Brave BioArt 2: shedding the bio, amassing the nano, and cultivating posthuman life

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Abstract
This article will address an overview of BioArt, biomedia and its practitioners, developed through a series of semi-structured, qualitative interviews and open-ended discussions with more than fifteen experts in the field. BioArt is approached from the perspective of scientific exploration, visual design in interactivity and installation, and social commentary and political activism. Of consequence is the fact that BioArt is relatively new, its nomenclature is without a codified definition, and bioartists have varied views on the parameters of its biomedia. Regardless, BioArt has been escalating as a fecund medium with the potential for spawning visionary and critical practices and theories. In lieu of a slippery slope in which artists rely on freedom of expression in substantiating artworks, the burden of proof is placed on artists to be creative and objective in understanding what it means to tamper with biology and alter life forms. Issues of ethics have already affected artists’ practices and venues for exhibition, and as BioArt continues to develop, research practice has become a necessary field of study. In addition, as biomedia evolve and emergent technologies partner with current biotechnologies, there is concern if the concept of BioArt is ambiguous in light of the fact that biotechnology is dovetailing nanotechnology, artificial general intelligence and cognitive science. Herein there is a need for practice-based scenarios for questioning constructive and destructive viewpoints about BioArt and, more particularly, concerning the future of life forms.

Introduction
Contemporary biotechnologies, and especially emergent technologies, are taking art into wet yet nimble associations with science fiction, science fraction and science fact. Numerous fields within the arts and sciences are exploring nascent technologies, but one particular field known as BioArt is the focus of this article. BioArt has been escalating during this BioTech Era and, as a fecund medium, has the potential for spawning visionary and critical practices and theories.

Science is a branch of knowledge that refers to systematic methods in collecting investigatory data to produce reliable knowledge. Based on objective observation and experimentation, and although this quality does not necessarily conflict with art, Science’s principles offer opportunities in contingent reasoning. In lieu of a slippery slope in which artists rely on freedom...
of expression in substantiating works, the burden of proof is placed on artists to be creative and objective in understanding what it means to tamper with biology and alter life forms.

Issues of ethics have already affected artists’ practices and venues for exhibition, and as BioArt continues to develop, ethics has become a necessary field of study. Further, the trend towards artists working in laboratories requires a need for pedagogy that focuses on artists as researchers. Lastly, as biomedia evolve and emergent technologies replace old technologies, in carving an intersection for art and futurology there becomes a need for practice-based scenario development concerning the possible futures within and around this field.

This article is primarily based on one-on-one interviews with bioartists, theoreticians and curators in order to provide a comparative, qualitative study of distinct artistic approaches. I conducted a semi-structured method, consisting of a formal questionnaire to define areas explored initially and an open-ended inquiry for further details. My analysis was to develop an overview of BioArt with some particulars of the principles and methods of biomedia. I was then able to evaluate interviewees’ ideas, method and practices to ascertain the possible futures of this field. As an artist who has spent several decades thinking about humanity’s pursuit, intentionally instigated or unwittingly faced, I am looking at how humanity is facing a posthuman condition. One way to excavate is through the looking glass at the currents and possible futures of BioArt.

1. Futurology is the comprehensive critical inspection and logical interpretation of the state in variables within a system as it develops and their relationships and possible outcomes within a certain time frame. History plays an important and necessary role in understanding how and why changes occur, and how these elements and methods can be applied when considering possible futures. Futurology means a systematic study of the future. (It was coined in 1940s by Ossip K. Flechtheim as a field of knowledge concerning new science of probability.)

BioTech Era
Stepping peripatetically into the future, who would you choose to be your guide – Lewis Carroll or Mary Shelley? Surely, it would depend on your purpose, whether it is a looking glass in wonderment of human nature, or a myopic vision in disdain of scientific development. Nevertheless, we are not in the future yet, and our time frame is marked by distinctive characteristics of the BioTech Era. These traits include an increase in biotech patents and genomic research laboratories, hi-tech companies turning from communications software to bioinformatics, university curriculum developing courses focused on biotechnology, increase in political interest in biotechnology policy-making and regulations, and a rise in public debates on the ethics of biotechnology. Whether or not BioTech is a valid categorization of this era in which technology and socio-economic innovation, growth and development are based in biotechnology, or whether it is simply a step across a transitional bridge towards posthumanity may not be known for many years to come. Although one thing is certain, we are participants in this current era, even as mythic stories and the forces of nature open their latches and lure us into the unknown.

Many millennia ago, ancient biotechnologists were herdsman and farmers who realized that they could manipulate and modify organisms and breed animals for stronger and more productive offspring, grow bacterial cells to make cheese and yeast cells to raise bread dough. After 6000 years of development of biotechnology, the world has awakened to the business of science producing beneficial, yet potentially dangerous outcomes due, in large part, to genetics and bioengineering. Not only this, but the most radical of professional practitioners – the artist – is also tampering with life forms and may even want to change the human genome.
So what is alarming and exciting about this brave new world of artists getting messy with biotechnology? Biotechnology has been described as a contronym or Janus-faced. One side shows technology as manipulating DNA to move genes from one organism to another in an act to help, support and relieve physical stress and biological decay. The other side involves untested and potentially dangerous techniques. Similarly, BioArt also has two sides—one for the creativity, ingenuity and distinct artistic style and the other full of socio-political avowals, expressed clearly by artists and experienced emotionally by audiences.

In effect, bio-practices are taking artists one step closer towards becoming co-creators of life, alongside the gods, stirring up moral issues while portraying the role of lab-technician, with scalpel or nano tool in hand. To understand what is occurring, it is necessary to first look at what BioArt is about now, and briefly, where it might be heading.

**About BioArt**

‘In its purest form, the term “biotechnology” refers to the use of living organisms or their products to modify human health and the human environment’ (Peters 1993b). What makes biotechnology such an apt medium for expressing art and how does it offer a new trajectory for artists? Bioartist Eduardo Kac believes that artists, largely, have outgrown a level of sophistication towards hard technology used in their practices. According to Kac, ‘Bio fulfills a visceral need of artists which stems from indulgence in a cold digital art in an attempt to go beyond a detached medium.’ In short, artists need—we thrive on—challenges in learning how to master new tools. We experienced a type of detachment from the plastic arts when artists shed the fumes, soiled rags, and tainted dust of paint and plaster and opted for the less encumbered, shiny tools of computers and electronic media. Now, as Kac suggests, artists have an instinctive drive to return to materials that have physical, sensory characteristics.

Many of the ideas that stimulated a departure from the digital or wired arts towards the bioarts are set forth in a manifesto known as The Moist Manifesto. In this manifesto, Roy Ascott anticipated that ‘[A]rt will increasingly inform a space between the computed and the living, between the electrical and the organic, between the silicon dry and the biologically wet’ (Ascott 2000, pp. 44–49). There is ample space for artists to branch out in a variety of directions to synthesize the sciences and the technologies in developing moist media. As Ascott so eloquently puts it, ‘[T]he most extensive changes in our environment can be attributed to science and technology. The artist’s moral responsibility demands that he should attempt to understand these changes’ (Ascott 1964, p. 128).

And in comes the BioTech Era, the genome and an array of sciences and technologies that offer new opportunities in the bioworld. And along with the tools, in comes a resurgence of the inspirational ideas generated by biotechnologists such as Gregor Mendel, Louis Pasteur and, more recently, James D. Watson. As Lee Silver writes in the *Newsweek International* (2007) cover story ‘Life 2.0’:

Scientists in the last couple of years have been trying to create novel forms of life from scratch. They’ve forged chemicals into synthetic DNA, the DNA into genes, genes into genomes, and built the molecular machinery of completely
new organisms in the lab—organisms that are nothing like anything nature has produced.

The people who are defying Nature’s monopoly on creation are a loose collection of engineers, computer scientists, physicists and chemists who look at life quite differently than traditional biologists do. Harvard professor George Church wants ‘to do for biology what Intel does for electronics’—namely, making biological parts that can be assembled into organisms, which in turn can perform any imaginable biological activity. Jay Keasling at UC Berkeley received $42 million from Bill Gates to create living microfactories that manufacture a powerful antimalaria agent. And then there’s Craig Venter, the legendary biotech entrepreneur who made his name by decoding the human genome for a tenth of the predicted cost and in a tenth of the predicted time. Venter has put tens of millions of dollars of his own money into Synthetic Genomics, a start-up, to make artificial organisms that convert sunlight into biofuel, with minimal environmental impact and zero net release of greenhouse gases.

(Silver 2007, p. 1)

Revolutionary developments have pushed science and technology further and further ahead, towards immense possibilities that have been consequential in the development of BioArt as a field. Artist and curator of Bios 4, António Cerveira Pinto points out:

Strictly speaking ‘bioart’ refers to all progressive work developed by living matter since the last 2,500 millions years or so. But when we are referring to an art fashion from the last 20 years it means artists that play both with biology in general, be it wetware, digital biology or future nano ‘consortia’. The fact is the particular of field BioArt is relatively new. Its nomenclature is without a codified definition, it is often discussed with a somewhat contested meaning, and its practitioners have varied views on the parameters of its media. BioArt is argued to be concerned with art practices that work with living organisms in which the manipulation of mechanisms of life ‘involves a wide array of forms both with respect to discourse and technique’ (Hauser 2005, p. 1). The umbrella terms BioArt, also bio art, biological arts and VivoArt are often applied to artists working with varied types of biotechnology and living organisms. Curator and theoretician Jens Hauser claims that biotext and biovisual arts reflecting ideas and practices of biotechnology are not BioArt because the artist must work with living organisms. Yet, he also believes that ‘BioArt interests more and more performance artists specializing in Body Art; structural relationships connecting both disciplines […] As a medium, BioArt cannot be nailed down with a hard and fast definition of the procedures and materials it must employ’ (Hauser 2005, p. 1). For example, hybridization bioartist George Gessert claims:

Multitudes of people, including me and you, cannot know ‘Alba’ [the transgenic florescent green rabbit with a jellyfish gene] except as an idea […]. A key feature of every work of transgenic art is a sequence or sequences of DNA that is/are invisible to audiences, and consequently functions somewhat like ideas in the context of the gallery.
It is true that manipulating mechanisms of life involves a large assortment of tools and methods, and especially terminology in discourse concerning BioArt. And because it is ‘constantly evolving’ (Hauser 2005), the conceptualization of future possibilities about the co-creating novelty while designing works of art that are alive is a constituent of BioArt, if not an entirely new medium, especially in the future when the human’s cognitive processes are augmented with cognitive enhancing nanorobots.

Melentie Pandilovski, director of Experimental Art Foundation, has established unyielding criteria for BioArt. In Pandilovski’s estimation, BioArt cannot be image-based, text-based, dead biomaterial, or solely software actions that resemble biological actions. However, it may be counterproductive to corner BioArt so impermeably. If BioArt is an umbrella term, it needs a malleable and hydrated membrane to flourish and evolve.

A more feasible outline for building criteria for BioArt is both practice-based, theory-based and conceptual, comprised of wet and moist media, and emergent technologies used in biotechnology research and eventually its practice. Nanotechnology, nanorobots and nanomedicine are partnering with biotechnology and it makes sense that they will also infuse BioArt. It has never been easy for art genres to segue from its past relationships with ease. It is precisely within this area of transition and overlap that distinctions are made – the breaking-away of one genre from another. Like any affair, in hindsight there remains a question of what one had before.

Oron Catts, co-founder and artistic director of the SymbioticA – The Art & Science Collaborative Research Laboratory, contends that ‘[T]here are, however, a growing number of artists who are working with living systems as part of their practice. I would refer to them as biological artists, looking at the media that they are working on (such as with computer art, video art etc.) but will not refer to them as being part of a movement, or a coherent artistic approach that can be reduced to a single narrative, or that requires a criteria.’

One important question to ask of BioArt is ‘[W]hat is it that it brings that we did not have before?’ (Kac 2006). Many artists, including myself, have experimented with the human body and its living cells in our works. Nevertheless, using biological substances such as expired blood does not necessarily constitute BioArt. According to a consensus of bioartists, it has to be a living medium wherein the art is produced, such as the blood used in Kac’s 1997 ‘A Positive’, which was funneled into a robot that then used the blood’s oxygen to create a spark and ignite a flame.

If being an alive organism, or any of its living parts, is required, then would my being alive right now and monitoring my bodily functions be BioArt? This brings to mind a performance art piece I performed, known as ‘Breaking Away’, wherein I applied sunlight as the main source of energy attenuated by the earth’s atmosphere to my body as it was sculpted into a rock formation at Red Rocks Amphitheatre. The heat from the sun radiating through ultraviolet light acted as an antiseptic for my cellular structure and aided in the production of vitamin D. As my skin and nerve endings were energized, a physical reaction occurred which energized movements that resulted in a dance as an embodiment of energy. As lovely as it may have been, according to performance artists such as Stelarc and I would merely be human performance artists tampering with our bodies and such works
would not be legitimate BioArt, or would it? In contrast to Melentie Pandilovski’s firm parameters, it seems that Hauser’s understanding is simply that it must be living or alive. However, he also asserts that the medium itself is evolving, which makes the most sense. If BioArt is comprised of biomedias, which is living, then it stands to reason that BioArt itself must be on-the-go and not restricted to a state of stasis. Therefore, I see a bias concerning how many cells are involved, its size, physical location, sex or what species of organism the cells ascend from, but I will address this later further along.

Examples of BioArt that are non-human related are seen in works such as Kac’s ‘Specimen of Secrecy about Marvelous Discoveries’ (2006). The images are comprised of biotopes, living substances in perpetual flux, changing in response to internal metabolism and environmental conditions. The specimen images of biotopes are a self-sustaining ecology, somewhat like a biosphere, consisting of thousands of tiny living organisms in an encapsulated environment, as a constantly evolving living exhibition. CalTech’s in-house conceptual bioartist David Kremers explains ‘Paraxial Mesoderm’ (1999–2000) of microbes genetically modified to produce enzymes:

With a few simple laboratory procedures a suite of paintings were grown from single-celled organisms which had been genetically altered to produce colored enzymes, or protein combinations that reacted with genetic trace dyes. The work was completely transparent when painted, a sensation rather like trying to paint on ice with melted snow. After a period of 16–18 hours, the growth was arrested by the removal of moisture from the plate. Air was sealed out with a synthetic resin, and the work entered a period of stasis. The work, while stable, is neither ‘dead’ nor ‘finished’. It exists in a state of suspended animation, and at any time the resin might be removed, the plate scraped, fed, and placed in an incubation room to grow to a new stage of development.16

Cells and tissue become both living sculpture and ideological statement in the projects of Tissue Culture & Art Project (TC&A). Zurr, wet biology artist and co-founder of Tissue Culture & Art Project (TC&A), claims that ‘[W]e see our role as artists as one in which we are providing tangible example of possible futures, and research the potential affects of these new forms on our cultural perceptions of life. It is not our role to provide people with goods for their daily use. We would like our work to be seen in this cultural context, and not in a commercial context.’17 An example of Zurr’s philosophy is found in ‘Victimless Leather’, a semi-living sculpture designed with animal cell lines of ‘differentiated cells or with progenitor cells which have a limited differentiation lineage’. The cells were cultured to grow a layer of tissue sustained by a biodegradable polymer matrix in the shape of a very small jacket. The cells bind with the form and became both a sculpture and social statement about the needless killing of animals for the sake of fashion.

Genetics bioartist Marta de Menezes ‘NATURE?’ exemplifies the precise alteration of physical characteristics of a living organism by interfering with normal development of Bicyclus and Heliconius butterflies. She creates unique and stunning wings, as she says, ‘never seen in nature before’18 in exploring possibilities and constraints of the biological system.

16. E-mail communications with David Kremers, United States, 29 January – 11 April 2007.
17. Telephone and e-mail communications with Ionat Zurr, Australia, 6, 10 June 2007.
18. E-mail communications, United Kingdom, 22–29 December 2006.
Evolving biomedia
A current list of biomedia include, but are not limited to, genetic engineering, cloning, hybridization, selective breeding, transgenesis, cell and tissue culture, bio-robotics, bioinformatics, xenotransplants, neurophysiology, homo-graphs and self-experimentations. The list is growing and I suspect that the parameters of what is or is not BioArt will change as the biomedia changes. In sort and in light of the BioTech Era in which life extension is a central issue, BioArt has potential for new perceptions concerning revivification biomedia and also creating new life forms.

Technological developments are usually an indication of where artistic innovation is headed. It makes sense that the next juncture will be such technologies that combine biotechnology with nanotechnology, nanoscale particles of 1–100 nanometres, nanomedicine and molecular manufacturing (MM), nanoscale machines capable of building products from the atom up.

BioArt evolving in the same or similar direction as the rest of biotechnology is probable. Narrow AI, the creation of programmes to demonstrate intelligence in specialized areas or specialized intelligence, has been one step forward for thinking machines. However, the interest in developing sapient or self-aware intelligences is more timely. For the purposes of solving complex, transdisciplinary problems, engineers are building artificial general intelligence (AGI).21 There is also a bevy of interest in Friendly AI (FAI),22 a friendly benevolent intelligence, to counter potential runaway superintelligences whose cognitive capabilities well outperform humans.

An area of potential interest could be to mirror Second Life by developing synthetic or cellular environments in which partially biological forms are able to interface. The biomedia would not be computational artificial life forms, but a partially biological, living media. Like Kremmers’ paintings which are exhibited in galleries, the media is actually living, breathing microorganisms.

A point to ponder is voiced by Pinto who believes that ‘[BioArt] will not go back to typical modern/contemporary de-constructivist strategies as long as it keeps close to cognitive strategies, either performed by humans alone, or by humans assisted by nanobots, computational networks and so on.23

Out of computational networks and into cellular connections, a biomedia of potential is revivification and/or cell apoptosis.24 Both media are not produced for exhibition or display. They are exercised for the purpose of reversing aging and for extending the life of the organism. Cryogenics is essential for revivification biomedia, as is nanomedicine and nanorobots for cognitive life forms because the brains cognition would need assistance in producing neuron connections and problem-solving.

Bias – monster inside
In the Renaissance, the term ‘genio’ was given to inventive individuals with an unusual talent for reproducing the works of the ancient Greeks and Romans, not for creating new works of art. It was not until the eighteenth-century Europe that brave, new ideas were favoured and like Gulliver’s Travels’s ancients vs. moderns,26 the moderns chose creativity over imitation. This time frame of historical, ethnographical, anthropological and technological query into what it means to be human is resulting in bioartists’ concern about what it means not to be human. This, no doubt, has entered into artistic works of George Gessert and VivoArt founder Adam Zaretsky

19. Nanomedicine is the medical use of molecular nanotechnology by developing nanorobots and biochemical machines to work with the body’s biology on a cellular level.


21. Organizations pursuing AGI include the Adaptive AI, Artificial General Intelligence Research Institute (AGIRI) and the Singularity Institute for Artificial Intelligence.

22. Design features and cognitive architecture required to produce a benevolent, friendly FAI (The Singularity Institute).

23. E-mail communications with António Cerveira Pinto, Portugal, 2 June 2007.

24. Revivification is the renewal of life or restoration of life. I call the biomedia of extending life and reanimation life revivification. Apoptosis is the self-destruction of life.

25. Cryogenics is the technology of vitrifying life forms in liquid nitrogen for the purpose of suspending life.

26. Swift, J. (1726), Gulliver’s Travels, Ancients vs. moderns refers to political satire and the rise of scepticism in society. Available for viewing.
who reveal concern with what it means to be an organism – a germ, a virus, a molecule and whose environment or home this earth actually belongs to if not to every and all life forms together.27 And perhaps one dramatic element worth noting is the realization that the human genome has, and has always had, genes from other, conspicuously lesser organisms – the monsters inside.

In lieu of a slippery slope in which artists and designers rely on poetic license for substantiating works of art, can art practices infuse visionary yet objective understanding of possible futures for more than just getting messy with biology, altering life forms? BioArt has been criticized for being insensitive to life forms, no matter how small and seemingly insignificant, and deliberately provoking the viewing audience into despair by exaggerating the mal-effects of genetic engineering. These signs of bias may be necessary for the messiness of BioArt, adding psychological incentive to cutting up and disposing of living matter. Although it might detract from the purity of the medium placing value, it might be received by its audience as intentionally propagating ambiguity for the sake of propaganda. Art needs to do more than telling the audience what to think. It ought to stir up novelty and provoke viewers into asking questions and forming connections between their world before and then after viewing such works.

Stelarc, performance artist working with media to extend his body, comments that

[O]ne can see tissue culture work as a sculptural pursuit rather than driven by pseudo political dogmas and Frankensteian fears. I don’t see bioartists any more biased than other artists. There is a multiplicity of conceptual and fabrication processes that drive bioart practice. These will express the diverse opinion, biases, desires and dreams of the artist. All art is biased in that it manifests this diversity.28

‘The key question is whether the artist must necessarily contribute to the process of knowledge production or whether their role lies in the subversive questioning of emergent concepts and dogmas.’29 Some Bioartists consider their role is to inform and even scar the viewing audience by demystifying biotechnology. Some make claims that genetic engineering and other biotechnologies are owned and run by corporate, capitalistic, fascists. Is this a broad stroke of reasoning and is it logical and fair?

There are obvious indications of concern with ethics, although some of the works do exude bias on the business of biotechnology and assumptions concerning what is or is not consumed and why.

For example, much of the incentive of Critical Art Ensemble (CAE) is driven by angst towards commodification. Steve Kurtz, founder of CAE, claims that ‘CAE does not really see itself as a group of bioartists or as doing bioart. In fact, we try to distance ourselves from that.’ He explains, ‘[F]or the most part it [BioArt] seems dangerous in that the genre primarily functions as public relations stunts for corporations.’ Kurtz adds,

[We] have to create a theater especially for this situation that weaves performance of the life sciences back into everyday life in a manner that increases

27. E-mail communications with Adam Zaretsky, 8 January – 14 April 2007.
28. E-mail communication with Stelarc, 31 January 2007.
29. E-mail communication with Jens Hauser, France, 9 March 2007.
Kurtz has a mission to create works that are ‘a means to a political/cultural end’. I interpret this as believing that the means are designed expressly to advocate CAE’s point of view and to diminish a point of view that CAE does not agree with. This is the worst type of bias possible — to instigate ideas for informing the public of one’s own political perspective without a balanced, critical approach. Thus, does CAE lack critical thinking? Not necessarily, only if it is neutral and impartial in its assessment in understanding the issues it counters. Albeit, objectivity is often difficult for activists whose works are impassioned by socio-political views. And during this era there are a number of issues that artists are passionate about, which include our environment and the future of humanity. These two domains are affected by biotechnology, the greater issue is to be aware of all sides of an issue, and to apply a balanced approach is disseminating the variables which affect one another. The one idea that Kurtz espouses, which I agree with, is that ‘All “bioart” is biased. The only question is it call attention to an awareness of its bias,’ which is precisely why I make note of this.

Media theorist and lecturer Anna Munster asks how artists engaged in BioArt practices rigorously considering the moral value in their work and on ethical consequences. Munster writes that

BioArt poses a micro/macro, life/death relation that travels in waves of matter moving. The force of BioArt is an ethics of affect that functions through the micro physics of power to effect strange new ways of becoming life. It calls into question the operations of indeterminacy at play in the constitution of the human. The human is forced to acknowledge its properly contingent existence as a macro construction that is formed in translation from the micro. The human is thereby encouraged to give up its claim to superior status and engage in an ethical relation with its surround. Like art, biotechnologies also affect new relationships between matter and life, human and non-human. BioArt must function in rhythm with these techniques in order to pose a critical counterpoint to their operations.

(Munster 2004)

When BioArt starts playing with Mother Nature, perhaps we all might heed a warning label. George Gessert thinks that the warning label ought to be ‘printed in red’ because the word nature has so many, many meanings. When bioartists take life forms and manipulate them, their nature is of consequence. Is it ethical to take any living form, cage it in a frame and mount it on a wall like an animal in a circus? Without oxygen it will surely die and is the artist considered to be a murderer. Does live art imply a new relationship between the artist and the practice? Must we ask, ‘What does this artifact want? Where does it want to live?’ ‘With only a few exceptions, the arts of evolution have not been studied systematically, but could provide indications of how we are likely to use biotechnology’ (Gessert 2001).

Joe Davis, a pioneer of BioArt, believes the ‘central problem with BioArt today is that artists don’t like harsh scientific scrutiny’. Davis contends that ‘Artists are dealing with materials as powerful and complex as living
bacteria or transgenic organisms that gives them a kind of responsibility they have never had before' (Kennedy 2005).

It is said that we are in a Post-biological Era. This is a misnomer. If anything, we are in a transbiological era, and the discovery and examination of the genome remains of great interest. BioArt is timely because it offers unleashed exploration into a field which has been sequestered by scientists and continues to be new and open for exploration. Artists participating in BioArt are providing a genuine service to the public by giving a closer look at what goes on in scientific laboratories. As noted, there are biases and there is plenty of time to witness consilience. One thing is for sure, BioArt is not standing still and if artistic tools follow the trends, what it means to be human, our future capacity to communicate and be alive in an array of environments means that we will be posthuman hybrids. As David Kremers says:

As biotechnology and digital technology hybridize, reality is going to get, not merely better or worse, but very weird and fluid. Technology development is going to be more like gardening than manufacturing, and like gardening, the harvest will be out of our direct control. To interface with these developments, humans will have to rely less on quantitative analysis and predictive models. To harvest the richer qualities of complex living systems, humans will have to develop new methods to understand factors that cannot be measured easily, if they can be measured at all [...] With the recent advances in biotechnology and computer science for extending life, artists of the 21st century are faced with both a leveling of artistic significance, and an expanded period of time for historical context. Civilization will need to create from this dilemma a less mechanistic world view than the previous industrial revolution has encouraged.34

Carrying art onwards

Poet Guillaume Apollinaire wrote, ‘One cannot carry everywhere the corpse of one’s father.’ Perhaps it is the same for art media. Art history is our great teacher, but art cannot carry its past incarnations and extracts around as symbolic gestures for eliciting recognition or proving merit. Each art time frame must stand on its own and do what has not been done before, or if repeating it, do it differently, thereby stimulating us to think and ask questions. Unlike Apollinaire’s father who was biological and, as a consequence, mortal; roboticist Hans Moravec welcomes an art which regenerates, transforms and could give endless life to humankind, but not in its human form. Vernor Vinge, father of the Singularity,35 mathematician and science fiction visionary, suggests the future of art will lie on in what I call a hyper-modern creativity augmentum:

Imagining what creativity and aesthetic issues might be for early posthumans is very intriguing. For these creatures, creativity and art might be among the most pleasurable aspects of the new existence. I believe that emotions would still be around, though more complicated and perhaps spread across distributed identities [...] In our era, almost everything we do in the arts is done with awareness of what has been done before and before. In the early posthuman era, things will be new again because anything that requires greater than human ability has not already been done by Homer or da Vinci or

35 The Singularity is a time in which supercomputing power advances to a point at which, and beyond, computers become more intelligent than humans. According to Vernor Vinge, at the Singularity, humans will no longer be the most capable, intelligent or creative species on the earth. There are other viewpoints concerning the Singularity, such as Raymond Kurzweil of Kurzweil Technologies and Eliezer Yudkowsky of the Singularity Institute. However, the consensus is that when supercomputers become more intelligent than humans, humanity and society at large will change as we have never changed before.
Shakespeare. (Of course, there may be other, higher creatures that have done better, and eventually the first post-human achievements will be far surpassed. Nevertheless, this is one sense in which we may appreciate the excitement of the early post-Singularity years.)

Moravec asks us to

Consider the human form, it clearly isn’t designed to be a scientist. Your mental capacity is extremely limited. You have to undergo all kinds of unnatural training to get your brain even half suited for this kind of work – and for that reason, it’s hard work. You live just long enough to start figuring things out before your brain starts deteriorating. And then, you die.

Moravec muses further, ‘But wouldn’t it be great’, he says, ‘if you could enhance your abilities via artificial intelligence, and extend your lifespan, and improve on the human condition?’ (Platt 1995, p. 2). ‘Artists and especially transbioartists might encourage the people to think about what to do when their life spans are increased and eventually immortal.’

Transbio

Could BioArt lead to transbio practices, transitioning from biotechnology towards NBIC technologies (nanotechnology, biotechnology, information technology and cognitive science, including robotics and AGI) for the purposes of revivification of single cells and multi-cell organisms? I suggest that the human lifespan can and will be extended and that generating a new type of human in which the genome is altered and living beings become both embodied and disembodied, biological and synthetic. Our attention to these relationships is consequential and immediate in art’s continued state of transition (Vita-More 1982).

Roboticist Leonel Moura claims that contemporary art is burnt out and we are on the cusp of an intelligent art and the evolutionary mechanism of nature, as it needs randomness in order to evolve. Like Moravec, Moura is an adjacent arm of the BioArt medium and perhaps part of an extended family of Transbio Art. He suggests that ‘We are in the process of generating a new homo species in which the extension of life is one of the components.’ And like Moravec, Moura sees that human intelligence will be decisive. George Gessert believes that ‘With only a few exceptions, the arts of evolution have not been studied systematically, but could provide indications of how we are likely to use biotechnology’ And that ‘Nanotechnology is deeply involved in biology, and perhaps AI is or will become involved in biology as well.’

In his introductory talk at the 2004 symposium of Art of the Biotech Era, Melentie Pandilovski asks: ‘Is the evolution of the human form at all possible? If possible, is the evolution of the human body at all necessary? If possible, should it be assisted by the humans themselves?’ (Pandilovski 2004). Hans Moravec seems to think so, along with Leonel Moura, Adam Zaretsky, and also Stelarc, who wonders if the human body is its ultimate form, and if evolution is not yet completed. And as David Kremers muses,
‘We are the first generation of artists to face the problem not of mortality, but of immortality.’

**Future**

The potential of BioArt’s influencing society and perhaps the future is inevitable. As techno-biological artist Dmitry Bulatov explains, ‘Contemporary art is the major instrument of humanitarian technologies. It takes immediate part in the procedures of interpreting the achievements of physical technologies, or, in other words, it participates in constructing the models of the future.’ However, artists are not practicing scientists, sociologists, or skilled in future studies of systems thinking, scenario development in assessment of preferred futures. Is it time for artists to think about the future, not in the Marinetti sense, but for conceptual practice and strategic speculation? If art is an expression of an artist’s inner-world of feelings, emotions, attitudes, then how do we combine highly imaginative ideas within our practices and, at the same time, objectively understand the consequences of altering the biology in life forms? (Hospers 1982, p. 192).

We have to implement personal behaviours, certain characteristics to assist our grasp of our own creative impetus and help direct methods of expression. We do the same thing when working with toxic fumes in the studios of plastic arts, and we know not to stand in a puddle of water when fiddling around with electronic equipment. Thus, it ought not to be thought of as squelching our creativity when considering a certain set of guidelines, if you will, when working with Biomedia. Oron Catts believes that Academics need to be more careful in the way they try the theorize artists who are working with living systems. If the trend of artists working in laboratories continues growing, there may be a need for a new pedagogy, which focuses on artists as researchers, and emphasis in futurology and ethics.

Futurism is usually, and I take liberty in stating this, not held in high esteem within the liberal and applied arts. Often the idea of futurism is mocked out of a 1960s predication of flying saucers and jetpacks. But this is not what futurism or futurology is all about. Futurology is the study of the short-term and long-term future, whose methodology is based on social, technological, economic, environmental and political domains. Studies are performed for the purpose of investigating systems in analyzing what could possibly occur based on existing information and the observed relationships variables within a system have upon each other. By extrapolating an amount of viable information through processes such as morphological analysis and scenario development, the likelihood of certain events taking place are examined. Futurology assumes that there is not just one future, but many possible futures and that humanity can propose a desired future and work to bring that about. Currently in academia, future studies is located, for the most part, in the social sciences and business departments of universities. However, it may be beneficial, and enormously visionary, to develop future studies coursework in the media arts pedagogy.

Lowry Burgess of Carnegie Mellon’s College of Art’s Studio for Creative Inquiry offers a pedagogical approach to artists and designers in learning about the future. The programme’s mission cogently states, ‘Interdisciplinary projects bring together the arts, sciences, technology, and the humanities, and impact local and global communities’. It seems that a wide-open view of
the arts and personal responsibility ties in nicely to the field of future studies. However, there is a difference between being adept at future studies and being a qualified scientific researcher. Is it necessary for bioartists to be skilled scientific researchers in their unique practice area?

According to Stelarc, ‘[BioArt] is an aesthetic and conceptual expression in a new medium, which is continually driven by a multiplicity of conceptual and fabrication processes. Artists are not in the business of methodical scientific research or even in the realm of science fiction, but bioartists are driven by pseudo-scientific desires.’

Marta de Menezes thinks that ‘art always tries to see ahead and that it is, in many cases, a tool to prepare society for certain technological advances that raises ethical or conceptual breakthroughs [...] More often than not we make the judgments without full knowledge of the issues, technologies and research involved.’

The interdisciplinary practices of the arts and design need to cultivate observational ‘polis pods’ for discourse on the future. This is more timely than ever because technological change is continuing to accelerate. The future is a result of impacts of change that affect everyone, regardless of what domain the changes originally occur in and where the impacts are first felt. Since artistic endeavours do have a future and these impacts could affect our practices, future studies is pertinent for visioning potential outcomes of change in our practices and curriculum.

One of the richest ways to envision what may lie ahead is through science fiction, which has a profound bearing on how people think about the future. Decade by decade the future is marked up, erased and revisited with false starts, high hopes and wide-ranging results. In the 1800s, visions of the future illustrated levitating sea vessels, aerial empires, steel highways and flying saucers. The Invisible Man (Wells 1897), a Faustian story of a scientist who has tampered with nature in pursuit of superhuman powers, Brave New World (Huxley 1931), a keenly illuminated, satirical piece of fiction and Metropolis (Lang 1927), a social epic about the haves and the have-nots, all depict the gray skies over industrialization and progress. The 1920s was an era of radio broadcasts, electric razors, frozen food and 16-mm movies – a Flash Gordon (Raymond 1934) epoch of invention before the 1940s downward slide, followed by idealization, triumph over fear and reunification of nostalgia (Clute 1995). But low and behold, before our current century, apocalyptic vision sprung a leak in the accelerating engines of progress. With grave concern about terrorism, global warming and an ideological, social divide, it is time for serious, highly charged artistic practices to coalesce with scientific methods to bring credence to the art of conjecture.

Critical methods of framing and systems thinking are not all quantitative, mathematics-based fact and figure, research and analysis, survey and strategy. Qualities of spontaneity, intuition and ad hoc inventiveness have a substantial role in envisioning the future. Simulation games and role playing create hypothetical structures for scenarios. Further, the comprehensive anticipatory design of complex systems incorporates holistic thinking, the futurists’ gestalt in pinpointing emergent trends and discontinuities in the endless cycles of change.

What can artists grasp from all this future discussion? The answer is we either become utopian – favouring massive change, biotechnologies,
nanotechnologies, artificial general intelligence, and other forms of manipulating ourselves and our environment for survival. Or we become dystopian – attacking the concept of the western society, capitalism, science as god, biotechnologies, DNA manipulation and other forms of altering what it means to be natural, and cease attempting to take charge of our destiny, our future. But these two alternatives are sorely outdated, pigeon-holing the potential of artists and designers and offering little option other than to choose between them.

Conclusion
The brave new world has come to represent the fears of society towards the possible outcome of emergent technologies and dictatorial hierarchy ruling humankind. This is a regretful paradox because Aldous Huxley actually borrowed the phrase brave new world from Shakespeare when he was inspired by a soliloquy by Miranda in Shakespeare's play *The Tempest*:

O Wonder!
How many goodly creatures there are here!
How beauteous mankind is! O brave new world
That has such people in’t!

Shakespeare’s words originally meant something far different than the intention of Huxley in his famed story *Brave New World*. Huxley’s satirical piece is fiction, not scientific prophecy. ‘Though Huxley’s vision seems, to the cynic or to the defeatist, to have prevailed in this strange age (which has come to be brave new world as a forecast of the future), it is Shakespeare’s vision that resonates more strongly in its deep perception, in its profundity and in its power to inspire’ (Ciesla 1996). Perhaps transitional state of BioArt will inject a little more Shakespeare and a little less Huxley-fear.

The directive of BioArt is not to eliminate fear but possibly to offer a means by which both visionary and objective ideas concerning life, nature and design can be explored and expressed. Silver Award Winning essay of The Economist/Shell World in the 2050 Essay competition, ‘Biological Technology in 2050’ by Robert Carlson (2007) takes a look at consequences of distributed biological manufacturing moving from academic labs to home garage labs. Carlson suggests that the practices will be a continuation of what we are experiencing today with attempts to predict the behaviour of designed biological systems. It is here that artists may seriously consider abiding by the protocols for ethical conduct and established guidelines.

Choosing our guides – poetically or practically – may be our most beneficial decision as we step boldly, yet bravely, into the future. The confluence of media, in which biomedia is just one, in building new life forms may not be known for many years to come. Although one thing is certain, we are participants in this current era and, even as mythic stories and the forces of nature open their latches and lure us into the unknown, we need a meaningful strategy.

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Accessed 8 June 2007.


**Suggested citation**

doi: 10.1386/tear.5.3.171/1

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Natasha received international recognition for the conceptual design of Human 2 known as Primo Posthuman, and has been featured in more than 50 magazines, including *Wired, Harpe's Bazaar, New York Times, U.S. News & World Report, Net Business, Teleopolis, Village Voice*. She has appeared in over fifteen televised documentaries such as PBS, BBC, TLC and ABC on the aesthetics of the human–machine interface. Her works have been exhibited at Brooks Memorial Museum, London Contemporary Museum, Women In Video, Telluride Film Festival and United States Film Festival.

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