrated that "there is increased acceptance, positive emotions and reduced risk perceptions of recycled drinking water when information is framed as coming from scientists who share regional identity" (Leong & Lebel, 2020, p.2). While the technologies involved may

have positive environmental impacts in the long term, the knowledge that this information can be disseminated in persuasive ways creates a distrust. Furthermore, "choices in language and terminology are pivotal in determining how new technologies are received" (Schmidt, 2008, p.526). This suggests that in some instances, the yuck factor could be prompted by how technologies are named and described, and reflexively, could be avoided by alternative wording and "to overcome that [yuck factor], you have to become sophisticated about how experts manipulate emotion" (Schmidt, 2008, p.526). However, as both a psychological and physical behaviour, the disgust that is a response to the yuck factor has been a useful mechanism for humans as "it evolved to protect us from illness and death. Before we had developed any theory of disease, disgust prevented us from contagion" (George, 2012, para.4). Therefore, the response of disgust and revulsion to stimuli including corpses or rotten foods may have an evolutionary function which is to protect the self from harm. The stimuli that evoke disgust, however, are not only limited to sources of abjection such as death, contaminated foods or bodily fluids, but are commonly associated with biotechnologies, as "the 'yuck factor', often automatically associated with genetic issues such as cloning and hybridisation, is a sign of a deep, intuitive wisdom" (Niemela, 2011, p.267).

In regard to biotechnologies, "genetic technologies have the capacity to fundamentally alter life as we know it, in some cases with uncertain benefits. By giving pause to technological progress, the yuck factor opens new opportunities for dialogue between scientists and the public" (Schmidt, 2008, p.525). Therefore, through the provoked responses of disgust and rejection, scientists can capture and harness this effect to produce new and meaningful conversations with the public. This is what bioart offers that other art media cannot, it provokes abjection and the yuck factor through its materiality, which consequently prompts new discussions around both art and science. A potential problem is that these debates about bioengineering between the public and scientists could end up being one-sided, with scientists

simply finding the most acceptable use of wording rather than changing or adapting the technologies. It is, however, significant to recognise that "the disgust attributed to certain violations of societal behaviour derives from an intuitive account of the motivations and desires of the violator" (Niemela, 2011, p.270). Consequently, disgust or repulsion towards biotechnologies is not only a response to the technologies but towards those who created them and their underlying motives.

One of the key questions regarding biotechnologies is whether the ability to perform certain actions equates to whether they should be performed; if pigs can be bred using human stem cells and farmed for organs, does that equate to an ethical practice that should be employed on a mass scale? Is it comparable to meat farming, which although attracts criticism from a growing number of activists, still exists as a somewhat accepted and legalised method of food production? These questions do not have answers, yet the reaction to these technologies suggests that they are new phenomena that have not been encountered before and potentially pose a threat, whether real or perceived, to the established hierarchical ordering of life within contemporary societies. What is clear, however, is that there appears to be an instinctual embodied warning against these practices when they are encountered, therefore enabling these questions to be asked.

5.1.2 The Power of Abjection

The presence of the yuck factor in response to many different types of biotechnologies suggests that it is not only linked to a specific type of technology or materiality, but to a deviation in expected norms, particularly in relation to habitual tasks, objects or beings. Described as a "gut response" (Schmidt, 2008, p.525), the yuck factor sits in opposition to the values and methods of science, and yet it plays an important role in disseminating and commercialising the products of science. Scientific research and experimentation rely on rigor, repeatability and evidenced-

based practice, where decisions can be made by logic and fact in an attempt to achieve objectivity and accuracy. The yuck factor, however, stands in opposition to these as it is based on instinctual, intangible emotions and feelings. Yet, the fact that scientists factor this response into the communication and dissemination of new technologies suggests that it is an important and powerful consideration in the processes of these technologies.

Comparing the effects and causes of the yuck factor with theories of abjection, it appears that the two phenomena share similarities; however, where the yuck factor is used to explain aversions to science and technology, the abject is an established theory often used in the arts such as film and literary criticism, as well as art. Both feelings stem from a repulsion towards phenomena that is 'other' that arises from a perceived transgression of boundaries which can emerge from new biotechnologies. The boundaries of self and other become obscured through the use of materials that at once are both of the self and of the other; for example, wastewater, that is water that becomes unclean through contamination with the human, or where an animal, well-defined and separate from the human, becomes genetically part-human through transgenic implantation of human genes. The fact that both of these effects describe subconscious, embodied reactions is important in recognising that the cause of abjection is through the perceived notions of existing boundaries which, therefore, locates the sense of abjection within the self. In this way, the abject arises not in the 'other' but in the self through a crisis of identity that occurs in the presence of the other. Consequently, the abject is a product of self-reflection and identification.

As abjection is, therefore, situated within the individual and not in the technologies or materials used, it is a reflection of our own moral codes being brought into question in the face of contemporary cultural endeavours. It is a product of confronting the cultural materiality of the twenty-first century. The affectivity of the yuck factor on the marketing and consequential acceptance of new technologies, along with the abjection of visceral bioart prompting

important critical debates around materiality, demonstrates the power of these responses to living materiality. Furthermore, Mary Douglas suggests that out of place matter is like dirt, it is uncomfortable and evokes fears of disorder and this disorder being contagious,

> as we know it, dirt is essentially disorder. There is no such thing as absolute dirt: it exists in the eye of the beholder. If we shun dirt, it is not because of craven fear, still less dread of holy terror. Nor do our ideas about disease account for the range of our behaviour in cleaning or avoiding dirt. Dirt offends against order. Eliminating it is not a negative movement, but a positive effort to organise the environment (2003, p.2).

In this sense, dirt is not only the materiality of bioart, but it is the transgressive practice of manipulating these living materials and then using it for art practices, thus disrupting the expectations of art and of science. The fear of this disorder is due to the way that bioart reorganises these expectations and the new ways for these materials to be used suggests a threat to the self and the materials of the self. Instinctive reactions to transgressive uses of these materials prompts subjective, critical engagement with biotechnologies. It is the power of abjection that prompts discussions around norms, expectations and acceptance of art materiality, democratisation of these materials, and our uses of life in technologies to aid and improve our lives at the cost of that of the other.

5.2 Bioart, Biotechnologies and Bioethics

Biotechnologies are a central component of bioart, both in the construction of the works and the thematic engagement with contemporary cultural debates. Biotechnologies have an interest in manipulating, altering and improving living matter at a fundamental level; therefore, in biotechnological research, bioethics is an important process in enabling practical experimentation to occur and consequently commercialised usage of these technologies.[26] The regulation of science practices through bioethics sees proposals being passed through ethics

26 Bioethics here refers to the institutional structures that permit or prevent practices based on assessment by committees rather than the bioethics that are discussed by theorists which contest, critique and contemplate the ethics of medical, animal and environmental issues.

committees in order to deem whether any risk or 'cost' of using and experimenting on living matter, organisms, animals and humans are worthwhile, and whether any harm or death can be offset by potential benefits. While most experimentation initially takes place on small rodents such as mice, rats and rabbits, testing on larger animals including cats, dogs, horses and primates also occurs; however, research facilities such as Cancer Research UK state that they only use these animals "in the limited circumstances of veterinary oncology studies or for toxicology and safety pharmacology studies where required for safety or regulatory purposes" (CRUK, 2020, para.6). Although on the surface, this caveat appears to suggest the use of such animals is limited, the range of possible experiments required to test toxicology and pharmacology appears extensive and demonstrates that through attempts to mitigate the risk to humans, this is at the cost of causing harm to animals.

Institutional bioethics emerged following the Second World War (Lopes, 2014) in order to protect individuals and their rights from issues such as involuntary human experimentation, as previously discussed. In the twenty-first century, biotechnological research is most often restricted to institutional laboratories, where scientific professionals and academics are given access to the uncensored reality of how many living beings are used in experimentation to test new technologies. These could be cockroaches with computer chips implanted into their nervous systems so that they can be controlled remotely like a toy (Sample, 2015), or the deliberate bioengineering of animals to carry diseases in order to test the efficacy of new medications or vaccines (CRUK, 2020). While some institutions such as Cancer Research UK are somewhat transparent in their animal testing policies (CRUK, 2020), the general public often only see selective scientific data being published (Schooler, 2011), with little insight into the processes and costs that enabled such results.

Bioengineering practices are therefore not without ethical concerns, even after passing applications to ethics committees and existing inside of bioethical codes of conduct, many new

technologies prompt new concerns as they change the ways processes occur and ultimately alter our world, world view and position within it. Due to the lack of visibility and transparency around practices, however, these concerns may not take into account all of the issues present, with many focusing solely on visible or known problems such as the morality of animal testing. However, through the visibility of bioart, artists are able to incite a reassessment of how we use biotechnologies and the expectations we have of them. The ethical concerns over new biotechnologies are therefore important in understanding the greater context of bioart and how these materials and processes are controversial even in their original context.

5.2.1 Ethical Concerns in Contemporary Biotechnological Practices

The ethical problems new biotechnologies create have been present in each new development in human history, from the very foundations of agriculture, such as the domestication of animals to the intensive farming of sheep, cattle and pigs for human consumption, there are challenges to ethical frameworks which have consequential impacts on our relationships with nature and other forms of life. These ethical challenges have steadily become more complex through the development of new technological capabilities, which not only affects our connection with nature, but with the very concept of what it is to be human. The ability to genetically alter life at a fundamental level, along with the developing abilities to artificially produce life, presents the greatest challenge to bioethics to date, as they possess the most significant opportunities for changing and enhancing the human, therefore posing the largest threat to the idea of the human.

Bioethics, as a method of controlling and restricting usages of biotechnologies to minimise ethical harm, is a process as well as a set of guidelines which takes place during research practices, experimentation and wider production of biotechnologies. While codes of bioethical conduct exist to guide best practice, the innovative nature of these experiments

means that ethical perspectives have the ability to change and, therefore, bioethics is a constant reassessment through time of what is deemed to be acceptable or not. The processes of complying with bioethics is often hidden from public view. The committees and decision-making processes are not public and, therefore, there is little consideration or consultation regarding what practices are considered to be ethical or not. This has produced a number of notable examples in recent history of new technologies and processes receiving high levels of public concern when reaching the consumer despite often having been regulated by and complying with bioethical guidelines, for example, the introduction of technologies such as GM foods have been met with controversy. The controversies around GM foods stem from several issues, including a lack of public consultation in produce being genetically modified. This has caused further issues in that the legislation for food being labelled as genetically modified varies highly between countries (Carter & Gruere, 2006). This lack of public consultation and communication, together with discrepancies in the labelling of genetically modified foods, has resulted in a divisive technology that has led to a global market of organic, non-genetically modified produce. This is a prominent example of bioethics not always being equitable with public opinion and morality.

Bioethics, although a relatively new occurrence in the history of human biotechnologies, must also take into account practices that are not necessarily new that may have once been deemed as acceptable, but now pose a threat to human health and climate change (Cox MacPherson, 2013). This is evident in the reliance on fossil fuels as an energy source. While once a small-scale industry, the exponential growth of the global population along with the same growth in mining and use of natural resources has taken a toll on the planet. The pollution damage to the environment, in addition to climate change caused by combusting these materials, is a significant ethical problem given the accelerating damage that this causes to the planet and its inhabitants (Greene & Kammen, 2014). Furthermore, in finding new

sources of these materials, natural habitats are destroyed, consequently harming wildlife, leading to a decline in animal populations, therefore, as time has passed, what once may have been deemed ethical no longer is, leading to global demonstrations and protests in order to incite change, exemplified by the global climate protests in 2019 (Taylor, Watts, & Bartlett, 2019). The dependence on these technologies, along with the commercial interest in the materials, however, does not always align with morality. Such technologies are ethically problematic and yet they continue to exist and to cause harm.

These considerations demonstrate the complexities of bioethics in terms of approved practices and the changing perspective of ethics and morality. However, these examples highlight how there is a fundamental difference between bioethics in practice and to the public. The general, day-to-day concerns of bioethics are kept within the laboratory and are not public concerns until, on most occasions, they are approved and are communicated to the public as new technologies. However, when they do become public knowledge, bioethics becomes more than processes of approval, but human judgements of right and wrong and issues of harm and damage are viewed from a broader perspective and in relation to the rest of the planet, not as an isolated technology. This is because biotechnologies are designed to interact with life and living materials and, therefore, must be considered in the context of culture, not only the context in which they are designed to alter; for example, the ability to grow organs in vitro must account for the wider socio-cultural contexts of organ donation as they exist in different countries, cultures and religions, in addition to the environmental impact of growing tissue in vitro and the potential impacts large scale industry of this nature could impose on the planet.

In terms of the technologies featured most frequently in living bioart sculptures, the ethical concerns are more nuanced and more focused on applications of the technologies rather than the living materials used; living materiality, whether donated cells, extracted cells or living animals, appears to be an accepted and unquestioned part of contemporary science. Used in a

range of practices, it appears to only be when these materials are transposed into a context outside of scientific research that issues around living materiality are truly addressed. Within the context of contemporary art, issues of materiality are heightened and allow for critical engagement with fundamental questions of what the materials are, and how or even if they should be used, and whether such usage should have limits. Thus, it is the importance of bioart, and the emotive, immersive and subjectivities of art practices, that draw attention to these issues. The most prominent biotechnologies used in bioart, as discussed in Chapter Three, concern the cultivation of synthetic living tissue culture. This is most often achieved through seeding shaped scaffolds with cells, which are then submerged in a growth medium and incubated, allowing and encouraging the cells to reproduce, forming the desired shape. However, this technology has developed even further through the ability to 3D print these objects, allowing for a higher degree of accuracy and repeatability of specific forms.

5.2.2 Synthetic Tissue

Synthetic biology spans a range of practices that concern experimenting with changing, altering and creating biological life through scientific methodologies (Roosth, 2017). This includes the practice of growing living materials, such as cells and tissues, inside of a laboratory using bioengineering tools and techniques. Tissue engineering shares a history with modern organ transplantation, as "perhaps the most obvious precursors to TE [tissue engineering] lie in the clinical domain. These are best understood as specific examples of general problem-solving strategies employed by physicians" (Lal, Viola, Hicks & Grad, 2003, p.11). In the process of attempting successful transplantation of organs, the move into attempting to grow and alter tissues to suit the needs of patients has become a logical progression. Therefore, tissue engineering has a direct link to the body and its needs, which has given way to the exploration and criticism of it through bioart.

In terms of ethical considerations apparent in the process of growing synthetic tissue culture, one of the most pressing issues is that of what kinds of cells are used and how these cells are accessed. The growth of plant tissue culture is a continually expanding practice within agricultural biotechnological research, exemplified by the aim and ability to improve crops to withstand certain environmental conditions or to create biofortified crops, heightening the nutritional value of foods to combat malnutrition (Hefferon, 2015). Following on from the study of the ethical implications of living materiality in Chapter Four, plant tissues do not post a great moral concern when it is used as a living material. However, there is a simultaneous growth in the use of human cells in tissue culture research, aimed at enhancing medical procedures, such as artificially growing skin for grafting, vascular grafts, and islet cells for diabetic patients (Lal et al, 2003). The ethical concerns of these practices are twofold; where did the cells derive from and whether they have been consensually taken? And, is it ethically sound to grow living human material in a context where it is designed to function as a consumer object rather than a subject, and a piece of medical equipment rather than human remains?

These are important questions to ask as the complacency of treating living matter as any other abiotic material poses the risk of failing to act ethically and responsibly towards these new types of life; this becomes particularly difficult when drawing a line between synthetic tissue and the human if these products are implanted into the body. Therefore, ethical considerations are vital to regulate practices and to protect the rights of the life involved. However, as with the difficulty of bioethics, these concerns do not exist in isolation but must be weighed against the potential beneficial outcomes of these new technologies. Growing synthetic tissue culture could create a dependency on living materials and a lapse in recognising the humanity or vitality of them, and consequently, "tissue culturing and the production of semi-living entities on a massive scale could lead to the emergence of a 'new class for exploitation', where the exploited are not necessarily fully developed complex organisms but,

instead, their fragments: cells and tissues" (Radomska, 2017, p.382). However, at the same time, the benefits of such technologies to human health and benefit is a strong driving force behind the production and implementation of these biotechnologies.

In bioart, the sculptures grown by the TC&A use the technique of seeding cells over a scaffold in order to grow the artworks into the desired form. The cells used in these works stem from various sources, however, one of the most frequently used materials is the McCoy cell line, as discussed, as an immortalised cell line, there is a continuous supply of living matter that does not hurt or affect the animal but provides material suitable for growing tissue culture. However, while the cells that form the basic structure do not cause any direct harm, the FBS required for nourishing the growing cells requires the death of unborn calves. This is ethically problematic, especially when these technologies are being used in the new industries aimed at growing cruelty-free meat.

Laboratory grown meat, or 'clean meat', is a new technology that is attempting to answer the ethical and environmental issues caused by farming animals for meat (Penn, 2018). Using stem cells from animals to engineer meat in vitro not only eliminates the need to kill numerous animals each year but would also significantly reduce the environmental damage caused by farming animals (Penn, 2018). However, immortalised cell lines are not used in this practice, but stem cells are directly harvested from animals and, therefore, "fresh samples of stem cells would be periodically removed from live cows and proliferated, since stem cells can become genetically unstable after many divisions" (Cassiday, 2018, para.18). While this does reduce harm, many of these companies growing and marketing such meats fail to acknowledge the need for FBS, for which there is currently no alternative (Reynolds, 2018). The need for this solution or another growth solution that is sourced from animals not only eliminates the benefits of clean meat, but the larger the scale of in vitro meat that is produced, the more FBS is required, rendering it more ethically problematic than the traditional slaughter method of

meat, as to grow one piece of clean meat numerous calves would be killed; Catts and Zurr, suggest that "growing around 10 grams of tissue will require serum from a whole calf (500 ml.), which is killed solely for the purpose of producing the serum" (2008, p.133).

This hypocrisy, or lack of transparency, is one of the key issues raised in the TC&A's *Victimless Leather*. While, on the surface, the name of the work suggests that by attempting to grow animal products, in this case a leather jacket in vitro, we can avoid harm to animals while still enjoying the byproducts of animal farming. However, in reality, there is always a cost and a victim in the production and consumption of animal products, as the artists reveal that to grow the artificial leather jacket, FBS is used and currently cannot be avoided in tissue engineering practices. While the TC&A do reveal the use of FBS and include this duplicity as part of the work, not all artists are transparent about the uses of such animal-sourced materials, as discussed in Chapter Three. However,

> bioartists often create absurd art pieces: the supposedly cruelty-free manipulations of the living bits (since these are in commonly understood as mere fragments or microorganisms) may in fact conceal and push away the 'animal-big-like-us' victims; and this is indeed the case in any project that involves tissues engineering. Violence is merely being transposed onto less visible, or less relatable levels (Radomska, 2016, p.45).

This, again, highlights the power of bioart as both an exposé of current practices and as a reflexive insight into contemporary practices through the displacement of traditional expectations of science and art. The ethical concerns directed towards the artwork reflect the current practices that occur in bioengineering and are in the process of being developed for public consumption. This, therefore, suggests that ethics is not only problematic for bioart, but for technologies in general.

5.2.3 Bioprinting

Bioprinting is a new form of growing tissue culture that is a variant of 3D printing; a technology which has become a mass solution to many issues in the twenty-first century, such as the ability

to locally mass-produce personal protective equipment and medical devices during the COVID-19 pandemic (Choong, Tan, Patel, Choong, Chen, Low, Tan, Patel & Chua, 2020). In place of plastic inks used in 3D printing, however, bioprinting uses biological inks, known as bioinks. Bioinks use living cells "such as differentiated, human embryonic or induced pluripotent stem cells (iPSCs) to print 3D constructs composed of living organic materials" (Vermeulen et al, 2017, p. 618). Furthermore, printing "usually also includes biomaterial 'scaffolds' for growing these cells into tissues" (Gilbert, O'Connell, Mladenovska & Dodds, 2018, p.74). The processes of printing living matter are complex and time-consuming, as after the printing process is complete, the cells then require time to grow and reproduce, before finally fulfilling the shape required.

The rapid growth in the applications of bioprinting follows a number of potential medical uses that could solve many contemporary dilemmas, particularly around organ transplantation. Organ transplantation developed during the twentieth century, transplanting healthy organs from deceased donors into the bodies of individuals who required new organs for a number of reasons. As the reliability of transplantation has increased in time, the greater the reliance on the process has become to resolve the medical needs of an expanding global population; however, organ transplantation has become "a victim of its own technological success; as a greater range of organs can be transplanted, more organs will be needed. And for organs that are not paired and cannot come from living donors, organs rest on an ethically double-edged sword; in order to save life another person has died" (Vermeulen et al., 2017, p.620-621). Therefore, the ability to bio-print organs, ones which can be tailor-made to fit the needs of individuals, made from their own cells to avoid rejection or the need to wait upon the death of another individual, shows promise for fulfilling more needs without relying on the death of others.

While bioart has attracted criticism for the potentially ambiguous ethical stance of using living materials for art media, the technologies themselves have also created dialogue regarding the new ethical dilemmas that they too can produce. Bioprinting both resolves a number of existing ethical problems while simultaneously creating new ones, as while

> bioprinting can avoid ethical dilemmas associated with xenotransplantation and clinical organ transplantation, it is not without its own challenges, practical, ethical and regulatory, which we will need to address. These relate to managing public expectations, and the ethics of biomedicine's continuing reliance on costly technoscientific solutions (Vermeulen et al., 2017, p.619).

The central ethical concerns raised in response to bioprinting, however, appear to refer to human-centric needs, demands and accessibility rather than the implicit ethical problem of creating and cultivating living materials as a commodity. Some of the ethical concerns cited include the cost of bioprinting only benefitting wealthy occupants of wealthy countries, the health risks associated with transplanting grown parts into bodies and the issue of legal ownership of transplanted parts, whether ownership sits with the producer or the recipient, as well as patenting issues as bioprinting could be "categorised as machines used for a medical purpose, and thus a patentable entity, or non-patentable medical techniques involving direct printing onto or into the body, and thus not possible to be patented through the legal 'medical treatment exemption'" (Vermeulen et al., 2017, p.621-622). These issues are problematic in the lack of clarity over who would be able to supply these organs and to whom and at what cost. This highlights one of the most problematic ethical issues in contemporary biomedicine, that is the accessibility to treatments and medicines as a result of the commercialisation and profitisation of these technologies; pharmaceutical companies in particular are criticised for putting profit before health (Deangelis, 2016), which is likely to infiltrate new biotechnologies in a similar fashion.

These ethical considerations only focus on bioprinting as a medical solution to health issues and the ethical concerns raised in the current literature often focuses on ethics as risk to

humans. These ethical concerns do not take into consideration the life used in these technologies, the issues of consent around donating cells for bioprinting, or the nature of the new products being human 'subjects' in their own right akin to the way in which bioart sculptures are both subjects and objects. The critiques of bioart using the same techniques, however, focuses on materiality and the tools and materials artists use for art. Therefore, the narrow ethical scope of biomedicine's gaze is highlighted by bioart practices and thus challenges the medical practice in a wider scheme of materials and processes rather than capitalistic economics, human expectations and potential effects on the human body.

A further ethical issue cited as being problematic for bioprinting is that "there is a concern that bioprinting could lead to unregulated DIY home use or bioterrorism. Almost anyone could bioprint tissue in their garage with just a proper bioprinter, biogell, cells, a computer, the internet, and freely available data" (Gilbert et al., 2018, p.75). This suggests an inherent distrust in the use of scientific apparatus outside of conventional laboratory settings, and a belief that any outside use would have a detrimental effect. While bioterrorism is an ever-present threat in the volatile political climate of contemporary society, the assumption that unregulated usage of bioprinting could result in bioterrorism is problematic for artists who seek to engage in these new technologies in their practice. Firstly, this concern could lead to legislation preventing individualised practices of bioprinting which could limit access for artists to these technologies; while most artists actively collaborate with scientists in these endeavours, requiring their skills and knowledge to grow such sculptures, this could still prove limiting for artists and non-scientific professionals. Furthermore, limiting access to these technologies has a wider cultural impact in that it normalises and perpetuates an authoritarian approach to knowledge and technologies. This subsequently limits access through legislated means such as artists collaborating with scientists within these settings and assists in constructing boundaries between fields of creativity.

The wider ethical implications noted around the practice of bioprinting, therefore, focuses heavily on the social impact of the technology and the ways in which implementation of the technology on a wide scale will impact current practices in terms of accessibility to its products and dependency on them or the expectation that it would be more effective than it might actually be. These ethical concerns have little direct comparison for works of bioart as they are not consumer products, nor are they intended to be. Therefore, it is clear that through bioart being an exploration and critique of these technologies, new ethical concerns are revealed that are directly applicable to the commercial medical applications of bioprinting within scientific settings. With issues of using living materials, sourcing living materials, and treating them as living beings, bioart can assist in wider, new discussions around appropriate ethical considerations of bioprinting and other biotechnologies.

5.3 A Bioethics for Bioart?

Bioethics, as applied ethical frameworks for research and experimentation, exist within formal institutions and based on committee agreement, decide whether or not practices should take place. Bioartists who undertake their practice within scientific institutions, therefore, must follow the same procedures as scientists (Vaage, 2016). However, due to the marginalised and pioneering nature of bioart, it is unlikely that these ethical committees have extensive experience on deciding the ethical status of art projects. As discussed in Chapter Three regarding SymbioticA, “in the first major project conducted by the artists and their collaborators at the UWA [University of Western Australia] in the early 2000s, the ethical committee members were at a loss as to how to relate to a project with ends they were not set up to deal with, and deemed themselves unqualified to assess it” (Vaage, 2016, p.94). While the UWA did consequently create a new committee which included art experts, the fundamental process of applying existing bioethics to the production of art is problematic as it

does not fit into the existing literature or values. Furthermore, outside of research institutions, artists engaging with life as media are not necessarily bound by any ethical guidelines. Zurr and Catts have stated that

> recently the need to develop an ethical framework for artists, who work with biological research methods and materials, has been suggested. Nicola Triscott, Director of 'Arts Catalyst,' proposed: "a possible structure for an independent arts ethics advisory panel, since a number of artists have said that they would benefit from expert ethics advice on their proposed projects, both to reassure funders, venues, collaborators and media, and to advise the project itself". We would support this development (2014, p.209).

In this way, a framework specifically created for artists could expand opportunities for engagement in accessing and using living materials, but also assist in bioart being recognised as a legitimate and intentional practice. The support of bioartists in seeking such a framework further demonstrates their considered motivations in seeking to manipulate life and not as an act of frivolity or without care.

The ethical concerns raised over bioart frequently pertain to the uses of biotechnologies and living materials for artistic purposes, with additional issues raised around responsibility of care. However, there are further pressing issues which present different challenges from the application of bioethics to science, which includes consent for responsible viewership and considerations for disposal of living artworks. In understanding the ethical positioning of bioart, the criticisms are often directed towards the use of biotechnologies for artistic purposes rather than the use of biotechnologies in general. This provokes the question,

> should life science artists be held to higher, the same, lesser, or different standards entirely than scientists? Artists who undertake body art are generally held to higher standards than scientists. Artistic exploitation of the body is frowned upon, while commercial and experimental exploitation by scientists—even without the person's consent— is allowed (Andrews, 2007 p.139).

From the concerns raised over bioart practices, it not only appears that bioart is inherently subject to greater criticism than the equitable processes that occur within scientific research, but to different criticisms. The overriding problem with bioart is that it is art, and consequently, is expected to fulfil a different role to that of science. By using the materials and processes of

scientists, bioart reveals the cultural privileging of science, where "the fact that medical institutions are allowed to do things with body parts that other individuals and institutions are not. This unquestioned privileging of the medical sector may be as outrageous to many people" (Andrews, 2007, p.141). It is this disparity between accepted uses of living materials that calls into question how ethics should be applied and whether they should be equitable or not. While the ethical status of bioart is not the central concern of this thesis, the effect of ethical perception and value on the practice as a public engagement with science reveals further cultural anxieties that contribute to the impact of perceiving and encountering living bioart; this particularly concerns the expectations of art and artists.

Beyond the unbalanced ethical considerations of categorisation, bioart also reveals the different cultural expectations of art and science, which consequently highlights the cultural values placed on both fields. The difference in values is demonstrated in the criticisms of utilising life as media for art, but not directed at the technologies themselves. Furthermore, the implication that usage of bioengineering technologies outside of the biomedical sphere is linked to subversive activities such as bioterrorism is problematic, as evident in the arrest of Steve Kurtz of the Critical Art Ensemble in 2004 for possessing biological materials. This attitude of suspicion presents limitations and restrictions for artists to be able to access materials and technologies, thus gate-keeping technologies and the subsequent cultural critique that art can offer.

While uncovering the hierarchies present in culture, bioart highlights the importance of the artists in contributing important opportunities for social engagement with new ideas and technologies. In existing as a controversial manifestation of embedded biotechnologies, bioart invites criticism and engagement with processes that are conventionally secluded to the laboratory. The consequential impact of this engagement has the potential to influence the overall considerations around the ethical position of these technologies as "if people are

confronted in an embodied way with something they would not have thought of themselves, it may spur them on in developing their personal ethical framework" (Vaage, 2016, p.102). Yet, despite these advantages and potential benefits of bioart, the issue of "whether the use of biotechnological animal products in art is morally defensible" (Vaage, 2016, p.99) continues to haunt bioart, again highlighting the continuing cultural and material separation of art and science. While, Radomska suggests that "the death of an animal killed in corrida (i.e. for reasons deemed 'aesthetic') and of the one butchered for meat – regardless of the symbolic value ascribed in each case – boils down to the same thing: in both cases, the fate of the animal is determined beforehand" (2017, p.387); it appears, therefore, that the symbolic or cultural expectations of artists as separate from scientists compels greater justifications despite the same fate of the living material used.

Fundamentally, the double standard that appears in ethical debates of bioart forces the artist to justify their engagement with living materials in ways that individual scientists are rarely asked to. The problem with this is not the accountability of the artists, but the lack of accountability in the position of the scientist. This manifests in the privileges that exist in both the practices of science but also in "the approach of treating artists more harshly than scientists or doctors [which] is suspect. For many people, art contributes more to their daily life than does science" (Andrews, 2007, p.141). The idea of art contributing a greater impact to the individual's daily life than science reveals the disparity in public perceptions and expectations of art and science, as art often inhabits physical space within societies, whereas science often infiltrates culture more subliminally. It is because of this that the explicit engagement with biotechnologies in art practices appears transgressive and prompts reflections on the expectations and allowances of artists and scientists.

While ensuring that practices are ethical and regulated, the application of existing bioethical rhetoric to bioart is in some ways problematic as the practices of scientific research

and bioart have fundamentally different purposes and motivations. Where biotechnologies seek to change the ways in which medical and environmental processes can be improved, bioartists engage in a more fundamental exploration of ideas of life and living matter. Therefore, "in remoulding life, bioartists cannot, therefore, be judged by the established normative criteria which correspond to entities and the world presumed to be a certain way if they themselves are involved—at the core level, we might say—in transforming the very fundamentals of that world" (Zylinksa, 2014, p.195). However, by pointing out the stark differences in practice and the more concrete aspirations of scientists, this argument could give preference to the privileging of science over art.

5.3.1 New Ethical Considerations

Beyond the ethical decisions underlying the construction of bioart and the collaborative practices of artists and scientists within research institutions, bioart presents unprecedented problems that are not encountered through the traditional methods of applied bioethics in science. This is through the process of the art display. Display, allowing for engagement and encounter with the art object, elicits new ethical issues that are not only unprecedented but also more difficult to regulate given that display often occurs in separate settings from research laboratories where applied ethics usually operate. While applied institutional bioethics regulates the practices of producing bioart within research institutions, the ethical regulations of display and viewership remain ambiguous and variable dependent on country and institution.

The key ethical considerations regarding the display of living materials includes consent for viewership, safety to the public in the presence of materials that could present a threat, and issues around responsibility for the death and disposal of bioart. For the living artworks, the ethical considerations concern the care of the artwork while it is alive and the ethical care of its death and disposal. These highlight the most central ethical concerns of

bioart; that living matter is most often created to be displayed and to ultimately be killed at the end of display. The care of bioart works during the process of display is similar to the requirements within a laboratory setting, which has been highlighted by the TC&A in the development of their 'feeding ritual' performance in the display of *The Semi-Living Worry Dolls*. While the artists also featured a killing ritual, the death of bioart works is a key issue that is not often addressed. How the tissue works are killed and whether this death should be a public event is one of many concerns that require ethical consideration.

As bioethics exist to minimise harm and risk, the ethical considerations in viewership and display are twofold, needing to consider both the living artworks and the viewer as they simultaneously exist as subjects. For the viewer, the ethical considerations include consent to viewing living works, assurance of respectful and responsible viewing whereby there are guarantees that the viewer will not damage, hurt or destroy the vulnerable living artwork, and finally, the safety of the viewer is important in ensuring they are not harmed by living materials used. Consequently, new bioethical considerations for bioart might include what materials are permissible for display and those which are not. Furthermore, it might consider viewing conditions, contemplating the ways in which these hazardous materials may be viewed safely and if consent is given by the viewer to view such materials in a safe environment.

A final consideration addresses one of the most fundamental problems in bioart; a definition of bioart. While the genre of bioart is still undergoing the process of definition as an art practice, in understanding the difference between empirical scientific research and bioart is an important consideration for ethics. Many bioart practices use processes that have originated within science, such as the growth of a living artificially grown ear, found in the Vacanti Mouse grown in the name of tissue engineering research, and *Sugababe* grown by artist Diemut Strebe. In understanding the ethical positions of art and science and whether they should be held to the same account, it is first important to consider whether and how these practices are different.

The point where a work becomes bioart rather than a biotechnological experiment is, therefore, a significant issue, and one which has the potential to impact the approval of ethical committees, and of the public through perceptions of art and science.

5.3.2 Is Bioart an Ethical Practice?

As evident, the ethical position of bioart remains ambiguous and contentious. While works continue to emerge, be passed and approved by research institutions in most cases, the cultural reception of these works remains unclear. Bioart works continue to incite debate around ethics and continue to attract both interest and revulsion through their living, physical, visceral otherness; but not only do they incite debates, but they also continue to begin debates such as the Bioart Society's 2021 project ART4MED, which aims to address

> questions such as: What kind of artistic approaches can deal with such complex issues as health and biomedicine, and what are successful strategies for production and presentation? How can we share good practices and methodologies for cross-disciplinary collaboration? How can we consolidate and broaden the networks of contemporary cultural operators dealing with health and biomedical research? How can we disseminate this content beyond our immediate peer networks? How can art improve awareness of the wider public on issues of health and care? (Salmela, 2021, para.2).

The continuous drive by bioartists and bioart networks to open and address the problems that bioengineering poses to our behaviours and concepts and values of life is clear, and yet, the practice often remains contentious and marginalised. Despite some changes having been made towards a more inclusive response to bioart practices, such as the development of a bioart approval committee at UWA, the fundamental problem of whether bioart is an ethical practice or not remains unanswered and potentially even unanswerable at this point in time.

Instead of the ethical position of bioart, we can look to the potential value and purpose of using living materials in art practices to understand their role as material products of the twenty-first century. Perhaps one of the most significant aspects of bioart is not only that artists have demonstrated a reimagining of what it means to be living materiality, but that these new

forms of life are brought into the public realm enabling direct, embodied, subjective encounters. The ability to personally encounter bioart suggests that "if people are confronted in an embodied way with something they would not have thought of themselves, it may spur them on in developing their personal ethical framework" (Vaage, 2016, p.102). Through the subjective and tangible experience of encountering and sharing a physical space and conscious relationship with bioart, the viewer is confronted by something that they cannot avoid. This, therefore, positions bioart as an important method of social engagement with scientific ideas and the ethical problems they evoke. While scientific communication is also a significant method in achieving this, "bioart is uniquely placed to undertake this kind of questioning knowingly and purposefully, since it lacks the pragmatic imperative of many science and technology projects, whereby innovation and economic growth frequently overshadow any non-goal oriented agendas" (Zylinska, 2014, p.194). The power of art to reveal and examine the self and contemporary culture is at the heart of the significance of bioart, as "beyond its aesthetic value, the work can help society to: confront the social implications of its biological choices; understand the limitations of the much hyped biotechnologies; develop policies for dealing with biotechnologies; and confront larger issues of the role of science and the role of art in our society" (Andrews, 2007 p.126). Furthermore,

> the works created by life-science artists can emphasise the limits of these technologies and the likely social impacts. But they can also serve as a guide to public policy. By pointing out the gaps in regulation, the risks of these technologies, the inequities in access, and the way in which application of certain technologies may harm important social and cultural values, artists can encourage the social discussion that is necessary to adopt social public policies for biotechnologies (Andrews, 2007, p.142).

These issues reveal an imbalance present in contemporary culture where value systems are affected by specific expectations which has led to a segregation of materials and processes expected of art and science, despite recent efforts to bridge and connect between the two fields. However, it is also apparent that bioart can offer a social commentary through public

engagement with actualised products of bioengineering through the construction of living tissue sculptures, thus providing a tangible link to ongoing debates and reassessment of our ethical standpoint. Consequently, bioart can, therefore, be perceived as both a window and a mirror of contemporary culture. Through instinctive psychological responses evoked by materiality, bioart provokes new ethical considerations of living materials and consequently reveals the status quo in current societies regarding the value of the 'other'. As a window, bioart offers a critical inquiry into the kinds of biotechnologies that are emerging and are on the cusp of radically changing biomedicine and the resulting ways in which our bodies will change. This, in turn, reveals the costs of these new technologies in terms of life and ethical consideration for use. Furthermore, as a mirror, bioart functions self-reflexively while also reflecting that the fundamental issues that are being debated around bioart are not situated in the art or the technologies, but in current human culture and how these new technologies are valued, used and negotiated by the cultures who have constructed them. Bioart is a complex reconfiguration of the contemporary technologies, tools, ideologies and bioethics that human culture has produced. Bioart is a product of human production. The critical concerns over bioart are not of the art but are a reflection of the society in which it proliferates. Therefore, as the tools of bioart, biotechnologies are also a reflection of current social positioning, along with the ethical concerns they produce, or fail to produce.

The increasing presence and reliance on biotechnologies which utilise, manipulate, alter and produce life in the twenty-first century creates new challenges in incorporating them into society. The ethical problems apparent in biotechnologies and the living products that are created through these processes demonstrate a need to fairly and ethically negotiate these new life forms as they become more embedded within everyday life. It is clear that some of these issues have been considered, but equally apparent that there are many more that need to be addressed. However, through the use of these technologies in new, visible, public and creative

contexts, we can begin to uncover what these further issues are and, in turn, create wider networks of dialogue and exchange which can assist with understanding the future as the concept and the physical body of the human, animals and the planet change under the tools of biotechnologies; this includes the ethical implications and restrictions of these practices and how they affect our relationships to the rest of the planet.

3.3 Bioart and Being Beyond Human

The prospect of bioart highlighting prominent issues of ethics, morality and the divisions between art and science, intellectually if not practically, highlights the key concerns that inform posthumanist thought. The posthumanist perspective is prevalent in both the discourses around creating bioart and also the commentary about its existence and display. As a broad category of philosophy that has many branches, it is clear to see that bioart engages with more than one perspective of posthumanist thought as discussed in Chapter Two; specifically transhumanist posthumanism, which envisages the human body moving beyond its current form and abilities, as well as critical posthumanism which seeks to decentralise the humanist world view which places humanity at the centre of the universe.

Bioart and the associated biotechnologies that artists use in the processes of creating these works demonstrate the impending changes to the composition and concept of the natural human body. As the development of synthetic tissues become more plausible in commercialised medical practices, the possibilities for the body, from medical needs to bodily enhancement, also change. In this way, our bodies are increasingly becoming posthuman. The reconfiguration of the human, where the body is no longer natural and relies on technologies and the materials of other species, therefore, implores that we become posthuman in our perspective as our bodies become posthuman physically. This suggests that as our bodies

change, our values and relationships with living matter must also change as the human can no longer be situated at the top of traditional humanist hierarchies if it is no longer fully human.

This posthuman perspective, however, does not remove the human from the framework, but instead seeks for a balance in recognising the needs, value and agency of the other. The other, until recently, has been the rest of the life on the planet as it exists naturally, as well as marginalised humans. However, now in the twenty-first century, the other has been born inside of a laboratory, often from our own genetic materials, and simultaneously inhabits the position of the self and the other. The spectre of the other haunts the self through this duality, together with the dualities inherent in the transdisciplinary practice of bioart. Bioart demonstrates that innate reactions to otherness, especially otherness which has not yet been encountered, is that of rejection and abjection. Although grounded in instinctual behaviours, the rejection of living bioart and living bioengineering, evidenced through the uncanny valley, the abject and the yuck factor, demonstrates the newness of these technologies and the inevitable conflicts that will arise as they become more embedded in contemporary life. It suggests that we must embrace life as an expansive concept, not limited to the traditional narrow concepts of the human, while simultaneously continuing to exercise caution over the uses and processes of biotechnologies.

5.3.4 Bioart and the Future

Bioart is a product of the twenty-first century's rapid development of biotechnologies. Like the emergence of new media art, in which bioart can be situated, these works not only critique and draw attention to the materials of contemporary science and technology, but use them as their media because they are the materials that create our everyday lives. New media refocuses our attention on the media that constructs our contemporary lives, such as the internet, computers and virtual reality, from being passive, subconscious experiences into a direct engagement with them. Biotechnologies are a key component of contemporary life and are challenging and

changing the ways in which we live. The new biotechnologies emerging from contemporary research suggests further, more invasive changes which are simultaneously more impactful yet often more discrete. The borders between the artificial and the natural are changing and, therefore, the definition between the self and the other is changing as a consequence. The use of these technologies as new media in contemporary art present a visceral, physical presence of these changing frameworks and consequently challenge perceptions and expectations of art as well as perceptions of life.

The criticism and concerns raised by the use of living materials as art media are important in examining the cultural expectations of art, the ethical practices of bioengineering and in understanding contemporary cultures that they have developed within. The immediate controversy provoked by using living media has suggested that bioart is a transgressive practice, disrupting the norms of art production and consumption through the disruption of expectations of science. The resulting field of bioart reveals, therefore, a plethora of questions demanding further investigation within contemporary practices. Furthermore, prompted by evolutionary psychological processes related to new and unencountered stimuli, the unease around using living tissue as art is a useful and important mechanism for wider reflection on greater biotechnological practices. This is possible through the visible and public facets of art, rather than being concealed inside laboratories only those with certain privilege can access, such as the National Institute of Agronomic Research in France, where Eduardo Kac's bioluminescent rabbit was born, genetically altered and died (Philipkoski, 2002). Bioart brings the processes and materials of bioengineering into the public realm.

Our responses to bioart reveal an overall moral compass for our usage of biotechnologies and of our treatment towards life, especially when used for human gain. By exposing and highlighting this abjection through the uncanny valley, bioartists ask us to consider these predicaments and consider the values we place on life, and for awareness of

processes. These processes which use life as a base material have a 'cost' beyond a financial sense and in this way must be acknowledged. This is further accentuated when the materials used are, in some cases, human genetic material. The uncanniness of bioart can therefore be said to be intentional in evoking the instinctual reaction to the exposed otherness of living materiality detached from the body. Through this forced encounter with an uncomfortable truth, bioart reveals the ambiguities and complexities of the changing concepts of life in the twenty-first century. Through examining ethical concerns of bioengineering, it exposes the narrow frameworks of bioethics where bioart does not fit neatly. Furthermore, the ethical problems suggested demonstrates a clear mistrust of technologies and their associated materials outside of the hands of professional scientists. This mistrust demonstrates a hierarchical value system of creative and exploratory practices whereby scientific practices are permitted broader ethical scope than artists, which then becomes evident in the access to materials.

The concerns highlighted by bioart suggests a move towards a posthumanist perspective when using life as material. Whether being used for art or science, life should be valued as such without the hierarchical needs and desires of human supremacy negotiating which uses are ethical or not. In the context of the Anthropocene, bioart also provokes an assessment of the position of the human in the context of bioengineering and human-induced climate change. This is because bioart is not a monstrous form of contemporary art, but an artform that is contentious because it reflects certain values, ethics and socio-cultural expectations that emerge alongside the development of bioengineering and its potential applications. Fear, disgust, repulsion and ambiguous ethical positioning are a reflection of the contexts in which bioart is positioned and reveals not only concerns around bioart, but of bioengineering and the place of the human in a context where living matter becomes materiality.

Conclusion

How we understand, interpret and experience living materials in an art context has been a central theme of this research. Bioart, as a transdisciplinary genre, in many ways has resisted definition and categorisation, although it might appear to occupy a specialist and ambiguous presence in contemporary art. This research has framed bioart in a context of aesthetics, ethics and materiality and has focused on how these aspects can affect viewership and the art encounter. Furthermore, this research has explored why artists would choose to use such materials and processes, and considers how such artworks as objects are intended to be experienced phenomenologically through subjective, embodied experiences. By contextualising bioart in the trajectory of new media art, this thesis has considered both the socio-cultural and political contexts of living tissue being appropriated by artists as materials and how they can be understood from the perspective of the viewer.

This research has used a novel mixed methodology that has included descriptive, theoretical and aesthetic elements of bioart. This pluralistic approach has explored a range of bioart work, including their facture, the motivations of artists and the ways in which different forms of biotechnological tools and processes have been transposed into art practices. Incorporating theoretical perspectives from posthumanism, new materialism and ethics, this research has also examined the complex interconnected framework of bioart and the ways in which the practice appears to explore, critique and question contemporary uses and processes of biotechnologies. Furthermore, combining these descriptive and theoretical perspectives with considerations of aesthetic implications including the abject and the uncanny valley, have allowed for new understandings of the relationships between art, biotechnologies and contemporary socio-cultural, ethical and environmental issues. This approach has allowed for these complex and innovative artworks to be viewed from multiple perspectives, in turn,

offering a comprehensive and detailed analysis of contemporary bioengineered artworks and the potential impact of such works during subjective processes of viewing.

The aims of this research included understanding uses of the term bioart, understanding the effects of living materiality in the art encounter, and how understandings of these living materials are challenged through the contextual shift from scientific to artistic practices. Together with understanding why bioartists have chosen to engage in living materials, and how artists might access and display them, the aims of this thesis have attempted to contextualise and understand the complexities of what remains a new and marginalised art form. Through this research, therefore, there have been four key findings deriving from these aims: that bioart is an ambiguous term, but the use of living materials is an intentional act by bioartists, that there are a number of inequalities present in the usage of living materials and biotechnologies between artists and scientists, that responses to bioart might be understood as a new, material-based extension of the uncanny valley, and that bioart practices are both a product and a reflection of the Anthropocene.

Key Findings

'Bioart' is ambiguous, but the use of living materials is intentional

A key issue encountered throughout this research concerned the definition of bioart; specifically, whether works described as bioart should include only material engagement with biotechnologies or if thematic critiques can also be considered bioart. The ambiguity of the name bioart is significant and is evident in its use throughout current literature, by scholars, critics, and artists, as well as in the labelling of exhibitions, events and collections by museums, institutions, and curators. The use of the term bioart does not always, therefore, reflect or refer to the practice of using and manipulating living biological materials as art media, and instead appears to refer to a number of different reference points, including materials, processes,

critical enquiry and new media for art. This ambiguity and the wide-ranging works that appear to be labelled as bioart, therefore, reflects a genre that is still in the process of emerging and forms increasingly complex relations with other disciplines and domains.

While the lack of a static definition allows for a greater wealth of practices to emerge without limitation, pursuing a greater degree of specificity when describing or labelling works considered as being bioart can lead to more individualised and in-depth discussions around the practice. This is important in avoiding an assumption that all works described as bioart use the same materials and processes or seek to engage in the same critical issues and concerns. Furthermore, this has an impact on viewers, including the differences in interpretation and understandings of different materials. This thesis suggests that while bioart does not require an exacting definition, more precision in discussions of the materials and processes of individual bioart works will offer more nuanced understandings for future research. This could have a significant impact on how institutional ethics committees might more effectively take into account material and situated specificities presented by individual works.

This research has also established that artists are choosing to engage with living biological materials intentionally and purposefully. In contrast to suggestions of artists using biotechnologies as a result of being naively manipulated into doing so by bioengineering companies, as noted by Frances Stracey (2009), it appears that artists are fully aware of what they aim to produce and for what purposes. This, therefore, consolidates the agency of bioartists in their intentionality towards producing works which are designed to evoke reflection, contemplation and critical discussions relating to bioengineering practices. Furthermore, this agency is apparent in the number of artists who have explicitly stated that their motivation behind engaging in biotechnologies is to assist with understanding, exploring and critiquing them and their associated materials. It appears that bioart is not a product of artists using certain materials just because they can, but as a result of a more complex

engagement with how technologies can affect our relationships with concepts of materiality and life.

Inequalities between practices

A significant outcome of this research is the deeper understanding of how expectations of art and artists are distinct and separate from those of scientists and technologies. While the separation of art and science has been previously described in a cultural context, the criticisms directed towards bioart reveal a material separation, in which expectations of what is considered as art materials have been challenged. Through practices of bioart, the boundaries between the arts and sciences have become complexly blurred as a result of the use of materials that are more commonly associated with scientific practices, technologies developed from science, and the thematic exploration of science for artistic purposes. This new practice of bioart, bringing the tools and materials of bioengineering out of their original context and into the art space, however, reveals that the historical separation of art and science is material as well as cultural and spatial. This material separation is evident in the responses towards bioart appearing to be a transgressive act, with questions arising as to whether the materials should be explicitly used for the purposes of art. The lack, however, of the same literature asking whether it is somehow more acceptable for scientists to use, manipulate, grow, and kill the same materials reveals inconsistencies in treatment and expectations.

The different standards, expectations and allowances for artists, when compared with scientists, is also evident in the legislative and institutionalised bioethical considerations; as seen in Chapter Three in the difficult process of establishing SymbioticA and recognition of the artists as conducting legitimate research. As such, this demonstrates a privileging of scientific research over that of art research, yet simultaneously highlights an absence of an open-minded perspective from scientific bodies. This is also evident in the limitations placed

on artists attempting to access biological materials and expertise in order to practice bioart, as demonstrated in Gina Czarnecki's difficulties in Chapter Three. Furthermore, when looking at licensing and the practical requirements for the display of bioart, as seen in Chapter Four, it would appear that science museums and institutions are more suited to hosting living materials and yet it is more difficult for art museums to fulfil such requirements.

A further significant finding is the acknowledgement that scientific information is purposefully presented in ways that make it the most acceptable for audiences. As discussed in Chapter Five, some technologies can evoke feelings of disgust, known as the yuck factor, however, when this feeling arises, literature tells us that the technologies have not changed, but that the language used to describe them, and how they are framed to make them more palatable, has. In contrast, however, it appears that artists intend to prompt this discomfort deliberately in order to provoke critical reflection and discussion. Yet, this is one of the criticisms aimed at bioart, that it causes controversy because the artists do not attempt to frame or justify these technologies, but to address them in an art context. These inconsistencies across the domains of art and science centre on a positivist framing for science and bioart being understood as transgressive, even though the same materials and technologies are used in each domain. These inconsistencies reflect profoundly different cultural expectations of art and artists to that of scientists.

Bioart proves to be a powerful platform for contributing to cultural dialogues regarding the uses of biotechnologies and how the ethical and moral accountabilities for using living matter are evaluated. Through the posthumanist motivation to move beyond the limited definition of human and its hierarchical separation from other forms of life and the environment, bioart works suggest that to condemn the products of bioart is misplaced. Bioart practices expose the subjectivity and contextual basis and bias of our ethical judgments and the extent to which we are able or willing to overlook ethical dilemmas if they appear to offer

tangible benefit or gain. Yet, the benefit and gain of having art act as critic and conscience of society is often not acknowledged.

Materiality as a new uncanny valley

The criticisms and responses evident towards bioart practices, as discussed in this thesis, appear to centre around the use of materials that are more frequently found in scientific research for artistic purposes. The transposition of materials from one context to another unexpected context appears to have produced a discomfort which is noted in the ethical criticisms and responses to bioart. This is seen in Ionat Zurr's assessment of the response to *Victimless Leather*, "one of the most common and somewhat surprising comments we heard was that people were disturbed by our ethics of using living cells to grow living fabric, while the use of leather obtained from animals seems to be accepted without any concern for the well-being of the animals from which the skin has been removed" (Wired, 2004, para.9). It is, therefore, the visceral and vital materiality of bioart which elicits these concerns, which bioartists appear to focus on to highlight and prompt a reassessment of our relationship with life and life's materials.

These responses are, therefore, the result of using the living materials of science for a new purpose in a different context. These known living materials consequently appear to cause some discomfort resulting from the context of their use. This thesis has found that this unexpected contextual encounter with living materials may be indicative of a new uncanny valley. Where Masahiro Mori's initial detailing of the uncanny valley describes a decline in affinity through the aesthetic proximity of robots to humans, bioart demonstrates a material proximity to humans, which appears to evoke a similar phenomenon. This is supported by Kerbe and Schmidt's 2015 study, which reveals responses are contingent on the type of materials used in bioart, where human materials and hybrid materials cause the most concern

through to microorganisms causing less concern. This is also reflected in the responses to animal testing, as discussed in Chapter Four, which demonstrates a similar correlation of concern that is based on the proximity of the animal to the human.

In the uncanny valley phenomenon, the closer an object appears to being human, yet is not actually human, causes a negative response. Through the replacement of aesthetic likeness with material likeness, it appears that negative responses to bioart could also be explained in this way. Where human-like robots cause discomfort by visually appearing human but are not human, bioart sculptures are human-like in their living materiality. In these materials of bioart, the viewer is, therefore, confronted with the malleability of life in the twenty-first century, where life and living materials are also objects, commodities, and disposable materials for experimentation. These current biotechnologies have transformed ideas of life where "cells and tissues are no longer exclusively bound to bodies but have become plastic materials to be manipulated, shaped and sustained through technological means" (Radomska, 2017, p. 383). However, the underlying processes that appear to produce feelings of the uncanny valley are currently thought to be situated in categorisation difficulties, wherein the uncanny stimuli appears to occupy two known categories but neither distinctively, therefore being unable to fit into either. In this way, the stimuli become othered through being unknown. In bioart, traditional categories of art/science, natural/artificial, living/non-living and subject/object are blurred, suggesting that these works offer multiple levels of combining familiarity and unfamiliarity.

The effect of this uncanny valley response is a rejection of otherness that may present a threat to the self. As with concerns regarding robots as noted by Mori, bioart and living engineered tissues may present a threat to the self in that it threatens the natural order of humans. Human life is no longer dependent on nature as it can be altered and changed through purposeful modification. It is through the living tissue materials, that in some works are human,

and in others often of mammalian origin, that we at once recognise the self, yet through the rendering of it in the context of an art object, it is othered. This research suggests that it is this difficulty in categorising bioart as something known and experienced that contributes to the criticism the practice receives, and that reflexively this lack of recognition is what allows for critical examination of biotechnologies.

Bioart is a material product and reflection of the debates about the Anthropocene

In the critical discussions surrounding the ethical, moral, and material problems that bioart presents, it appears that these issues are not situated within bioart works, but in the wider socio-cultural context in which they are produced. Bioart is, therefore, not inherently uncanny, abject or unethical, but becomes so through the transgressive act of displacing living materials from an expected context to the unexpected. This thesis suggests that bioart is an intentional material manifestation of the many problems suggested by the Anthropocene, such as committing to the rights of, and ethical conduct towards, other life forms and moving beyond limited concepts of the human, and re-evaluating the current hierarchies present in humanist worldviews. In this way, bioart appears to follow the perspectives offered by posthumanist theorists and forces the viewer to engage with alternative compositions of life and of the human. Furthermore, through the use of living materials bioart works, therefore, actualise configurations of life, and the human, beyond limited definitions and understandings of what the human is or can be.

Bioart is a product and a reflection of current knowledge and contemporary socio-ethical values through the use of new technologies that are currently being researched, produced and implemented in other aspects of contemporary life, such as medicine, and in this way bioart offers a window into contemporary practices. However, this research has also found that bioart is a mirror, offering critical reflection away from the work itself and onto the cultures

in which these technologies are being produced, allowing for contemplation on what is being produced, how it is being produced and for what or whose ends.

This research has explored bioart and bioartists' intentions, as well as critical responses, from an art history perspective; a perspective which is somewhat limited amongst the current literature. While the broad span of transdisciplinary engagement with bioart reflects its wide-ranging reach and impact, it is significant to understand that such works are intended to be viewed and encountered as art and, therefore, are part of a historical trajectory of art which utilises new media as its materiality and art which deals with ideas of transformation, categorical confusion and monstrosity, in addition to art with concerns of disgust, the abject and posthumanism. Through consideration of form, construction, display, the embodied phenomenologies of the encounter and the responses to bioart, this research offers a new perspective into understanding the impact of bioart as a socially engaged art form.

Finally, this thesis contributes to understanding why bioart might elicit criticism, unease, and ethical concerns. There are a number of discussions present in the current literature which address the ethical issues that arise from using living materials in art practices, however, they do not provide in-depth understandings of why this practice produces these concerns beyond the fact that it is art. This thesis offers an understanding of the separate cultural expectations of artists and scientists, and how this is often an ingrained expectation. Furthermore, this research suggests that it is then through subversion of these expectations that discomfort arises, and through a conflation of expectations and the subsequent difficulties in categorising practices and objects that these concerns may come to the fore. Consequently, bioart presents a subversion of expectations which, in turn, renders categorising bioart as either art/science, an object/subject, natural/artificial and living/non-living difficult. It is this difficulty that, therefore, appears to elicit discomfort and ethical concerns.

Final Remarks

The Anthropocene, a period of time that many have suggested is a new epoch defined by human presence and actions, is a time of exponential and fundamental change. We are witnessing the effects of our own actions, both positive and negative, on our environment, other life forms and ourselves, physically and culturally, and in real-time. It is also a time where existential anxieties seem to have multiplied, evident in global movements demanding social equality steps to avoid the current climate emergency and the spread of pandemics. Bioart is a part of this picture, offering a reflective and critical lens on our own practices. Under the microscope and removed from the context of medical, financial, or personal benefit, artists have drawn attention to the accepted and routine practices of this time.

Bioart has attracted criticism for transgressing the expected norms of art and art materials, yet still remains an ambiguous artform that is marginalised and has little presence outside of specialised institutions and research outlets; this, in part, is as a result of the limitations and difficulty in accessing the materials for artists. However, the presence of this genre, with artists in different countries, cultures and contexts beginning to utilise the same technologies for similar critical purposes in the same time period, suggests that bioart is both part of, and speaking to, a wider scepticism of so-called human progress.

This research documents and examines the contemporary practice of using living materials and bioengineering processes in art practices. It is apparent that although these practices are a relatively recent occurrence, there are a growing number of works, each utilising diverse and nuanced materials and tools in order to convey, provoke and ask compelling questions that are important in the twenty-first century. The nature of our relationships with biotechnologies, with living materials, and what basis our bioethical decisions are made on, are just some of these questions. There will, however, continue to be new questions arising as newer technologies are developed, implemented, and understood. Bioart offers a platform for

discussing these questions, and for forcing and facilitating an encounter with ideas and technologies that are often hidden, packaged palatably or that drift without notice into a new normal. Bioart is, therefore, a confrontation with the values and processes of the Anthropocene, bringing the viewer face-to-face with the impressive yet seemingly limitless power of our current technological capabilities.

List of Figures

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