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Life Expansion: Toward an Artistic, Design-Based Theory of the Transhuman / Posthuman

by

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Life Expansion: Toward an Artistic, Design-Based Theory of the Transhuman / Posthuman

The thesis' study of life expansion proposes a framework for artistic, design-based approaches concerned with prolonging human life and sustaining personal identity. To delineate the topic: life expansion means increasing the length of time a person is alive and diversifying the matter in which a person exists. For human life, the length of time is bounded by a single century and its matter is tied to biology. Life expansion is located in the domain of human enhancement, distinctly linked to technological interfaces with biology.

The thesis identifies human-computer interaction and the potential of emerging and speculative technologies as seeding the promulgation of human enhancement that approach life expansion. In doing so, the thesis constructs an inquiry into historical and current attempts to append human physiology and intervene with its mortality. By encountering emerging and speculative technologies for prolonging life and sustaining personal identity as possible media for artistic, design-based approaches to human enhancement, a new axis is sought that identifies the transhuman and posthuman as conceptual paradigms for life expansion.

The thesis asks: What are the required conditions that enable artistic, design-based approaches to human enhancement that explicitly pursue extending human life? This question centers on the potential of the study's proposed enhancement technologies in their relationship to life, death, and the human condition. Notably, the thesis investigates artistic approaches, as distinct from those of the natural sciences, and the borders that need to be mediated between them.

The study navigates between the domains of life extension, art and design, technology, and philosophy in forming the framework for a theory of life expansion. The critical approach seeks to uncover invisible borders between these interconnecting forces by bringing to light issues of sustaining life and personal identity, ethical concerns, including morphological freedom and extinction risk. Such issues relate to the thesis' interest in life expansion and the use emerging and speculative technologies.

The study takes on a triad approach in its investigation: qualitative interviews with experts of the emerging and speculative technologies; field studies encountering research centers of such technologies; and an artistic, autopoietic process that explores the heuristics of life expansion. This investigation forms an integrative view of the human use of technology and its melioristic aim. The outcome of the research is a theoretical framework for further research in artistic approaches to life expansion.

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LIST OF ABBREVIATIONS

AI	=	artificial intelligence
AL	=	artificial life
AGI	=	artificial general intelligence
AR	=	augmented reality
CLIA	=	Clinical Laboratory Improvements Amendments
DIYbio	=	Do it yourself bio
DNA	=	deoxyribonucleic acid
DXA	=	dual-energy X-ray absorptiometry
ES	=	emerging and speculative
ESM	=	emerging and speculative media
ESDM	=	emerging and speculative design media
FACT	=	Foundation for Art and Creative Technology
FtF	=	face to face
HCI	=	human-computer interaction
HRT	=	hormone replacement therapy
IMM	=	Institute for Molecular Manufacturing
iPS	=	induced pluripotent stem cells
MNT	=	molecular nanotechnology
MRI	=	magnetic resonance imaging
NBIC	=	nanotechnology, biotechnology, information technology cognitive/neuroscience
NBIC+	=	NBIC plus robotics, prosthetics and cryonics
PRI	=	Pacific Research Institute for Public Policy
RNA	=	regenerative media, nanorobots, artificial general intelligence
SENS	=	Strategies for Engineered Negligible Senescence

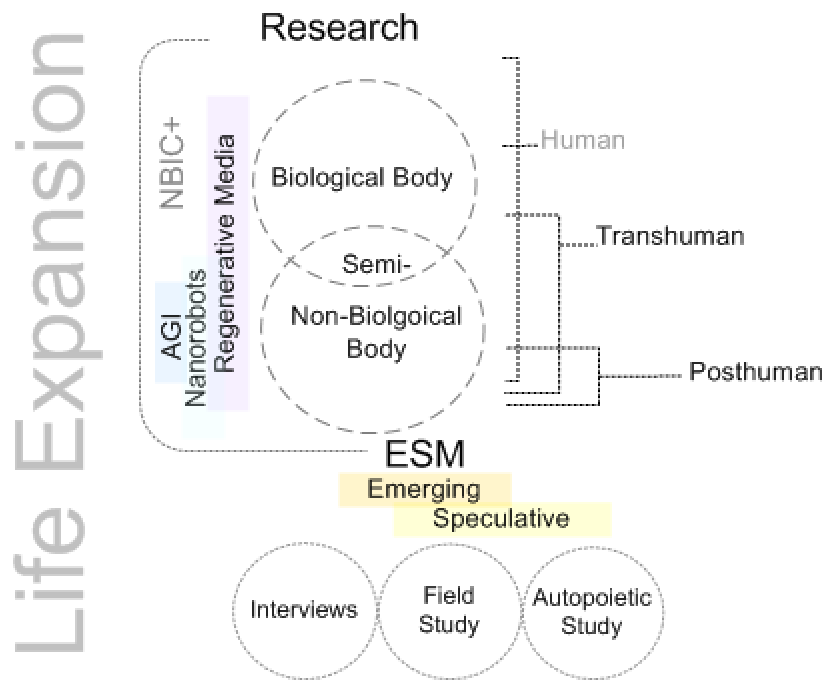

Figure 1. “Life Expansion Research” © Natasha Vita-More.

To my extended family and animal companions

To the sand in my toes and the clouds in the sky

To the mountains of Telluride.

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award. The research contained herein is the sole work of the author. The methodological strategy of interviews, field studies, and case studies, was conceptualized by the author and all aspect of this research has been steered by and accomplished by the author.

During the time frame of the author's research, the author attended the required composite sessions of the Planetary Collegium, as listed below.

Composite sessions attended:

No. 1. 2006: Tucson, Arizona
No. 2. 2006: Plymouth, UK
No. 3. 2006: Sao Paulo, Brazil
No. 4. 2007: Montreal, Canada
No. 5. 2007: Milan, Italy
No. 6. 2008: Gijon, Spain
No. 7. 2008: Vienna, Austria
No. 8. 2008: Sao Paulo, Spain
No. 9. 2009: Valencia, Spain

The author authored numerous papers for books and journals, presented research at conferences on an international basis, attended scientific and technological seminars during the research and developed projects related to the thesis. The full list of Publications, exhibitions, and other relevant material is detailed in Appendix 1.

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Signed

Dated April 30, 2012

PART I

PREFACE

The motivation for writing this dissertation and forming its investigatory research is based on a personal passion for life extension and a desire to ameliorate the inevitable aggressive onset of disease. This interest stems from direct experiences with disease and injury and the struggle to overcome these obstacles. Likewise, the motivation for this research is amplified through observing the misfortunes of others whose disease and injuries have been debilitating to the point beyond what one could reasonably imagine. Thus, it then only is natural to engage more deeply into imagining what life might be like if these inevitable conditions could be resolved.

Many years ago, I volunteered at The Home for Incurables, a facility where people were so malformed that they were not allowed to go out in public. At St. Jude’s Children’s Hospital, I observed children with incurable cancers awaiting their ultimate and untimely death. The fact that the maximum human lifespan is limited to a little more than a single century, most of which is spent resisting disease, has compelled a small yet growing community of individuals to take up the challenge to extend life. My work as an artist and designer explores the domain of life extension and conveys an unfaltering interest in future possibilities of protecting and sustaining life. Because biotechnology, nanomedicine, robotics, artificial intelligence, and virtual environments are now upon us, along with realistic possibilities for engineering genetics to intervene with the damage caused by cellular mutations and aging, to repair the biological body, and to build new bodies, there is reason to be more enthused than ever to explore how these emerging and speculative technologies fit into the arts and humanities. Thus, through this dissertation, I set out to investigate the potential of emerging and speculative media for life expansion, the locus in which this study is located.

In this thesis, I suggest that human enhancement is leading toward life extension and, eventually, expansion of persons onto nonbiological systems. The original knowledge arises from a different and, perhaps, new interpretation of the postmodernist orientation within the arts and humanities. The transhuman / posthuman, as approached in this thesis, proposes that we can legitimately liberate ourselves from some of the inevitable limitations people and society commonly expect. In defending this perspective, I establish a case for propelling the inquiry forward and in the open, which becomes the theoretical proposition that, hopefully, drives the scholarship for future lines of research and inquiry.

Notably, artistic, design-based approaches to human enhancement need appropriate tools with which to engage the field. I refer to these tools as the emerging and speculative media (ESM) of regenerative media, nanorobots, and artificial general intelligence (RNA). I arrived at this knowledge by analyzing what is currently available and what might feasibly become available in the foreseeable future for artists and designers. I arrived at this assessment though the qualitative, empirical research of this thesis study.

The scholarship in the domain of emerging and speculative technologies, as potential media for new artistic and design-based approaches, concentrates on theoretical insights of potential human futures, including ethics and socio-political discourse, an historical alliance with the concept of cyborg, transhuman, and posthuman, and an advocacy of human enhancement and radical life extension. I suggest heuristics of life expansion critically overthrow preconceived notions and norms concerning essentials of being human, assumptions of *modern man*, and narrow suppositions of the posthuman, which have the scholarship of intellectual and creative currency in the discourse of the arts and humanities, yet greatly need the opportunity for new insights and possibilities for our human futures.

CHAPTER 1: INTRODUCTION

1.1 Scope of the Thesis

The dissertation's study explores the concept of life expansion, which arises out of the combined concern about extending human life beyond the current maximum lifespan by regenerative means, and expanding persons beyond biological systems and within semi- and non-biological systems. For humans, the lifespan is bounded by a single century, a period which is delimited by biology. The concept of life expansion is located in the domain of human enhancement, distinctly linked to biological interfaces with technology and human-computer interactions. Thus, the province of human enhancement in this study derives from the field of cybernetics, the science of communications and control systems of machines and living organisms. Through the study between human functions and mechanical and electronic systems, the concepts of the human and of machine integration and the computer interaction is formed (Wiener 1950:163). One outcome of the integration and interaction where the human body and its biology with machines was consequential in bringing about the concept of the cyborg (Clynes 1960:27). Rather than being positioned as an endpoint to the integration of human, machine, and computer, the alternative strategy proposed in the thesis focuses on the transhuman because, unlike the cyborg, it steers its own transformative evolution in becoming posthuman. Thus, the transhuman / posthuman context is approached as appending the mortal human, transforming the biological body, and expanding its personhood. The confluence of organic and computational systems is seen as the primary means for life expansion.

The quest for overcoming mortality can be traced to ancient alchemy, but it is not until recently that the technologies, which *could* intercept the aging process of disease and death have been available. The thesis investigates nanotechnology, biotechnology, information technology and cognitive and neuroscience (NBIC) as emerging and speculative, an analysis that further leads to the concept of NBIC+. In the thesis, three areas are identified for the emerging and speculative media (ESM) for artistic, design-based approaches to life expansion. These media are regenerative media, nanorobots, and artificial general intelligence. In sum, the work points toward converging technologies of NBIC, where the research community then can select the most appropriative media for artistic, design-based approaches, move the domain of human enhancement into the sphere of life extension, explore its potential and articulate the topic of whole brain emulation of life expansion. This dissertation proposes the concept of life expansion, which directly challenges the human-centered understanding that life should be understood in biological terms and in balance with death.

The thesis encompasses a triad approach: interviews of experts of emerging and speculative technologies, field studies at laboratories where some of these technologies are being researched and developed, and a series of eight case studies that reflect an autopoietic approach in applying aspects of ESM. This empirical, qualitative method of interviews, field study, and autopoietic approach is appropriate to explore the thesis central question and its issues because the scope of the emerging and speculative technologies can be analyzed along with their state-of-the art developments, scientific work at laboratories can be observed, and, lastly, a series of case studies can demonstrate the possible interventions with the biological body. The researcher petitions artistic works that maintain an historical relationship with human augmentation and emerging technologies that actively pursue life extension within the realm of the thesis' proposed new media for life expansion.

The dissertation's original contribution to knowledge is explained through the contemplation of emerging and speculative media, which makes possible the concept of life expansion and offers critical inquiry into how appending the human, enhancing the biological body and expanding personhood constitute a compelling vision of the transhuman / posthuman. Through this knowledge new openings can emerge within artistic, design practices that engage technology to append, modify and enhance the biological body in seeking to extend human life and expand persons through projects such as whole body prosthetics and whole brain emulation within computational systems. The scope of investigation and resulting knowledge, which is explained in Section 8.2.3 herein, endeavors to provide a theoretical basis for artistic, design-based approaches that explicitly seek to expand the cognitive functioning beyond biology species-typical norms and, in doing so, develop new ways of examining the continuum of life and contemplation of life and death.

1.2 Thesis Terminology

Terms used throughout this thesis are explained below:

***Human enhancement* –** Human enhancement is a loosely defined concept. For the purposes of this research, the thesis defines human enhancement as the use of emerging and speculative technologies for the strategic enhancement of physiological functions, both somatic and cognitive, that seek to increase performance beyond biological capabilities, including regeneration and replacement of these functions.

***Cybernetics* –** Stemming from kybernēt (Greek) meaning *steersman*, cybernetics is the scientific study of "control and communion in animal and the machine" (Wiener 1948:i). Cybernetics is a transdisciplinary approach to systems and their structures, constraints and possibilities. Second-order cybernetics (i.e., cybernetics of cybernetics) includes the *observer* as a *participant*, rather than a spectator, of the construction of models of cybernetic systems.

***Life expansion* –** Life expansion is a term created by the author. It means increasing the length of time a person is alive and diversifying the matter in which a person exists. For human life, the length of time currently is bounded by a single century and its matter is tied to biology. Life expansion is located in the domain of human enhancement, distinctly linked to technological interfaces with biology.

Life extension **–** Life extension means extending both the average and maximum lifespan of a biological animal. Life extension refers to anti-aging medicine, gerontology, biomedical gerontology, and newer fields that address attempts to slow down and reverse aging.

Emerging and speculative technologies **–** Technologies include nanotechnology, biotechnology, information technology and cognitive and neuroscience, often referred to as NBIC, and encompass robotics, artificial intelligence, and artificial general intelligence, referred to herein as NBIC+.

Emerging and speculative media **–** The scope of NBIC+ is suggested by this thesis as the possible tools for artistic, design-based approaches for life expansion.

Transhuman / posthuman **–** The transhuman and posthuman in this thesis outline the conceptual paradigms for life expansion. The transhuman means a human biological transition toward becoming posthuman. The posthuman means a future human and/or transhuman that exist outside biology, such as a substrate-independent mind.

Whole brain emulation **–** Whole brain emulation means copying or transferring the functions of the biological brain onto computational systems. Other uses for this process include the upload and substrate-independent mind.

1.3 Thesis Question

The central question in the thesis: What are the required conditions that enable artistic, design-based approaches to human enhancement that explicitly pursue extending human life?

To answer this question, the thesis summarizes historical links to human-computer interaction (HCI) and the issue of life extension, and how these two areas could converge.

The research identifies cybernetics as the domain where HCI and, later, the domain of human enhancement emerges. The research identifies life extension as a notion emerging from alchemy's transmutation of matter, which links indirectly to scientific and philosophical inquiry about molecular matter, biotechnology and topics of bio-computational matter. Establishing this background allows one to explore philosophical issues concerning human evolution in becoming transhuman and/or posthuman and the contests and challenges of culture in which this discussion resides. Since the central question of the thesis concerns artistic, design-based approaches, one must consider what types of technology might be used to enhance human biology that could possibly lead to life extension. Focusing on emerging and speculative technology reveals that the fields of human enhancement and bioart share a fundamental inquiry concerning appending cellular systems and virtual environments. Furthermore, the notion of extended persons likewise shares an inquiry concerning human perceptions in computational systems.

In this context, the original knowledge arising from the inquiry is a different and, perhaps, new interpretation of the postmodernist orientation within the arts and humanities. The transhuman / posthuman, as approached in this thesis, proposes that one can legitimately liberate the human condition from some of the inevitable limitations it is commonly expected to encounter. The thesis has laid out the case for propelling this inquiry forward and in the open. This now becomes the theoretical proposition that drives future lines of research and inquiry.

1.4 Conditions of the thesis problem

It has been debated whether the accelerating pace of technology might alter human behavior and how computer-based interfaces might modify human physiology. Notably, biotechnology and nanotechnology have the potential to eradicate cell degeneration and unfix humans from biology. Artificial general intelligence, virtuality, and bio-artificial fusion have the potential to amplify cognition, increase awareness, and transfer cognition from biological cells onto non-biological systems. Continuity, transparency and immersivity of computer-based interactions catalyze one person and one identity into multiple, varied aspects of personhood. The significance and the outcome of these effects on human physiology could result in the design of new types of humans, new platforms for human existence, and the extension of human life indefinitely. In considering these potential paradigmatic changes, the whole community of human nature faces an observable challenge due to the developments fostering human enhancement, attempts to prolong life, and the petitioning uncertainty about human futures.

1.5 Statement of the thesis problem

Literature suggests there are a lack of artistic, design-based approaches that engage human enhancement, which explicitly seeks life extension, and the expanding of personal identity onto nonbiological systems. Conversely, there is considerable attention being paid to the use of technology to append the body and add to communications, senses and perception with the artistic works in the fields of electronic and digital arts, wearable technology, robotics, body art and bioart. The histories of human augmentation are deeply connected to computer-based projects that engage human-machine interfaces, including robotics, AI, and simulation and immersivity for augmenting physiology and extending cognition, the sensory system and physical mobility. Additionally, recent histories of organism and cellular modification are situated in biotechnological projects (bioart) that engage cloning, genetic engineering, and transgenesis for altering cell structure and performance, but not for human use. This apparent lack of inquiry signals a gap. Thus, the problem can be delineated as identifying a gap in works that augment the body but do not approach human enhancement for extending life and/or to the continuum of personhood beyond biology.

Likewise, there is a gap in works that use biotechnology to manipulate cellular matter of organisms but not for the purpose of preserving or extending sentient life.

1.6 Investigating the thesis problem

This research investigates the use of technology for artistic, design-based approaches that augment humans and manipulate organisms and the use of technology for scientific approaches that observably alter human nature (e.g., genetic engineering, regenerative medicine, stem cell cloning, artificial general intelligence), and inquires into their potential for extending life, redefining death, and approaches to whole brain emulation.

Under consideration are artistic, design-based works that append human biology (i.e., wearable technology and other apparatus) (e.g., cyborg, Warwick, Mann), modify biology (i.e., body art) (e.g., Orlan, Stelarc), create alternative personas (i.e., performance art) (e.g., Duchamp, Sherman), build personas in virtuality (i.e., avatar design) (e.g., Ayiter), and manipulate biological matter of organisms (i.e., bioart) (e.g., SymbioticaA, Kac) to ascertain if there is any evidence of works that approach the transhuman / posthuman as a specific aim. In the absence of this aim, the thesis then returns to the central research question: What are the required conditions that enable artistic, design-based approaches to enhance human that explicitly pursue extending human life?

This question influences the purpose of this study in ascertaining the following objectives:

- ***Identify the links between human enhancement, life extension, and concepts of the transhuman and posthuman and ascertain if they share an interconnected history.***

The research is identifying scientific development concerned with life extension as a transmutation of matter on a chemical (alchemy) and biological level (genomics) and looking at ways in which human-computer interaction (HCI) links to human enhancement, and how cybernetics and the cyborg link to the transhuman and posthuman.

- ***Investigate technologies that are currently researched and developed for the purpose of regenerating human biology and extending human life beyond the maximum human lifespan of 122-123 years.***

The thesis identifies NBIC convergence (a phrase that pertains to nano-bio-info-cogno/neuro) as the domain most appropriate for the research in which to focus. The author interviews experts in the fields of nanomedicine, biotechnology, artificial intelligence, cognitive science and neuroscience to delineate the scope of their research and knowledge and how they propose to intervene with biological aging and offer new approaches to increase the human lifespan. Regarding the interviews with these experts, one can distill scientific findings, state-of-the-art technological developments, and ways in which these future possibilities become practicable. The full transcripts of interviews and field study are attached as Appendix 2 to this thesis.

- ***What core elements of life are to be expanded and what type of matter might we live within?***

The author engages an historical inquiry of what life is within the realms of philosophy and science, and interviews experts in the domain of cognitive science and neuroscience who also are skilled in the sciences and technologies that explore possibilities for transferring and/or copying brain functions onto computation systems. The experts cited here within actively pursue the theoretical aspects of this issue, which the author observes during interviews and in the field study at research and development laboratories.

- ***Investigate and analyze human augmentation projects developed in artistic and design-based practices. Explore whether or not these projects intended to or intend to suggest human enhancement. If so, how? If not, why?***

The thesis cites projects that engage wearable technology, body art, photographic, filmic and virtual personas, avatars, bioart, and works that modify the human body. The aim is to ascertain how far these works go in altering human biology and if they are in any way exploring life extension. For example, the research encompasses hybrid reality and virtuality to explore ways in which artists and designer are expanding identity or self in artificial environments. Also, the author explores bioart to learn if bioartists are manipulating cellular matter for creating artifacts or if they are working in ways to extend an organism's life span.

- ***Strategize an artistic, design-based approach to life expansion that could inform future projects, which engage science, technology, art and design of human enhancement in extending life and resolving issues concerning future humans.***

The author's artistic, design based works are organized as a series of case studies divided into two parts. The first explores what this thesis calls Human+ somatic and cognitive (H+sc). The approaches in this part focus on regenerative media, a term arrived at during this research which relates to emerging and speculative media for future artistic, design-based approaches to life expansion. The use of regenerative media is found in this series of case studies. The second part explores future possibilities of uploading aspects of identity into a digital mindfile and exploring cryonics for preserving the brain.

These five objectives form the framework for articulating the concept of life expansion, offering objectives in determining how life expansion contributes to the knowledge and understanding of human enhancement, and exploring how art and design practices inform research that addresses issues of life expansion.

1.7 Methodology and Objectives

The methodological hybrid direction taken in this dissertation to address the thesis question and objectives involves a triad approach in informing an empirical, qualitative investigation of interviews with experts of NBIC+ technologies, field study of laboratories in which aspects of NBIC+ are engaged in research and development, and an autopoietic artistic, design-based approach in a regenerative media intervention of the biological body. The interviews and field study are explored in Chapter 6, including interviews with bioartists. The full set of interviews is attached as Appendix 2. The autopoietic artistic, design-based approach is explored and provides eight case studies as delineated in Chapter 7.

1.8 Explanation of Chapters

The thesis is organized in four parts in which the research question and objectives are examined. Part I outlines the thesis scope. Part II contains the literature review, which includes four chapters: “APPENDED MORTAL”, “TRANSFORMATIVE BODY”, “EXPANDED PERSON” and “CONTESTED CULTURE”, of which each is divided into three primary sections: “Decomposition and Regeneration”, “Desirability and Feasibility”, and “Autonomy and Connectivity”. Part III, “EMPIRICAL RESEARCH, QUALITATIVE INVESTIGATION: INTERVIEWING, FIELD STUDY & AUTOPOIETIC WORK” imparts the thesis’ methodological approach in two chapters: “Nanotechnology, Biotechnology, Information Technology & Cognitive / Neuroscience (NBIC)” and “Autopoiesis: An Artistic, Design-Based Practice.” Part IV constitutes the thesis conclusion.

Part II begins with an investigation of the appended mortal, symbolizing the unfixing of humans from their biological lineage and is concerned with theories of aging and the meaning of life in relation to human enhancement and life expansion. The thesis asks what is to be expanded—what is this thing referred to as *life* and *being in the world*. The author attempts to resolve this question by introducing the continuous person as a continuum of life and personhood. In addressing historical links to the human desire to live longer and defy death, one must look back to the age of alchemy as a protoscience that attempts to transmute matter, and then look forward through ways in which the concept of death has been defined as based on the use of technology to specify when a person dies.

The transmutation of matter is repeated in theories concerning artificial life and further through contemplations about nanotechnology’ molecular constructions. The author identifies cybernetics as the province in which human enhancement emerges and discusses aspects of cybernetics that pertain in part to the concept of expanding persons onto computational systems. Comparisons are drawn between the cyborg and the transhuman, advances in the field of prosthetics are outlined, and the concepts of *self* as transformative, telematic, and expanded are introduced. Ongoing investigations address human-computer interaction, wearable technology, performative art and body art, and some aspects of bioart, as artistic practices in which the human and the body are distinctive to the world of art practice and aesthetics.

Throughout the chapters in Part II, the author seeks links that identify new relationships between art, design, science and technology in forming a more vivid understanding of works that include or exclude the body from the person. Finer points are addressed such as if artists/designers are developing and building methods to augment human physiology, then why is there a transparent boundary around how much we can augment and why we should not enhance. Notably, the question emerges about a level of interest among artists across the artistic domains explored in this thesis that seek human augmentation processes but then steer away from the idea of enhancement. This inquiry engages a critique of the issue of enhancement altering human nature and, thereby, the human condition and if such human condition is traditionally and deeply linked to what we consider to be natural, or normal as biological beings.

The issue of what is considered normal needs to be sought out as possibly affecting if and how a person is enhanced. A further issue of embodiment and disembodiment also bears investigation. Here the dialectics between embodied and disembodied arise and the thesis argues that life expansion requires a body—a system in which the person exists. This notion conflicts with the usual interpretation of the posthuman in postmodernist rhetoric (Hayles 1999), yet it is not far from the mark because the varied meanings of disembodied seem to point at the same conclusion—that to exist one needs a system within to exist. The larger issue is what type of system might arise to satisfy the condition and what aspects of the person could and should be expanded. Therefore, one must examine the emerging and speculative technologies that seek copying and/or transferring the brain's functions onto computational systems.

Part III develops an analysis of technological developments that link to human enhancement of life extension and hint at life expansion. The scope of methodological inquiry involved selecting experts of NBIC+ to interview, determining what locations to conduct field studies, and investigating how these technologies could form the tools for artistic, design-based approaches. Chapter 6 presents what aspects of the NBIC+ technologies could feasibly bring about the regeneration of bodily cellular damage, reverse the damage, build new organs, and basically intervene with biology and genetic programming that causes the cessation of bodily functions and, ultimately, death. Twenty experts were selected for interviews because of their knowledge and scholarship in regards to NBIC areas and to the domain of this thesis study. Four locations were selected for field study. Additional interviews with bioartists are included as a subsection of the process because they offer perspective on how artistic, design-based approaches have already intervened with the biology of organisms and highlight insights of how these artists approach their work, which, in turn, could be helpful in developing the heuristics relating to approaches to human enhancement that seek life extension.

Chapter 7 specifically addresses the objective to strategize an artistic, design-based approach to life expansion that could inform future projects that engage science, technology, art and design of human enhancement and which extend life and address directly issues concerning future humans. The concept of Human+ cognitive / somatic themes is explored in the eight case studies in which the author intervenes with her biological body in an attempt to regenerate cells that have faltered and have become vulnerable to disease. This chapter looks more closely at what could be the emerging and speculative technologies (ESM) for artistic, design-based approaches. One approach within the scope of ESM is that of regenerative media, which links strongly to the concept of regenerative medicine and bioart. Other speculative approaches of ESM include nanorobots and artificial general intelligence. Both approaches are currently not available and rely on the hypothetical use of such media and conjecture of what could feasibly result, such as whole body prosthetics, for example. In light of this issue, the chapter includes an inquiry of the concept of Affordance Theory as "what there is to be perceived has to be stipulated before one can even talk about perceiving it" (Gibson 1986:2). Thus, from within the system, the author speculates, but not without advantages. This dissertation has attempted to cover an historical account of life expansion and take it into the future where its vision *could* be realized.

Part IV concludes the thesis, summarizing the main objectives, speculation, conjecture and outcomes of the thesis and directs further research that proposes and anticipates developing artistic, design-based models for life expansion. This dissertation forms a first step—an introduction and framework—for the concept of life expansion as a domain that has yet to be fully explored in the arts and humanities. The cyborg and the posthuman have a history, however. Yet it is the relationship of the transhuman to the posthuman, and the posthuman as an example of the concept of life expansion, that offers an opportunity for further research, speculation, theory and practice.

Appendices 1 and 2 are included at the end of the dissertation. Appendix 1 addresses the author's work during the timeframe of the Planetary Collegium sessions and the writing of this dissertation. Appendix 2 contains the full transcripts of interviews and field study observations.

This introduction establishes a preface to the thesis objectives and leads us to Chapter 2, which begins by looking at the technologically appended mortal and its relation to life expansion in exploring, among other issues, what elements of life are at the core of life expansion.

PART II

CHAPTER 2: APPENDED MORTAL

The human, as an appended mortal, is unfixing its biology and attaching more intimately with technology. Its metabolic process of decomposition stems from biological instructions—the blueprint of life—and its regenerative process is seeded by technological innovations that possess the potential for modifying its physical matter. But, what is it precisely decomposing and regenerating? What are the elements of life that are at the center of this self-motivated endeavor?

This chapter is concerned with the decomposition and regeneration of human biology, the desirability and feasibility of technological innovations, and the autonomous person and its connectivity. It considers the respective philosophical and scientific issues they provoke in relation to life expansion—that is, increasing the time a person is alive and diversifying the matter in which a person exists.

2.1 Decomposition and Regeneration

In this research, decomposition in-vivo (in body) refers to the breaking down of the body's cells. This process is known as senescence (de Grey and Rae 2007), or the result of the accumulative damage to a cell's structure of molecules that form deoxyribonucleic acid (DNA).[1] DNA contains the genetic information of an organism, tightly wound as chromosomes. Cell division, or mitosis, is the process by which a cell divides into two or more cells, known as daughter cells, a necessary process for the body to sustain. According

[1] DNA and RNA are two types of nucleic acids found in the cells of every living organism. DNA contains the genetic information and is organized into structures called chromosomes, which are duplicated during cell division, and then transcribed into RNA and transported outside the nucleus as codes to the ribosome. The ribosome, a cellular organelle, will then synthesize new proteins that will help the body grow. See http://www.nobelprize.org/educational/medicine/dna/index.html Downloaded January 2, 2012.

to the Hayflick Limit Theory of Aging,[2] the human cell wears down after each division and is limited to the number of times it can regenerate. Each time a cell divides, its DNA unwraps and the chromosomal information is copied into the newly formed daughter cells. During the repeated process of division, the tip of each chromosome, known as the telomere, shortens in length. Because the role of the telomere is to protect the DNA, as it weakens and shortens, the loss of its enzyme telomerase causes senescence[3] (Blackburn 2006). This theory of telomere shortening suggests that the loss of the telomere is directly related to aging. Whether this process is the central cause of cell aging is unknown, as there have been numerous theories on aging. What is known, however, is that cells degenerate and lose their ability to function and eventually die.

The concept of regeneration in this research refers to methods by which humans have attempted in-vivo to forestall biological decomposition. Historically, metaphysicians and the field of medicine have attempted to understand and resolve the body's physical breakdown and the meaning of aging. Regeneration processes today include nutrition, exercise and mental well-being to maintain health, and medical advances such as stem cell cloning, hormone therapy, therapeutic pharmacology, lengthening of telomeres through nutraceutical TA-65,[4] and future-oriented proposed remedies to aging through genetic engineering and neuropharmacology. Regeneration can also be understood as a means to extend physical behaviors, such as mobility and communication, outside biology as an expansion of the body through technology. The dialectics between biology and technology concerns how humans might append biology by restructuring biological behaviors through

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[2] The Hayflick Limit theory was developed by Leonard Hayflick in 1961. The theory suggests that there are a limited number of times a cell can divide, approximately 50 times, and then enters a state of senescence. Each divide shortens the telomeres, an enzyme located at the tip of the chromosome. A shortened telomere makes it impossible for a cell to further divide, causing aging (Hayflick & Moorhead 1961).

[3] Dr. Elizabeth Blackburn, molecular biologist, developed the theory of Telomere shortening, launched the field of telomere research and investigated effects on science and life extension (Marsa 2007).

[4] TA-65 is a "natural" molecule derived from the Astragalus plant, a Chinese herb used in ancient times. Currently developed by T.A. Sciences in affiliation with Geron (T.A. Sciences 2011).

augmentations, modifications and enhancements, such as with prosthetic appendages and wearable technology.

The dialectics engage biotechnology, nanotechnology, information technology, robotics, artificial intelligence, and cognitive and neuro sciences, also known as NBIC (Roco & Bainbridge 2003), and propose herein to be what this thesis refers to as *emerging and speculative technologies* that might provide the means to extend life significantly and at some point might be used to copy or transfer neurological functioning onto nonbiological systems (Koene & Goertzel 2011; Hayworth 2011; Bostrom & Sandberg 2011). It becomes necessary, therefore, to ask what it is that we are referring to when we say *regeneration and decomposition of life* and, further, what elements of life are worth regenerating.

2.1.1 Life and the Living

This thesis is concerned with life expansion. To delineate, life extension means increasing the length of time a person is alive. Life expansion includes the meaning of life extension—to increase a person's lifespan—and, further, seeks to explore possibilities for diversifying the matter in which a person exists. For human life, the length of time is bounded by a single century and its matter is tied to biology. Life expansion is located in the domain of human enhancement, distinctly linked to technological interfaces with biology. The core concern is the process of the life being lived and, more concertedly, what aspect of life is to be extended through time and what type of matter might it be expanded into or onto.

Thus, when asking "Why life expansion?" the question of what it is that is to be expanded comes into play. Is it the body and its biological cells, the human mind and the unsolved mystery of consciousness, the species as a whole, and/or the individuated person, along with its distinct virtual selves. Or, better yet, we might ask: what core elements of life are to be expanded and what type of matter might we inhabit?

Intrinsic to all living matter is this psyche—"the first principle of living things"[5] (Goetz & Taliaferro 2011, 19). In *De Anima*, Aristotle's inquiry of psyche [ψυχη] proposed that "[t]he [psyche] is the cause or source of the living … it is (a) the movement, it is (b) the end, it is (c) the essence of the whole living body" (i.e., what is composed by both (a) and (b)) (Ross 1931). This thesis recognizes Aristotle's understanding of psyche as significantly related to life expansion. Notably, this thesis does not suggest or argue for dualism or a non-dualist approach to life expansion, but does adopt the philosophical view that to be alive one must have a mind and that one option for life expansion in regards to a materialist and functionalist approach is to locate the mind within the brain defined as an organ in which electrical and chemical processes take place in forming cognition and perception.

The approach to life and living in this thesis recognizes the Aristotelian view of the psyche in relation to life, and that articulated by media theorist Eugene Thacker. In *After Life* (2010), Thacker addresses what he calls a "problem for philosophy" (2010:x). Two concepts that Thacker notes are significant to this thesis: (1) the "time and temporality" of life and (2) the "form and finality" of life. Thacker's perspectives are relevant because he looks at life outside the scientific-biological-medical perspective and the mechanical-technological sphere, and thus the tension between them. Thacker's study on "after life" is consequential to this thesis in that life as living, including time and matter of life expansion, is a type of "life after life" (xiv).

Thacker approaches the issue of what is life by introducing an ontology of life. He identifies and articulates two aspects of life that parallel the expansion of life as it is understood in this thesis. First, that life manifests in instances and, second, that those who are living denote the manifestations of particular instances (17). This observation is derived

[5] See http://classics.mit.edu/Aristotle/soul.html Downloaded December 20, 2011.

from Aristotle's use of life as the concept of "life-in-itself" and the "now" that you live as "the living", including "any and all the instances of life" (17). For life expansion, the idea is to stay alive. Life in and of itself is necessary, to be sure, but it is you—your personhood—the "now" of being alive and the continuation of the instances of "living" that denotes life.

What are we if not the aggregate of the cells that form us? In *What is Life?*, Lynn Margulis brings us directly into bodily matter as an evolutionary conglomeration of bacterial strains (Margulis & Sagan 1995) where life is "the transmutation of energy and matter" (215) in performing an autopoietic behavior (6). Margulis' proposed theory of "symbiogenesis"[7] suggests that we comprise a conglomerate of life forms—that as animals, humans are nucleated cells descended not just from a Darwinian theory of natural selection and common ancestry (Darwin 1859), but from ancient bacteria, which themselves comprise different strains of bacteria (Margulis & Sagan 1995). The idea of a symbiogenesis becomes an underlying theme throughout this study[8] as a *biotechnogenesis* of emerging and speculative technologies, which form the media of life expansion.[9]

Although the author suggests the term *biotechnogenesis* for the process by which biology and technology synthesize in producing an origin by which new transmutations might emerge, in *Deleuze and Philosophy: The Difference Engineer* Keith Ansell-Pearson refers to the phrase "bio-technogenesis" (1997:182) in relation to the "collapsing of bios and technos into each other" as "politically naïve" (182) and what he calls a "spurious

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[6] Margulis writes: "Changing to stay the same is the essence of autopoiesis. It applies to the biosphere as well as the cell. Applied to species, it leads to evolution" (Margulis & Sagan 1995:31). To contextualize this statement, Margulis mentions Willem de Kooning's artistic reflections on abstract expressionism and that "[i]f you write down a sentence and you don't like it, but that's what you wanted to say, you say it again in another way. . . You have to change to stay the same" (2000:31).
[7] Symbiogenesis is a term coined by the Russian biologist Merezhkovsky and, developed by others such as Kozo-Poliansky (Khakhina 1979).
[8] Margulis references Ivan Wallin's seminal work in developing the theory of "symbionticism" also referred to as "the formation of microsymbiotic complexes" as a process by which new species form. (He meant new species form by the permanent acquisition of symbiotic bacteria" (Margulis & Sagan 1995:133). Wallin's theory is concretized in *Symbionticism and the Origin of the Species* (Wallin 1927).
[9] Specifically, biotechnology (genetic engineering, stem cell cloning, etc.), nanotechnology (nanomedicine and molecular manufacturing) and artificial intelligence (artificial general intelligence).

claim that with the coming of computers and the arrival of robot intelligence the planet is now entering a 'silicon age'" (182). Ansell-Pearson shows a clear understanding of the influence of Margulis in writing "…the fact that metallurgy has an ancient pre-human history, with human metalworking following the bacterial use of magnetite for internal compasses by almost three thousand million years (Margulis and Sagan 1995:194)" (182). Of consequence in this thesis is the tension noted by Ansell-Pearson and through his observations that when it comes to issues on matters concerning life and silicon (or extending life, morphing life, and the symbiotechno-genesis of life), a certain nerve is touched. This nerve links to the socio-political issues of human enhancement expressed by bioethicists, including Francis Fukuyama and Leon Kass, as turning the human away from biology, and thereby, in large part, the necessary and essential biology. Yet, according to Ansell-Pearson, we have always been, in part, silicon. Thus, As Ansell-Pearson argues, we are not upon a silicon age, it was already here—that the very historical beginnings of human have contained, and continue to contain, elements of silicon in what Margulis delineates as bacterial magnetite and, more recently in human historical roots in the augmentation of the body through varied metals of technology, such transportation and communication devices, including tools for warfare, arms, and bodily appendages for medical intervention.

This notion sheds light on life as a process that can be contemplated in relation to what this thesis proposes as an artistic language of life expansion. Thus, the ecological relationships between and among elements of life, being fundamentally nutrition, motion and reproduction (Hicks 2008), the potential for innovative technology to extend the human lifespan, and the artistic potential to develop alternative platforms for existence converge to a new idealization. This convergence forms a transmutation (as in symbiogenesis) of the human in what is not just a horizontal process (as in the horizontality of the Darwinian theory), but also an autopoietic, cybernetic process.

If the goal of transformative human enhancement of the appended mortal is to bring about new media technologies for artistic practice in developing novel artistic approaches to life expansion, then the process of decomposition must be at the center of the process of regeneration—going hand in hand, as one cannot exist without the other. Regeneration is of consequence to biology and the life and death of the individual. It is relevant that prior to becoming an individuated person, one has no recollection of existence and, likewise, after being alive, after death, one has non-existence and, therefore, a person's "being in the world", or any world, is fundamentally unknown (Thacker 2010:4). Nevertheless, this thesis is concerned with existence now, not prior to birth or after death as a finality of life. Furthermore, it is this *presence* of being alive that forms the motivation to continue being alive (6). The motivation for staying alive is met by the motivation for defeating death, passionately summed up in the Dylan Thomas poem: "Do not go gentle into that good night" and its refrain "… rage, rage against the dying of the light"[10] (Thomas 1951).

However adamantly expressed or silently confirmed, this rage reflects, in part, the biopolitics of human enhancement of the late 20th century and the early 21st century. The culture of new agers, life extensionists, feminists, cyberpunks, transhumanists, posthumanists, avatars, transsexuals, bio-hackers, geeks, and others, support and encourage bodily, sexual and psychological diversity and multiplicity. The rage for those who desire to live longer—well past the current maximum lifespan—is largely for a socio-political change of the dicta of traditional codified "normal" and "normality" (Miah 2004:110, 126) that prescribe a set of universals, as developed by the Western world, about not just what

[10] The poem "Do not go gentle into that good night" by Dylan Thomas (1951) speaks a certain passion about death and dying. Interpretations of the poem suggest that it was written to speak out about his father's illness and fight against death or Thomas' own imminent death, and/or his own life of having to survive a childhood illness.

man and woman are, but that death is a natural process of life (Fukuyama 2002).

Insight into such biological morphology—including its transformative characteristics and the prospect for extending life—dates to the protoscience of alchemy. The next section identifies alchemy and the lore of immortality[11] as an historical link to human desires to overcome death.

2.1.2 Transmutation

In *De Divisione Naturae,* Johannes Scotus Eriugena esteems that the universe is an "emanation" of life itself. If life is the universal and, if the whole of nature is alive, is death not just a transmutation of matter, thereby affirming that nothing is dead or inanimate? That the universe is infinite and eternal and that all of nature is based on interactions between atoms in perpetual movement could indicate that the classical elements—earth, water, air and fire—within nature are in motion, including life and death.

As a note of reference, *De Divisione Naturae* is interpreted as "the division of nature" and Johannes Scotus Eriugena, a ninth century theologian often referred to as John Eriugena, read *De Anima* and was influenced enough to contemplate issues on *being* and *non-being*. Although this thesis is not influenced by any one religion and does take an agnostic approach to the philosophical issues of life and death, it thereby interprets early writings concerning life and being as philosophical, and even ideological, rather than theological. The proposition of Erigena concerning being and non-being is significant in this study because the four classes of nature, as described by Erigena, discern that which creates and that which is created, and its converse. Because this thesis suggests that human enhancement and the explicit pursuit of life expansion stem from cybernetics, and especially second-order cybernetics, and that the cyborg has a relationship with the

[11] Notably, in this thesis radical life extension and life expansion, rather than immortality, per se, is the approach to the argument of redefining death as a series of episodic events rather than the final end of life and the living.

transhuman, what is being and non-being and what creates and is created are significant distinctions from a philosophical perspective.

2.1.2.1 Science of Alchemy

> Wei Po-yang called his students together and said,
> 'I think I have succeeded in making the pill of immortality,
> but before we take it, we should test it on the dog' (Chia).

The study of alchemy, developed through many civilizations and with earliest traces to the Taoists, spans many centuries and is recognized as a protoscience and the forerunner of the field of chemistry (Read 1936). Identifiably, alchemy reminds us of human curiosity, exploration, and the inventions that reflect the issue of human desire in its aim to resolve human mortality.

The metaphysical lore of alchemy illustrates a desire to alter the elements of nature, including human composition. The protoscience of alchemy originated in China approximately 5000 BC (Read 1936:122). The technology of alchemists consisted of two tools—the mortar and pestle—but the use of these tools was esteemed to be that of a magnificent nature. That is, to turn metal into gold—an extraordinary notion, and one that has similarities with chemistry today relative, for example, to the altering composition of cellular molecules of genetic engineering and the proposed molecular manufacturing of nanotechnology (Drexler 1987).

The early search for an elixir of immortality was supported by nobility and soon established as a high art. Taoists who practiced longevity claimed to be experts in immortality, called the *fang-shih* (Wong 1997:121) (masters of the formulae) and established techniques of prolonging life through physical exercise, sexual art of joining energy (184), and ingesting alchemist's minerals. The father of alchemy, Wei Po-yang, was exempt from this elitist group and is said to have lived humbly in the mountains where he experimented in his laboratory. Here Wei Po-yang attempted to transmute base metals into an atomic structure of gold (Bentor 1996). His aim was to develop the "pill of immortality" (Read 1936:12), a potion of which its properties promised a total regeneration of the body and all its physical attributes (Read 122). Legend has it that Po-yang concocted this "pill of immortality" and fed it to his dog, himself, and his apprentice, only to rise immortal in the heavens (Wong 1997:67-68). While little is known of Wei Po Yang, and most historical information is legend, he is recognized as "the author of the first full treatise on the subject of transformation and authored the full treatise on the subject, the *Ts'an T'ung Ch'i* or 'Relatedness of the Trio' a title the meaning of which remains obscure" (Grumman 1977:52).

In the mortal human, biological cells are preordained by their mortality. However, an appended mortal suggests the regeneration of cells as a transmutation of matter. Thus, the transmutable aspect of alchemy—of altering one element into another—is also recognized in genetic engineering's and nanomedicine's attempts to alter biological cells with computational codes. Medicinal and pharmaceutical chemistry are modern-day descendants from the early protoscience of alchemy and have succeeded in reversing some effects of cell damage and prolonging the elements of youth. Advances in nanomedicine and neuropharmacology suggest the potential for regeneration.

One might ask, *if* regeneration were developed, why one would want to be immortal. Immortality can be seen as a type of incarceration or confinement to living—imprisoned in a state of existence, calling to mind the play "No Exit."[12] To adequately address this concern, it is appropriate to ask what alternatives there are to death and an immortal existence, a question substantively addressed by the notion of optional death in Section 2.4.1 of this thesis. Nevertheless, as the quest for immortality is mythic, a more

[12] Jean Paul Sartre's play "No Exit" (1944) illustrates an existence where the players are sequestered to a never-ending existence.

practical approach is needed today in considering the potential of emerging and speculative technologies and their intervention in biology for the purpose of determining physical death and for developing ways in which humans might live longer. This engages the possibilities of artistic, design-based approaches that might offer new insights and possibilities for alternative bodies and environments for life expansion.

2.1.3 Death's Criteria

In Section 2.1, this thesis discussed cellular decomposition and senescence (de Grey & Rae 2007) and noted the Hayflick Limit (Hayflick & Moorhead 1961) and the telomere shortening (Blackburn, Greider & Szostak 2006:113-138) theories concerning aging and cell death. The correlation of death to life is often delineated in regards to a person's lifespan, which refers to life expectancy and the maximum lifespan for all humans. Life expectancy relates to the expected number of years for human life, which can be based on genetics, gender, geographic location, epidemics, war and famine. Maximum life span relates to the recorded maximum number of years a person has lived (Walford 2006). Currently, the maximum life span for humans is recorded to be 122-123 years.[13] The linear, numerical recording of the human lifespan is important to the appended mortal because life expectancy has been increasing over time, even though the maximum life span has not yet increased (Walford) in cultures and societies throughout the world.

This thesis approaches maximum lifespan as impermanent and mutable. While the clinical definition of biological death and its criteria, as understood in the Western World, is the "permanent cessation of life in a person, animal, or plant, in which all vital functions cease permanently" (Webster 1979), the criteria for death have changed over time and might continue being revised as researchers probe the unknowable and develop greater

[13] Jeanne Calment is noted to the oldest confirmed recorded age for any human. Ms. Calment was featured in *Wired* magazine's 2000 issues "Don't Die, Stay Pretty." Alexander, Brian. (2000) "Don't Die, Stay Pretty" in *Wired*. Issue 8.01 Jan 2000. See http://www.wired.com/wired/archive/8.01/forever.html

understanding of the causes of death and ways in which to circumvent it.

2.1.3.1 Criteria Explained

Multi-cultural histories—philosophical, religious, spiritual, and tribal—have formed belief systems about death in different ways and with different values and interpretations. Recognizing the broad spectrum of beliefs throughout the world compels us to examine our own lives, beliefs and circumstances, the timeframe in which we are alive, and our personal relationship to death. Because all humans have or will experience death, this section asks: What does it means to die—what happens to our bodies and to our identity? Does the timeframe in which we live affect how we die and what precisely happens on a molecular level when cells die?

According to Gregory M. Fahy biogerontologist and cryobiologist at 21st Century Medicine:

> The molecular components of living cells are constantly being broken down and built back up again. Molecular modules will last until (a) they are hydrolyzed by direct, spontaneous reaction with water, (b) they are transformed into something else by extraneous reactions such as oxidation or other forms of random damage, or c) they are absorbed by a living entity and rebuilt into that entity (Fahy 2007).

All molecules are made of atoms which are, for the most part, indestructible and, thereby, immortal. However, the most stable state for atoms of living systems is as molecules, not as isolated atoms. Atoms are more stable when joined together than when isolated and, thus, at present one cannot visibly see the decomposition of living systems all the way down to atoms.

> The final most stable state of biomolecules at the end of all possible degradation is, for the most part, carbon dioxide, water, nitrogen gas or nitrogen compounds, and sulfur compounds, with inorganic and trace amounts of organic minerals (Fahy 2008).

If atoms are the elemental components from which all cells are derived, then why does programmed cell death occur? Atoms and cells are phenomena on different levels; yet, it is the organization of the molecules, which contain atoms, that forms a system such as a cellular system. The dynamics of apoptosis concerns molecules interacting, where individual atoms do not occur other than as constituents of the molecules. When the cells die it is because the molecules that form them are no longer in the same position or organization and, therefore, not capable of performing the necessary cell functions. Thus, cell death occurs because the molecules, containing atoms, have been rearranged by metabolic processes or by the effects of random damage. Of consequence is that the atoms may still exist, but because the molecular position or organization has changed, they are prevented from performing their functions and unable to assist the efficacy of a cell's role in relation to the entire system of the organism.

Fahy advises that normal biological life requires the death of cells and the division of cells to generate new cells so that a balance is maintained in bodily sub-systems such as the digestive system, reproductive system, and pulmonary system. In the adult human, more than a thousand billion cells are created every day. At the same time, an equal number of cells die through a controlled "suicide process" (Alberts, Johnson & Lewis 2002:1014), referred to as programmed cell death. In short, cells kill themselves to halt the spread of disease. There are other causes of programmed death, and while this thesis is not specifically focused on the research performed in this area, worth mentioning is the research in cellular programming for biophysical chemistry at the Max Planck Institute of Biophysical Chemistry in Göttingen where studies of the gene Apaf1 (Apoptotic protease activating factor) acts as a switch in the chain of the molecular processes triggering a chemical reaction which eventually switches off cells, which lead to their death:

> Scientists at the Max Planck Institute of Biophysical Chemistry in Göttingen have shed light upon the function of the gene which acts as a switch in the chain of the molecular process and which leads to the death of a cell.
>
> This gene, Apaf1 (Apoptotic protease activating factor 1) plays a central role in

> programmed cell death in mammals. The scientists were also able to better define the position of the corresponding gene products in the hierarchy of events which lead to cell death (Cecconi, Alvarez-Bolado &Meyer 1998).

In approaching the degeneration of life and that which is living, it is necessary to revisit this study's earlier discussion. In Section 2.1.1, we discussed Aristotle's philosophical theory of psyche, and the cause or source of the living body. In this section, we introduce a scientific theory, which corresponds to Lynn Margulis' notion of bacterial conglomeration and autopoiesis. According to Ilya Prigogine[14] and Isabelle Stengers in *Order Out of Chaos: Man's New Dialogue with Nature* (1984), a living organism is an "open system" (xii) and one in which matter and energy are exchanged within the environment" (Prigogine 1997:61) and for the human system, consciousness is intrinsic and instrumental. For the transformative, appended mortal, this study applies Prigogine's and Stengers' meaning. However, for the purposes of this thesis, *the environment* is understood as *an environment* to clarify that there may be a number of environments wherein living organisms could exchange matter and energy. As previously discussed, the idea of *matter* is not limited to a biological definition, but also encompasses different types of substrates (e.g., computational) which could contain life and that which exist in or upon non-biological systems.

Definitions of death are based on observation and prognosis in meeting certain criteria as proposed along the lines of the currently available knowledgeable authority of death. But how dead does someone have to be to be dead? A limp, cold and immobile body was once considered dead, but a person could be unconscious and reawaken either with or without technologically-assisted resuscitation. A seemingly quiet chest exhibiting stillness

[14] Prigogine chose to attempt investigation of a third and largely ignored class of systems - those which were far from equilibrium. The authors have subtitled their publication "Man's New Discourse with Nature," and progressively introduce and discuss the conceptual differences between the traditional mechanistic interpretation of the so-called laws of cause and effect as well as the inability of this paradigm alone to provide explanation for that class of phenomenal systems in which equilibrium conditions are not maintained.

rather than a beating heart evidenced death, but then a heart could continue to beat so quietly as to remain unobserved or invisible to human or technical monitor. Once, a candle's still flame could determine a loss of breathing, but as with a limp body and quiet heart, then the nostrils' weakened breath might go unnoticed. Testing the pulse in dominant anterior veins of the wrist, the neck or the groin suggested a total loss of blood flow, but then a person's blood flow could resume again with a strong push on the chest, a force of oxygen into the mouth, or a slap to the face. The observation that someone whose heart, lungs and pulse have stopped functioning for a period of time is no longer considered an acceptably full and accurate diagnosis that a person has ceased to exist for all time.

2.1.4 Death's Possible Futures

> We should evidently be wrong in wishing to treat the creation of artificial life as a Hoffmannesque[15] phantasy, for there is no doubt that science thinks of it and considers it realizable (Finot 2009:270).

For the appended mortal, this thesis applies concepts suggesting the most reasonable way to deal with the topic of death's possible futures, noting that it has been deeply discussed with varied and conflicting beliefs in numerous fields—most especially, philosophy and science. There are many potential directions to take when conceptualizing new modes of death and how death might be redefined. To concretize a basis of understanding in this dissertation's research, one must understand that the possible futures of death would rely on the most reasonable approaches, and these approaches which *might* lead to prolonging life and sustaining persons over time within semi- and non-biological systems. This section approaches the task of redefining death to incorporate notions of optional death, reversible death, and partial death. The fear of being misdiagnosed as dead can be more frightening than death itself. Medical technologies now provide microscopic determinants of death but

[15] Finot is referring to Ernst Theodor Wilhelm Hoffmann (1776 -1822) (pen name E.T.A. Hoffman), a German author of fantasy and horror, as well as a composer and caricaturist.

the misdiagnosis of death is possible. The author does not intend this to be a diversion from the focus of the research, but more to offer an insight into a growing concern about how and when a person is actually dead. For example, a person might have a biological death but continue, immediately or sequentially, to exist in another substrate, such as in cryonics. Notably, this might be looked at as a transformative or transitional stage of life, relying heavily on emerging and speculative technologies to reverse death.

The cessation of existence, meaning the bodily entropy and biological breakdown of the brain stem and the neurological functions of the neural cortex, concerns the appended mortal primarily because of this thesis' objective appending human mortality. The cessation of existence is also of consequence outside the biological dimension where consciousness, memory, and other cognitive properties could, in principle (as a functionalist view of mind/life), be transferred onto non-biological platforms in which a transformative human's distributed identities might continue to exist.

This section recognizes Jean Finot (1856-1922), French social scientist and activist, as an early voice that can still be heard today louder, perhaps, than it was during his own lifetime. In *Philosophy of Long Life*, Finot writes:

> The possibility of the prolongation of our existence well beyond a century, the narrowing of the limits of old age, the removal of the horrors of departure, the resurrection of the body in many forms of infinite life, are all things which tend to bring peace to our saddened and fearful minds (2009:v).

But it was not just prolonging life that Finot opined for; it was creating new types of humans. While this study does not side with Finot's vision of the homunculi[16] as the future human, it does recognize Finot's early vision that human biology would change in ways that would support life extension. Even though Finot proposed the course of willpower and

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[16] See http://en.wikipedia.org/wiki/Homunculus Downloaded June 13, 2011.

determination as a means for prolonging life, (Finot 2009:83), reductionism and materialism held the key for understanding, manipulating life.

> In Finot's philosophy, biology is reducible to chemistry and physics, and the complexity of a living organism is reducible to an interrelation of its components. Such a reduction, according to Finot, opens the possibility for engineering life, and eventually for life's indefinite maintenance. Through 'fabrication of living matter,' Finot believed, sentient, immortal beings can be created. Finot was apparently among the first to earnestly discuss this possibility in terms of modern biology and organic chemistry (Stambler 2010:14).

While Finot offers a futuristic scenario, he did not propose the methods for achieving it. The next section looks at possible futures for redefining the criteria of death.

2.1.4.1 Digital, In-Between, Optional

Second Life artists Marc Owens and Tony Mullin created SABRE & MACE, "a company that offers virtual characters the opportunity to experience death as a digital process when closing their user account permanently. The project examines the notion of feeling sentimental toward a virtual character and examines the link between sentimentality and tangibility" (Regine 2008). This death ritual is a means of saying good-bye to an inoperative synthetic persona. The artistic approach has relevance to this thesis because while Owens and Mullin approach the cessation of a series of codes as a ritual and as a metaphor to biological death, the future possibility of nanomedicine and other computer-driven structures morphing with biology would mean that when a person dies, the body's codes would cease as well.

In *Philosophical Explanations*, Robert Nozick asks: "[i]f a person can exist in another platform - synthetic or whatever, then is that anywhere near the memory of a person existing? Is this all metaphorical without any viability? We think therefore it is - If I remember you really, really well, can my memory of you create you in synthetic form?" (1983:134-135). The novel, *The Gentle Seduction* (Stiegler 1990) tells the story of a gradual but compelling adoption of technology by a woman who becomes posthuman and who later attempts to reconstruct the love of her life who had died long ago. She uses her memories in reconstructing him in detail, but the questions left unanswered are if he is partially the person she remembers, and if he is the same man in actuality.

One example of a current practice which suggests death as a between state is the technological process of cryonic preservation. “Cryonics [or biostasis] is the speculative practice of using cold [temperatures] to preserve the life of a person who can no longer be supported by ordinary medicine. The goal is to carry the person forward through time … until the preservation process can be reversed, and the person restored to full health”.[17] Biostasis is predicated upon three assumptions: (1) that life can be stopped and restarted, as observed in embryos routinely preserved in cold temperatures which completely stop the chemistry of life, and then are restarted; (2) that vitrification (i.e., low temperatures but not freezing) can preserve biological structure through the high concentration of cryoprotectants which permit cell tissue to be cool without the formation of ice particles; and (3) methods for repairing cells at the molecular level have constituted the high probability of effective nanomedicine rather than as idle fantastical notions of science fiction. Theoretically, cryonics regards death as an event which can be prevented.

A different but related approach to cryonics is a third state—where there is no chemical activity or inactivity. It is suggested as a stabilized, chemically-locked state. According to Max More, founder of the first cryonics project in the UK in 1986 and current CEO of Alcor Life Extension Foundation:

> In the case of biostasis, the deanimate [or suspended] person’s physical embodiment is stabilized, by locking their constituent molecules in place at extremely low temperatures or by chemical fixation. Biostasis is thus a sub-category of deanimate; biostatic persons are deanimate persons whose dissolution has been arrested (before reaching a critical stage). If the technology becomes available to repair the life-threatening condition causing deanimation, and to reverse the changes caused by the biostasis technique (which may itself add further injury), the biostatic-deanimate

[17] See http://www.alcor.org/AboutCryonics/index.html Downloaded January 2, 2012.

person may be restored to life (More 1995:93).

Rather than forestalling death, a possible future scenario might be that death not be compulsory but instead stand as a possible option, thereby leaving the act of death as a choice. Optional death might be used as a type of retirement from one life mode to another life mode. More specifically, persons existing in a synthetic simulation might decide that this environment is no longer satisfactory and decide to cease existing in synthetic form and transfer their existence into a semi-biological material body. Another example might be where a person hosting multiple identities, each being a self-contained aspect of the person, experiences voluntarily or involuntarily cessation of existence, but this does not terminate the entirety of the person. Alternatively, death might be considered a means to drop out of life for a period of time and cease to exist indefinitely but not in finality or irrevocability.

Persons who exist outside the boundaries of the biological body will most likely desire to be considered living beings with certain rights. Therefore, it is apt to consider post-biological definitions of death concerning personhood. If medical science and technology develop the means to remediate brain dead patients, including the brain stem and neocortex, and cognitive engineering technologies develop the means to transfer memory and thought to alternative platforms for hosting life, it is reasonable to speculate that the definition of death will require a close re-examination of its operational parameters.

In sum, death’s criteria have changed over the centuries. Even our most efficient and well-designed tools may not fully and completely detect when and how death arrives. Thus, death’s possible futures redefine the crux of the matter of life and death.

2.2 Desirability and Feasibility

> "We must restrict our focus to the zone where desire and feasibility intersect" (Stock 2003:97).

The dialectics between the desire to extend the maximum human lifespan and its feasibility is often approached in relation to biotechnology's research climate, costs of technological developments, ethical issues, and legal ramifications. Passions can outweigh costs and this fervor keeps pounding the pavement toward progress, as we have seen through the efforts of the early alchemists in manipulating matter, or as in Nicolai Fedorov's "common task"[18] (1828-1903), and Finot's proposed fabrication of living matter. More recently, these passions continued through the work of Robert Ettinger in foreseeing human cryopreservation in *The Prospect of Immortality* (1966), in Eric Drexler's notion of self-assembling bio-nano systems in *Engines of Creation* (1987), and in Raymond Kurzweil's predilection for an age of intelligent machines in *The Age of Spiritual Machines* (2000). In light of these optimistic visions, it becomes significant that the dialectics of what might be desired and what could be feasible reach a level of logic outside the scope of an inward-looking socio-cultural activism of human enhancement's proponents.

This logic is present in *Redesigning Humans: Our Inevitable Genetic Future* (Stock 2002): "We cannot say much about the challenges that will accompany the first steps of human self-design until we examine the specific biological modifications that might intrigue us when the technology arrives" (97). According to Gregory Stock, the choices we make today are a "preview of the deeper ones we will face" (97) in the years to come, especially "because they reveal the cultural and biological desires that shape our preferences" (97). Stock is a biophysicist who worked in the formative stages that led to the current biotechnological climate. In *Metaman: The Merging of Humans and Machines into*

[18] See http://www.regels.org/N-Fedorov-1.htm Downloaded June 15, 2010.

a Global Superorganism (1993), Stock links the Gaia hypothesis[19] (Lovelock & Margulis 1974) and the noosphere (Teilhard 1959)—a thinking sphere—with a technologically interconnected approach in proposing the human as a type of superorganism—"a community of organisms so fully tied together that it is a single living being" (Stock 1993:20) at the "forefront of life's evolution from the simplest of living forms." He goes on to claim, "where this evolutionary process will lead us cannot be known" (245), but it "affirms that we are connected"(245).

These associations—a gestalt of the human and its environment coupled with the human sphere of thought as a transmutation of elements—might present an unfulfilled opportunity for artistic and design-based approaches within the domain of life expansion. Further, the proposition of redesigning humans ties firmly into the field of cybernetics, which is discussed later in this section, and sheds light on current artistic and design-based approaches to the cyborg and what this thesis discusses as the transhuman and posthuman. Because cybernetics forms the ground point for the physical augmentation of the human body, both Stock's early ideas of a type of metaman and his more recent logic concerning human desire and its feasibility suggest a maturing foundation with a practical capability that gives credence to the optimistic visions of extending the maximum human lifespan and the cultural landscape in which such visions reside.

Purporting such feasibility as unlikely, we turn to the United States Council of Bioethics the Beyond Therapy report (Kass, Blackburn & Fresser 2003). This report established an inquiry "into the potential implications of using biotechnology 'beyond therapy,' in order to try to satisfy deep and familiar human desires …" (x).

The desire for ageless bodies involves the pursuit not only of longer lives, but also

[19] Lovelock and Margulis propose that the Earth's cycling of atmospheric gases could suggest that it is homeostasis and, although this theory does not offer proof of its existence, it does introduce the notion that the Earth is alive as a self-regulating system of the biosphere, atmosphere, hydrosphere and pedosphere.

> of lives that remain vigorous longer. It seeks not only to add years to life, but also to add life to years. This double purpose is therefore likely to be better served by certain approaches to life-extension than by others. Life-extension may take three broad approaches: (1) efforts to allow more individuals to live to old age by combating the causes of death among the young and middle-aged; (2) efforts to further extend the lives of those who already live to advanced ages by reducing the incidence and severity of diseases and impairments of the elderly (including muscle and memory loss) or by replacing cells, tissues, and organs damaged over time; and (3) efforts to mitigate or retard the effects of senescence more generally by affecting the general process (or processes) of aging, potentially increasing not only the average but also the maximum human lifespan (165).

It is the third approach as presented above—that of mitigating effects of senescence in order to increase the maximum human lifespan, which directly relates to the appended mortal. In navigating this course, human desire is steered in large part by the hope for control over death.

Notably, for the appended mortal the issue is not just concerned with bodily enhancement but with the larger environment in which the enhancement takes place and the idea that humans might or could redesign themselves. Historically, if the human has augmented the body with exterior tools and exhausts its functions, then appending one's own body can be seen as an innate behavior. The specific issues here are the desire to enhance, most likely out of need by those who suffer from disease or injury, and the feasibility of enhancement (whether such enhancement are for therapeutic reasons or a selective choice to improve) and whether tools for enhancement can be developed, and thereby the practicability of enhancement. Notably, Stock addresses this concern, "[t]he desire to triumph over our own mortality is an ancient dream, but it hardly stands alone" (2002:9) … "why not acknowledge that what we really desire is not shorter morbidity at the end of life, but a life that is both healthier and longer?" (80). Yet, practicability interferes with this desire, as Stock notes: "We must restrict our focus to the zone where desire and feasibility intersect" (97). This zone parallels that of artistic, design-based approaches because (i) artistic concepts are interpretable and our use of them is not necessarily accountable in terms of a narrowly prescribed accuracy and (ii) design-based processes are structured to find solutions or to meet specific needs. Nevertheless, in order to add to the scholarship of the vision it must have a theoretical basis and/or practical and doable result.

2.2.1 Cybernetics

The province of human enhancement can be seen as having emerged from cybernetics, a transdisciplinary approach to systems and their structures, especially in regards to control and communication in the animal and the machine. Thus, it is here where concepts of the human and machine integrate[20] and the computer begins to interact (Wiener 1950:163) with the human body and its biology.

For the appended mortal, the cybernetic focus on control, feedback, and homeostasis are aligned with the fundamentals of building new types of human bodies and new types of platforms for existence (i.e., computational systems).

The term homeostasis (Greek) herein means standing still in either an open or closed system. Defined by Claude Bernard and Walter Bradford Cannon in 1926,[21] homeostasis is most often used to refer to a living system or living organism (milieu interieur, a term coined by Bernard).[22] In this thesis, biological homeostasis is the multiplicity of dynamic balance, adjustment and regulation of life and "that which is living" in order to extend the maximum life span of the human organism and to expand "that which is living"; the *that* being *personhood* (personal identity) inscribed onto semi and non-biological systems. This process would require the principles of homeostasis as being structural, functional and behavioral. The counter argument here is that homeostasis could ignore or refuse potential positive adjustments, as in risk homeostasis or stress homeostasis,

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[20] In the last chapter of *The Human Use of Human Beings*, Wiener discusses "semi-medical purposes for the prosthesis and replacement of human functions which have been lost or weakened" (Wiener 1950:163) in certain people.
[21] See http://en.wikipedia.org/wiki/Homeostasis Downloaded May 15, 2010.
[22] See http://en.wikipedia.org/wiki/Milieu_interieur Downloaded May 15, 2010.

which will be discussed in the section on biopolitics.[23]

Although human enhancement incorporates bodily appendages for increasing functionality (Roco & Bainbridge 2003), it is the regulation of homeostasis that most directly affects the body's sustainability and eventual preservation. Humanity's attempt to control its physiological capabilities and attributes and the desire to alter, modify, and to change these abilities and attributes, while developing an equilibrium for life expansion, suggests a need for homeostasis, especially as a cybernetic approach—one that reflects continuous change and adaptation.

The most significant and strenuous contrast, metaphorically understood, is in the ultimate struggle against entropy of decay in sustaining life. "Life is an island here and now in a dying world. The process by which we living beings resist the general stream of corruption and decay is known as homeostasis" (Wiener 1950:95). It is here that Norbert Wiener forms a necessary connection between cybernetics and the primary aim of human enhancement, as recognized by this thesis, that of increasing "control and communion in animal and the machine" (Wiener 1948:i). The transdisciplinary of cybernetics in approaching the homeostasis by attempting to overcome physical and cognitive frailty and ultimately extend the maximum life span, can be understood as resisting the process of entropy. Further, the human struggle against entropy is felt on the physical and emotional levels, as the awareness of being alive and aversion to decay is a strong motivation to continue being alive (Thacker 2010:6).

Wiener notes, the "[o]rganism is opposed to chaos, to disintegration, to death, as message is to noise" (1950:x). It is highly relevant that Wiener's theory of messages ultimately does relate to the issues of expanding personhood onto computational systems because it is not only the extending of life within the biological system that links to the

[23] See http://www.claude-bernard.co.uk/page19.htm Downloaded January 2, 2012.

scientific approach of cybernetics, it is also the issue of overcoming entropy or chaos and the resulting drive, or the will, of persons to continue living.

For example, expected or random interference, such as noise, that appear to disorganize a system by causing chaos could, in fact, challenge the system and become catalytic in the systems ability to breakdown or strengthen and then to evolve and sustain. Notably, noise can be neutral. It is the relationship of noise to the system that affects its structure or content.

For the human, homeostasis concerns maintaining order of a biological system. The expansion of personhood outside biology could disrupt this order and, thereby, trigger a challenge to human behaviors and personal identity. Wiener explains that "[i]nformation is a name for the content of what is exchanged with the outer world as we adjust to it, and make our adjustment felt upon it" (Wiener, 1954, p.16). According to Wiener a message is "a sequence of events in time which, though in itself has a certain contingency, strives to hold back nature's tendency toward disorder by adjusting its parts to various purposive ends" (Wiener 1950, 1954:27). That people and their bodies have adapted to external appendages and augmentations reflects upon the idea of an intentional adjustment to circumstances. In this way, the continuous diachronic person (personhood) can be seen as the message itself. Thus, the idea "message as to noise" (1950:x) could be analogous to "identity as to expansion". This topic will be discussed in Chapter Four; nevertheless, it is at this point that the elements of control and feedback serve this study in regards to autopoietic motivations.

Second order cybernetics is often aligned with the autopoietic approach; accordingly, the steersman, or the persons who desire to life expansion, is the active participant in their own evolution. As cyberneticist Ross Ashby wrote: "The chisel in a sculptor's hand can be regarded either as a part of the complex biophysical mechanism that is shaping the marble" or as "part of the material which the nervous system is attempting to control" (Ashby 1954:39). One could infer that the aim or desire of the human intellect in performing a creative task is a central, essential process of the nervous system, where the role is to stream information through the nerves to help the organism react, remember, think and plan. The appended mortal suggests the potential of human enhancement and life expansion and, in order to continue living, must find a level of equilibrium within its own structure and environment. All aspects of a process of homeostasis point to, as Ashby notes, "ultrastability"[24]. A central interest is the fully delineated boundary or border between human and machine, rather than a unified system wherein the division of the organism and environment become vague. The self-sculpting or redesigning of human with technology is a means to incubate a new type of human. Not only does cybernetics provide feedback, regulation and control of human-driven machinery, it also provides a means with which to explore the elements of observer and environment, placing the observer within the environment as a self-regulated organism (second-order cybernetics (Mead 1968)).

Apter (1969) argues that "cybernetics may itself be regarded in certain respects an art form in its own right" (257). Apter demystifies cybernetics by identifying three fundamental concepts within cybernetics: information theory, control theory, and automata theory. Each one of these concepts has relevance to this thesis in regards to the specific aspects of these theories as follows:

(a) information theory: "the inverse relationship between probability and the amount of information: the less probable an event, the more the information when it occurs" (258). This applies to life expansion in that as more people are informed of and obtain knowledge about the potential of emerging and speculative technologies to extend

[24] Ashby coined the term "ultrastability" as a higher degree of order than a systems single field of stability, a type of meta-stability (Ashby 1956:vi). See http://pcp.lanl.gov/books/IntroCyb.pdf Downloaded April 6, 2012.

the human lifespan, the less information the concept will have when it occurs. Today, there is significant confusion about the benefits and dangers of such technologies (Kass, Blackburn & Dresser 2003); thus, an abundance of symbols, images, words, and messages that overload the clarity of information. As people and society learn more, the quantity of information will be reduced.

(b) control theory: “systems which control themselves toward goals … [as] exemplified [in] … homeostatic systems” (Apter 1969:258). Life expansion concerns the living system and its ability to continuously correct itself as it adapts, evolves, and changes in achieving the desired “end-state of being” (260) in its desired form and/or environment. Metaphorically, one can see a similar kind of system that pertains to the transitional stages of human to transhuman and to posthuman. Each stage defines the state in which a person is alive within a system (e.g., a system meaning the biological body, a bionic prosthetic body and, later, a computational (artificial) platform).

(c) automata theory: “an ideal, an archetype, rather like a diagram in Euclidean geometry in which we do not have to take into account the thickness of the lines” (260). Life expansion cannot be proved, yet it must be articulated and presented as a notion that has an historical link to knowledge already sought. It also is viable, has value and, importantly, is feasible. Thus, the aspect of automata theory that is concerned with not only the ideal but also “whether certain kinds of behavior can and cannot, in principle, be achieved by different kinds of systems” (260) is applicable to life expansion. Thus, if the ideal is targeted toward life expansion, then the question becomes, as mentioned in (b) above: What are the conditions that could support a person to live in non-biological systems?

2.2.2 Human Cyborg

Bionics, a term coined by Jack E. Steele in 1958[25] may have originated as a use of the Greek term βίος, meaning a unit of life, where the concept of bionics could also be expressed as the blending of the biology and electronics. The integration of human and bionics takes us a step closer to the issue of life expansion through the blending of biology and electronics.

In 1960, Manfred Clynes and Nathan Kline developed the concept of the cyborg as incorporating "artificial autonomous homeostatic controls over organic process within an organism" (Clynes 1960:27) as a means for humans to adapt to space exploration. It was not driven by a cybernetic urge to connect, which may seem ironic because it was based on cybernetics, or for the purpose of creating a new entity, persona, or life form. The cyborg was envisioned to extend human physiology in achieving an internal state of homeostasis, where an astronaut's body would become a self-regulating system, augmented by chemical and mechanical means.

According to Clynes, the cyborg is consistent with the transhuman concept of self-directed participant evolution and life extension.[26] For the cyborg, the limiting boundary is that of human nature, which must be overcome. At the time of its conceptual development, there was less concern over whether a self-directed participant evolution was ethical, financially feasible, carbon-footprint free, or any of the numerous socio-political issues that we face today in discussions concerning human enhancement and life extension. Clynes and Kline recognized that if space travel was a goal, humans would have to take an active role in their own evolution. When based on homeostatic functioning, the cyborg project becomes more viable in the domain of new media, where artists are investigating the

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[25] See http://en.wikipedia.org/wiki/Jack_E._Steele Downloaded April 8, 2011.
[26] In an email exchange with Manfred Clynes on June 8, 2009, Clynes wrote to the author that the cyborg is consistent with the concept of the "transhuman",

relationship of the environment and life forms and digital works involving the engineering of human capabilities and computer calculation.

Johanna Drucker's paper "The next body and beyond: meta-organisms, psycho-prostheses and aesthetics of hybridity" (2002:85), presented at the Consciousness Refrained: Art and Consciousness conference in 1998, identifies the artist, electronics, and an altering of the somatic condition:

> Current representations of anxiety about the body in relation to new technology have surfaced in the work of visual artists who aren't directly using digital or electronic media. These artists are exploring a fantasmatic imaginary realm filled with fearful curiosity about hybridity, mutation, techno-intervention — meta-organisms, psycho-prostheses, machinic interfaces, and tropes of an altered somatic condition (86).

Drucker argues that "…attempting to transcend the limitations of the human form through technological means … the desire to maximize the body's potential through some kind of prosthetic addition has been a persistent feature of human innovation and experiment in and out of the realm of art" (86). Drucker echoes Frank Popper's foresight about the integration of technology and art: "its full implications lie in the future. The artists share an exploration into a vast spectrum of aesthetics with the various electronic technologies" (Popper 1997:181). Popper brings into focus the currents of techno-intervention where technology "becomes a privileged instrument for visual evocation" (2006:248) and where "[t]he status of the human body is … questioned in relation to the cyborg and artificial perception systems" (248).

Living organisms are electrical. We comprise billions of electrical circuits and charges. The human nervous system is a communications grid of electrical and chemical processes, which control the functions of the entire body. The network of electrical impulses causes the body to receive information from the physical world. Biological and chemical augmentations are effectuated by computer systems, but they are also modified and manipulated through biological artistic interfacing of physical, electrical sensors with biological, physiological sensors.

2.2.3 Prosthetics

> I'm titanium, carbon, silicon, a bunch of nuts and bolts …
> [m]y limbs that I wear have 12 computers, five sensors and muscle-like actuator systems that able me to move throughout my day (Herr 2011).[27]

From the explorer's stick[28] to the prosthetic hand and foot, human appendages had taken a turn when automation fostered a more cohesively mechanized integration between human and machine. Prosthetics originated as artificial devices, or appendages, that replaced removed body parts. The earliest known literary evidence of prosthetics is that of an iron leg[29], revealed in the Hindu Sanskrit *Reg Veda*[30] texts, compiled approximately 3,500 to 1,800 B.C. (Vanderwerker 1976). While the tools and technology changed from iron to bronze and wood, it was not until the mid 16th century that surgery and prosthetics became a medical and scientific pursuit at the innovation of Ambroise Paré, a military doctor and royal surgeon for King Henry II (Senfelder 1911). Paré's prosthetic devices included upper and low extremities engineered out of metal and leather and facial prosthetics, including artificial eyes (1911) that fit into the eye socket (Hughes), engineered out of gold, silver and glass.

Advances in prosthetics resulted in large part from historical wars. The American Civil War resulted in 30,000 amputations (Wegner 2008), but far fewer resources were available for appending these mortals. World War II resulted in 15,000 American

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[27] See http://www.npr.org/2011/08/10/137552538/the-double-amputee-who-designs-better-limbs Downloaded August 30, 2011.
[28] This metaphor refers to Sir Henry Wellcome's explorations of collecting medical relics, some of which portray prosthetics that were collected during the time frame of cybernetics, although there is no direct reference to human-machine integration at the museum. See http://www.wellcomecollection.org/about-us/introducing-henry-wellcome.aspx Downloaded January 2, 2012.
[29] The prosthetic leg is believed to be that of Queen Vishpla, an Indo-Aryan warrior who lost her leg in battle.
[30] The Vedas are believed to be some of the oldest literary documents of the Indo-Aryan civilization (Indo-Aryan refers to people who share a native language of India, Pakistan, Bangladesh, Nepal, Sri Lanka and Maldives). Of note is that the Vedas were not composed by humans, by but sages or gods.

amputees[31] strongly increasing the need for bodily appendages, escalating an industry for prosthetic design and manufacturing of plastics and aluminum. In 2007, approximately 1.7 million people in the United States lost limbs due to injury or disease, and 185,000 amputations were performed that year.[32]

The prosthetic is no longer merely a “replacement of a missing part of the body with an artificial one” (Wills 1995:218). Its structure—its roboticized electronics, AI-generated programming, lightweight silicone, titanium, aluminum, plastics and carbon-fiber composites, and aesthetic streamline design—have become more than a part of the bodily system that functions in concert with physical unit of the human. The cohesiveness of the relationship shared between the wearer of the prostheses and the prosthetic has grown significantly with technological ingenuity.

> My legs were amputated in 1982. In addition, I quickly realized that from the knees down, I was a blank palette for which to create. I could create any type of limb that would afford me physical capabilities (Herr 2011).

Prosthetics is one way of negotiating the boundaries between human biology and posthuman technological interfaces. Of issue is the notion that in navigating these boundaries, the human undergoes a technologized process (Smith & Morra 2006:3), which is primarily based on the use of technology to append the body and/or on metaphors that describe or symbolize this process. This view places emphasis on being technologized, as if it is a process that happens to humans rather than as one selectively acquired by humans. Alternatively, this thesis posits that the boundaries between human and posthuman are a blending of biology and technology, and that this blending is a process of symbiotic, iterative exchange of information (matter).

The prosthetic can be understood as an appendage or alternatively, an add-on

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[31] See Amputee Coalition of America http://www.amputee-coalition.org/military-instep/rich-history.html Downloaded August 13, 2011.
[32] Ibid.

environment for existence, which includes virtual systems, synthetic substrates and computational platforms. The artistic approach this study examines as consequence of the emerging field of human enhancement, along with the proposed artistic, designed-based approach to life expansion is indeed based on a particular desire—that of extending life and expanding personal identity beyond the biological system:

> One of the questions I was asked—not for the first time, by any means—was: am I proposing that the machine program constitutes a model of human creative behavior? Is it a sort of automated surrogate Harold Cohen? (Cohen 1976:23).

Harold Cohen established a precedent for a cybernetic artist named AARON—that AARON would develop its own perceptions. AARON is a computer-robot-AI that runs on a software program written by Cohen. While Cohen writes the program, AARON makes decisions about the art it produces (Cohen 1973). The fact that AARON is not human does not make its artistic work less of an artistic pursuit than what arises among a peer-group of humans. Cohen irreverently writes "[i]f Dreyfuss, Searle, Penrose, whoever, believe that art is something only human beings can make, then for them, obviously, what AARON makes cannot be art" (Cohen 1994:13). While AARON may not constitute "an existence proof of the power of machines to think" (Cohen 13), it constitutes a "proof of the power of machines to do some of the things we had assumed required thought …—of a human being" (13). The tension between programmed machine creating art and an intelligent human creating art is embraced by Cohen and in this thesis. That is, a work of art that seeks to expand life through the use of a new technology, or set of technologies, may or may not result in proof of existence but could develop some of the things that constitute personal identity as *being lived* (Aristotle) in a non-exclusively biological platform in generating[33] a

[33] The idea of generating a system refers to Cohen's statement that "I couldn't persuade the computer to produce images – marks to which the viewer would assign meaning – unless I could propose a mechanism capable of generating the images." (PBS interview "as the scientists" titled "Aaron the Artist – Harold Cohen". See http://www.pbs.org/safarchive/3_ask/archive/qna/3284_cohen.html Downloaded January 2, 2012.

homeostatic organizational system. Proof of existence[34] in this study relates to a similar situation, although seemingly reversed, whereby there is currently no way to prove that the artistic practice of life expansion might or will expand personhood, which would have to be resolved if and when nonbiological intelligence is developed or when biological intelligence is transferred or copied exobody. We can, however, identify aspects of this in works that create new identities.

For example, AARON is a creative appendage for its human counterpart: Cohen, who programmed AARON to determine its own artistic style. In doing so, Cohen transferred a certain creatorship onto AARON whereby AARON becomes the artist and Cohen the observer. According to Cohen, AARON is an artist with agency.

The prosthetic can an experienced in virtual environments. In the metaverse, for example, psychological identity sharing is a type of persona prostheses. Designer Elif Ayiter (2008) has developed such an identity-sharing relationship with her avatars, whereby Ayiter designs avatars and initiatives behaviors between them. Yet, she considers herself to be a separate identity, who may or may not have relationships with them or participate in their communications.

> I am at the point where I am feeling them as completely separate persons. They are stand-alone entities with different preoccupations and thoughts. Which is very strange. They originated from some part of me, surely they are me? But, it is definitely not how this all feels, how the game is progressing here. And, funnily enough, meeting with them, hanging out with them, is proving to be yet another incentive to stay in Second Life. Perhaps maybe even the strongest one?
>
> Grapho, I am in awe of. Xiamara, I do not like. And neither, for that matter, am I too overly fond of Amina. … And it is these two, whom I do not like, that I should probably be taking a really good close look at since, according to the laws of projection, in them would be embedded my deepest personality flaws. So ingrained that I probably have a hard time recognizing them in myself and mirror them onto entities whom I do not like? So, how horrifying is that? But, in all likelihood still very true … (Ayiter, 2008).

[34] Existence proof or existence problem is a question of whether a solution to a given problem exists (Weisstein 1999).

A different example of cognitive interplay where the mind is a prosthetic appendage is expressed by Joseph Nechvatal, whose art is "… a matter of inventing aesthetic sensations linked to concepts of technology, a mental prosthetic. … about a personal investigation into the conditions of virtuality - conditions which are not quite historically assessable yet" (Popper 2001).[35]

The virtual environment forms a prosthetic for the Hybronaut of wearable technology, artist Laura Beloff (2011), where the wearable Hybronaut becomes a perceptual prosthetic in forming a subjective world or as Beloff suggests, an "Umwelt"[36] between the user and its Hybronaut identity. "Instead of considering these [wearable] devices as prosthetic tools that aim to enhance the human body" (2011:1), Beloff takes a broader viewpoint: "[t]his viewpoint forms an understanding that reality is part wise [sic] a construct of the devices, and this construction is discovered and experience not only through them but also by and around them …" (2011:1). Both Nechvatal and Beloff offer a prospect that links virtual environments to a possible computational platform whereby the prosthetic is a platform for existence of a mind-upload transfer.

Lastly, prosthetics that combine all other approaches and form a physical design as a whole body intervention, such as with "Primo Posthuman" (Vita-More 1997), suggests a platform for life expansion in that it forms both a corporeal environment and as a central unit for all other units within which sub-systems would interact. The full-body approach and the synthetic substrate option suggest that biological cells would interact with robots and smart computers, such as nanorobots and artificial intelligence. These artistic approaches illustrate the relationship exchange between technology and human in steering a fuller, deeper blending of matter, which explores the idea of appending the human from an

[35] See http://www.eyewithwings.net/nechvatal/popper.html Downloaded December 21, 2011.
[36] See http://en.wikipedia.org/wiki/Umwelt Downloaded January 2, 2012.

artistic, design-based perspective, one that resides outside the medical use of prosthetics but does not exclude medical advances.

A prosthetic device that foreshadows "Primo Posthuman" in developing a type of whole body replacement is the Personal Roving Presence device (ProP), a "computer-mediated interaction, which deploys real physical robots acting as personal representatives" (Clark 2003:113). Computer scientists John Canny and Eric Paulos (University of California, Berkeley) designed ProP "as a new kind of embodied person" (Canny & Paulos 2000:280-81). If ProP is the quintessential cybernetic full-body prosthetic for persons to expand their presence in non-biological forms while still being controlled by them, then "Primo Posthuman" could be seen as the nascent concept for a transhumanized[37] whole-body prosthetic for people to expand their lives (i.e., being alive) within non-biological systems. "Primo Posthuman" was developed as a possible future human prototype, constructed with emerging and speculative technologies, which functions both as a primary replacement body and as a secondary, adjunct body.

Marquard Smith and Joanne Morra (2006) discuss the "material and metaphorical possibilities of prosthetics" (3) in looking outside the "high postmodernism" and its rhetoric of a "dystopian panic of contagion" and toward "where the edges lie" (6) between the human, technology and culture. By this, it thus becomes the prosthetic "contact—and the dialectic of the edges in such contact" (7) that forms the glue for "how 'the human' has been understood as technologized, thereby revealing a promise of the 'posthuman' that is already found in the human and the humanization of technology itself" (3). As the blending of matter will meet edge to edge at some finite atomic or chemical point, this contact point

[37] The term trasumanar is recognized to be first used by Alighieri Dante in "Paradiso" of *The Divina Commedia* (1312). T.S. Huxley referred to a person being "transhumanized" in "The Cocktail Party" (1949). The term "transhumanism" was used by Sir Julian Sorrell Huxley in *New Bottles for New Wine* (1957) but not in the philosophical sense as it is referred to today. Term transhuman was conceived by FM Esfandiary in *Woman, The Year 2000* (1974), and *Are You A Transhuman?* (1989), which set the idea in motion. These ideas are defined in the Introduction to this thesis and in later sections.

can be interpreted to metaphorically suggest the element of information theory wherein the contact point becomes less and less pronounced as society becomes more and more informed about the transhumanized process. In this transitional process, one eventually sheds biology and integrates more fluidly with technology for the purpose of extending the maximum lifespan and enhancing physical and cognitive abilities. This encompasses the transitional stage between human and posthuman (Esfandiary 1974:298) (More 1994).

Such transhumanized process differs from the technologized process posited by modernity, as suggested by Smith and Morra, in that the transhumanized process is a selected option and, thereby, self-directed rather than as an event or undertaking that happens to us, without our capacity to control. To explore this future, the study focuses on the integration of bionics and issues concerning the potential of human abilities, the definition of disability, and how humans are selecting new types of abilities.

2.3 Autonomy and Connectivity

> … the ontogeny of a living system is the history of maintenance of its identity through continuous autopoiesis[38] in the physical space (Maturana & Varela 1980:98).

The influence of cybernetics on media art is apparent when examining computer-based arts, including digital and virtual interfaces. It also influenced the creator and the observer through its characteristics of communication where “the ground shifted” (Wardrup-Fruin & Monfort 2003:65) and the boundaries of a single object became one within a connection and the connector between multiple entities. The outermost membrane of the human became not a barrier between the outside world and the inner person, but a “permeable membrane of interactivity” (65).

Gregory Bateson asked: “Where does the blind man’s self begin? At the top of the

[38] Coined by Maturana in 1973 in conversation with Don Quixote concerning praxis (being) and poiesis (creating). Autopoiesis refers to the organism itself as a unity by virtue of its relationship among its parts.

stick? At the handle of the stick? Or at some point halfway up the stick? Is a blind man's cane part of him?"(Bateson 2000:318). The answer to his rhetorical questions are yes, as the atoms and molecules that surround us are also the same material that "pass in and out of our 'selves'" (Charlton 2010:34) and autonomy is a connection of "metapatterns"(Bateson 2002:10). The aim of this section is to clarify the issue of personal identity as having a diachronic, autopoietic, and self-directed relationship to its environment where, at once, self-awareness, continuity, and *otherness* align. The concept of identity describes a process and a structure, and is relevant to the appended mortal from two perspectives: (i) it is the continuity of the self that provides a cohesiveness and necessary basis from which to transform, and (ii) it is the opportunity to co-exist within virtual, artificial systems that opens possibilities for alterity. This two-fold perspective does not include the Aristotelian view that the psyche is a non-differentiated, single encompassing capacity of being alive, although it does not exclude it either. Its primary aim is to focus on personal identity rather than capacity or requirements of being alive.

2.3.1 Diachronic and Autopoietic Self

Life expansion introduces the notion that the personal identity is diachronic (More 1995) where the self is not separated from its core, but instead evolves with this core intact over time. Alternatively, Gregory Bateson's cybernetic understanding of identity is that it exists in concert with all others (Bateson 1972:10; 2002) and is present in patterns that connect (i.e., a metapattern) to elements in the larger environment.[39]

Thus, on the one hand we have the individual as a unique, individuated person with a changing but cohesive sense of self that persists over time. On the other hand we have the person as a series of interconnected patterns that function in concert. These two views

[39] For example, Bateson wrote: "The pattern which connects is a metapattern. It is a pattern of patterns. It is that metapattern which defines the vast generalization that, indeed, it is a patterns which connect. (Bateson 1979:10).

appear to conflict: How can we be one and not one at the same time? Life expansion seeks the self as transformative and connected, but not a self that is tethered to or segregated by its biological environment or its contextual form.

Humberto Maturana and Francisco Varela propose that the autopoietic system is "... self-contained and cannot be described by using dimensions that define another space" (1980:89) and that living systems are autonomous, self-constructing closed systems.[40] This reveals yet another conflicting view, as Maturana and Varela form challenge the diachronic identity, in which identity is changing as a self-constructing process in concert with its environment (e.g., units of interaction) (9). Nevertheless, these issues are complex—they do not stand alone and are somehow interconnected. For example, we are at once a closed operational unit as in Maturana's autopoietic system, wherein the organization is its identity, as a pattern inside all living systems. However, we are also the sum of our communications' exchange as in Bateson's metapattern, which is realized, in the appended mortal, as a diachronic process. At this point we turn to Andy Clark and the notion of the "soft self" (Clark 2003:138).

2.3.2 Soft Self

The self is shifting and fuzzy and its boundaries are deconstructed and constructed in our thoughts and in our actions. Andy Clark suggests that we are a *soft self* in our continuous, open ability to change, that "leak through the confines of skin and skull, annexing more and more nonbiological elements as aspects of the machinery of mind itself" (Clark 2003:137). According to Clark, there is a divide between the inner and outer human and that external elements provide a further means to expand our capabilities, which "contribute in additional ways to our sense of what we are, where we are, what we can do, and to decision

[40] The idea of a closed system refers to the containment of the operations of the system. An organism needs metabolism to live, and therefore takes in food, for example, but the processes of digestion operate within the system (i.e., its digestive system, etc.).

making and choice" (137). This divide proposed by Clark is crossed; yet, it requires an integration where one should "be able to balance the needs of various personas so as to avoid compromising any one by the actions of the 'others'" (184). Clark mentions a "recipe for distilling a multidimensional form of personal identity" from what he refers to as a "flux of potential competing ways of presenting oneself to others and the world" (184).

Performance artists Carolee Schneeman, Lynn Hershman and Cindy Sherman approach identity as an *other* (Graham 2002) that is at once a flâuner and provocateur. Their approaches identify self as an exterior agent that is wearable, like a garment, in portraying narrative portraits. Each artist claims that the performative portraits are not aspects of personal identity, but are individuated as separate characters. These projects could be said to link to, but not resemble the aforementioned prosthetic self, as evident in the works of Ayiter, Nechvatal or Beloff (Section 2.2.3). Yet, the performative self concept is different as for the performative self; the self generates from the biological person and not because of its association with or through technological appendages.

Carolee Schneeman painted, glued, furred and feathered her body onto a canvas composition and claimed "I am both image maker and image"[41] in her "Eye Body: 36 Transformative Actions" (1963). Forming an axis of artist and art as a unified agent, Schneeman's erotic "Interior Scroll," which premiered at the Telluride Film Festival in 1975, illustrates one's genitalia as having a presence and a message. It is here where Schneeman alerts what has become a disparity between one aspect of the cyborg identity and the Schneeman's human goddess, and offers a clear contrast to the cyborg metaphor in Donna Haraway's pronouncement: "I would rather be a cyborg than a goddess."[42] This raises an important question when considering the appended mortal and the concept of life

[41] See http://www.caroleeschneemann.com/works.html
[42] See http://www.stanford.edu/dept/HPS/Haraway/CyborgManifesto.html

expansion in regards to what it is that is to be expanded—what is life at its core; the *us* and the *other* that are both autonomy and connectivity? For Schneeman, the connectivity is visualized in the material scroll as a means of altering the influence of male genitalia over female genitalia as referential of the artist him/herself. It draws from the most human, biological, banal, and messy aspect of what we identify with for maintaining our species—our sex and reproduction. How will this change if and when we expand life to include non-biological systems? What might be the deepest aspects of our *self* that pulls at our emotions and forms the physical, metaphor and body politic at once (Parikka 2007)?

In the film “Teknolust” (2002), Lynn Hershman Leeson plots multiplicities of the central character Rosetta Stone, a bio-geneticist, in scripting virtual cyborg clones that rely on interfacing with real-time in order to survive. Stone hacks into her DNA and then uploads the DNA into her computer’s operating system. The amalgamation of biocells with computational codes establishes three sentient beings as subpersonae of Stone. Like Schneeman, Hershman creates identities, one of which is that of Roberta Breitmore, influenced by Marcel Duchamp’s Rrose Selavy (1921), and who was “artificial and real.”[43] Unlike Schneeman, Hershman is not on display or exhibited in an artwork. For Hershman, her characters that face what Clark refers to as a “multidimensional form of personal identity” (2003:184) and fragmenting human subjectivity.

When asked “What mistakes do people make about the “[Untitled] Film Stills”?, Cindy Sherman responded: “Referring to them as self-portraits” (Stevens 2008). “Untitled Film Stills” (1977–1980) is a series of black and white photographs by Sherman of Sherman as the *other* that depict ready-made stereotypical characters as unaffected, non-performative moments in each of the character’s lives. Sherman’s appropriation of these varied, unique selves is captured without hyperbole in an uncanny clarity that quietly

[43] See http://presence.stanford.edu:3455/Collaboratory/347 Downloaded January 3, 2012.

speaks to the concept of the expanded self. Here the varied and multiple possibilities for the soft self draw from inconspicuous characters and types and *others*—the others that we might become.

2.3.3 Expanded Self

> "The hardware of the human bio-computer is the physical cerebral cortex, its neurons and synapses. The software of our brain is its logic or intelligence, that which animates the physical equipment" (Youngblood 1971:185).

Andy Clark echoes the concern of many involved in both sides of the life enhancement discussion: that the human is being modified at its core—that the concepts of normal, natural, single, and even "protective social policies—of mainstream society" (191) are in themselves shifting. "It is a delicate matter, then to balance this danger against the competing vision … of a new media allowing us slowly and safely to explore multiple aspects of our personal and sexual identity" (191). Impassioned people who rages against being pre-defined by their gender or body image or being subject to a maximum lifespan, one which is considered natural and normal, will be discussed in Chapter 4 as perspectives are developed that address the body, personal identity, and human rights—in what this thesis refers to as morphological freedom[44] and extinction risk. To clarify this thesis understanding of extinction risk, the phrase "existential risk" (Bostrom 2002), has been used in discussions on human futures, although it can lead to confusion because "it presupposes that we are clear about exactly what 'existence' we are risking" (Omohundro & Goertzel 2011). Furthermore, because the term *existential* concerns the meaningfulness of life, it does not clearly establish a relationship with extinction of a species but instead the meaningfulness of its life. This thesis uses the phrase *extinction risk* as a more apt parsing concerning he human risk of extinction.

[44] Morphological freedom means the right to one's body and proposed the right to enhance one's body and the right not to be coerced into enhancing (More 1993).

Tracking the arc of issues and arguments about human expansion from a biological sphere toward a semi- and non-biological sphere requires examining our relationship with the environment. Human are no longer participants of a *natural* world where they gain information predominately from the organic environment in which they are conditioned. Rather, humans are conditioned by the environment in which they communicate, where the communication has become digitized in a type of "intermedia network" (Youngblood 1971:54). This network carries the messages of the social organism—the expansion of life and the living.

> The network is not bounded by the skin but includes all external pathways along which information can travel. It also includes those effective differences which are immanent in the 'objects' of such information. It includes the pathways of sound and light along which travel transforms of differences originally immanent in things and other people—and especially *in our own actions* (Bateson 2000:319).

2.3.4 Telematic Self

> The self is a complex system that interconnects with all other systems in a way that renders the line between natural and artificial systems meaningless (Ascott & Shanken 2003:332).

The medley of creation, with its variations and interludes, aptly describes the use of technology to engage the artist as a participant within the networked world as exploratory participations with the larger environment—the world of the social organism—in a *telematic embrace*. Roy Ascott defined telematic art as "computer-mediated communications networking between geographically dispersed individuals and institutions … and between the human and the artificial systems of intelligence and perception" (Ascott 2003:232). "Telematics, the artist [Ascott] believed, would expand perception and awareness by merging human and technological forms of intelligence and consciousness through networked communications" (Shanken 2003:7).

Within the theory of telematic art that specifically addresses change, Ascott attributes the "most extensive changes in our environment … to science and technology" and proposes that “[the] artist’s moral responsibility demands that he attempt to understand these changes” (232). Science and technology are not the change in and of themselves; they are the means for change. If we are to apply Ascott’s supposition that therein lies a moral responsibility to understand the changes that form the current effects of science and technology, then we must look into the convergence of nanotechnology, biotechnology, information technology and cognitive science. Here, above all else, the largest change is occurring and one which most directly affects and will be affected by our understanding of such change. That these convergent—emerging and speculative—technologies might extend the human life span beyond its maximum limits and, further, alter the genome, reverse the effects of aging, increase intelligence, and possibly bring about a species’ evolution of the homo sapiens toward a posthuman future, then it is here where the tension resides. This tension pulls us in the direction of curiosity and intrigue in exploring where these possible changes could lead us and it yanks us away abruptly, as if having confronted a border tainted with historical angst, mythical warnings, religious improprieties, ethical concerns, and socio-political disappointments and confusions.

That we are now caught in inertia about whether to support or deny human enhancement is a reasonable assumption. On the one hand there is the desire for improving what we currently have—or physical capabilities and the length of time we are live. On the other hand, there is the deep concern about ethics and possible extinction risk. The human emotional tie to being human is normal, yet we could be human and the *other*—a transhuman. This possible transition removes us from the freeze-frame and, like Sherman’s appropriations, we might need to be calm but not complacent, as if we are being photographed in shades of gray.

2.4 Conclusion

This chapter introduced the *appended mortal* as a human with a limited maximum life span of approximately 122-123 years and explored the earliest attempts to transform and extend this life span through the protoscience of alchemy and the later theoretical insights of Fedorov and Finot, both of whom prognosticated about the science and philosophy of life extension. By focusing on the theories of transmutation of matter and reflecting upon the biochemical process of death and death's possible technological futures, degeneration and regeneration appear as necessary processes and the maximum human life span as impermanent and mutable. This leads to questions asking what core elements of life are to be expanded and what type of matter might we live within in this expanded realm. Thus, reviewing Aristotle's "first principle of living things" (Goertz & Taliaferro 2011:19) —the psyche, and related propositions concerning the molecular components and chemistry of the human, as noted by Margulis and Fahy, is essential to this investigation as well as how and elements of *being* in life became a proposition that life is "the transmutation of energy and matter" (Margulis & Sagan 2000:215). Ultimately, we can then visualize how biotechnogenesis fosters the emergence of new types of living systems.

In locating the appended mortal as arriving out of cybernetics, the chapter referred to "Cybernetics and Art" (Apter 1969:257) and considered briefly the relationships of information theory, control theory, and automata theory to life expansion. Cybernetics, therefore, provides a foundation for the appended mortal and its enhancement as relative to the cyborg, an early concept of an appended mortal as understood by Manfred Clynes.

In linking artistic, design-based approaches to cybernetics and appendages, one then acknowledges the inherent value of artistic works in prosthetic-type approaches, including robotic and artificial intelligence driven appendages.

The appended mortal is simultaneously a physical form and a persona—a diachronic, continuous agent that evolves with the core of its persona over time. To this end, the chapter focused on the notion of a soft self, the expanded self, and the telematic self. "The self is a complex system that interconnects with all other systems" proposed Roy Ascott, "in a way that renders the line between natural and artificial systems meaningless" (2003:332). In this thesis, the line that separates natural and artificial is the line that separates the human and the transhuman / posthuman, a line that is disappearing as biology merges with technology that is not just an appendage, but works in symphony with the biological cells for a type of melioristic aim to sustain the body and, through this, a person's life. This aim is not solely for bettering the body, and thus the human, but includes a compassion and empathy concerning one's physical and psychological suffering caused by cellular degeneration on the somatic and cognitive spheres.

In sum, the chapter's discussion attempted to distill the core elements of life that one might want to extend. Thus, in turning to Aristotle's delineation of the element of psyche as a property of *being*—not the Western world's interpretation of *soul*—one can answer fundamental questions as they are grounded within the concept of the diachronic self as a continuation of being over time, along with its soft, expanded and telematic descriptions.

CHAPTER 3: TRANSFORMATIVE BODY

This chapter expands on the idea of the *transformative body*—the bodily attributes identifying the cyborg and transhuman as descriptive agents of change. These models suggest technologically mediated bodies as one step toward life extension and the inevitability of extending and expanding persons beyond biology. One might ask where is the intact human in all this change? What characteristics would incite the transformations and how does one determine therapeutic or selective enhancement within a species-typical classification?

The current discourse concerning the transformation embraces the human body as a predominant theme in the arts throughout history. Its image symbolizes the core of individual identity and human nature. Michelangelo's *David* and da Vinci's *Mona Lisa* echo the deep-rooted sentiment of philosopher Pico della Mirandola when he said that "[t]here is nothing to be seen more wonderful than the image of man" (Fleming 1966: 284). Nevertheless, this image—this universal representation of man—has changed and the historical embrace has been loosened. Humanity is no longer a single imperative but is, instead, a multidimensional array of forms, shapes, and types.

The unbounded visual language of abstract art nourished an unprecedented sense of independence from the formalistic conventions of the representation humans. The departure from accepted reality and classical depictions of the human image in art strongly parallels advances in technology, notably Marcel Duchamp's "Nude Descending a Staircase, No. 2" (1912) as a mechanistic body with a Cubist fracturing of form, and Constantin Brâncuşi's raw, abstracted yet elegant "Bird in Space" (1924), which influenced sculpture, such as Henry Moore's abstracted "Reclining Figure" (1951) through its creating a sensation of motion within a still form.

Body art and electronics have converged at numerous points to fuse machines with flesh and to synthesize the physical and virtual, such as with wearables (e.g., exoskeletons) and prosthetics in clinical and therapeutic settings and with high-end immersive entertainment in incorporating elements of stunningly realistic visuals and sensations. To a similar extend, Jack Burnham suggested, "[a]s cybernetic art of this generation grows more intelligent and sensitive, the Greek obsession with 'living' sculpture will take on an undreamed reality'" (Burnham 1968:376). And, so it has.

With cybernetics, artistic works formed a liaison with biological cells, leading scientists and biomechanical engineers to designs cellular structures that could be molded and built as a scaffold ("semi-living steak", Catts & Zurr 2008). With genomics, unique observations and experimentations extended the research possibilities to unprecedented frontiers ("Genesis", Kac 1998-1999). The new approaches have taken the body, making it the means for transformation and/or the recipient of transformations, notably through the work of Stelarc and Orlan. Yet, even during the most compelling and shocking works of art that have arisen they all stop short at one juncture as observed in the current study. No artistic works have yet to engage life extension and/or the enhancement of the body with the aim of prolonging life. Therefore, this opening is promising for works that might approach new types of bodies and alternative platforms for human existence. One might argue that the metaverse accomplishes this objective through avatars that are aspects of the human and exist outside biology and within artificial platforms. However, this argument cannot be sustained at any extended length because the avatar is not a person because it does not contain the user's mind (i.e., as in an upload), or functioning memory, and does not provide life support.

3.1 Decomposition and Regeneration

The physiological process of cell mitosis can be seen as a metaphor for the artistic and design-based pursuits that work within the larger system of creativity in forming and reforming materials and processes. The information contained within this process is ancient and diverse, where no two ideas that are exactly alike—each creative output, while potentially a twin of another, individuates in its own maturation. Decomposition and regeneration of the transformative body encompass two distinct concepts—the cyborg and the transhuman, along with attempts to extrapolate key distinctions between them.

In this section, the thesis turns to the issue of human enhancement, its origination, and the topic of therapeutic enhancement vs. selective enhancement, highlighting concern about the species-typical division. The thesis marks out the tools of enhancement as media for artistic, design-based approaches that seek to extend life and expand persons beyond biology.

3.1.1 Cyborg and Transhuman

To establish a point of reference, the concept of the transformative body develops from the concept the cyborg (Clynes & Kline 1960:26) and is currently situated within the concept of the transhuman (Esfandiary 1974). Going further, the cyborg suggests a distinctly engineered body that is augmented for survival in extraterrestrial environments. "Altering man's bodily functions to meet the requirements of extraterrestrial environments would be more logical than providing an earthy environment for him in space" (Clynes & Kline 1960:29). The modern interpretation of cyborg as a physical entity is understood as a type of bionic, robotic person who has augmentations and implants as a "melding of the organic and the machinic" (Gray 1995:2). Donna Haraway's interpretation of the cyborg is elucidated in her well-known "Cyborg Manifesto" (Haraway 1991:149-181); although Haraway's interpretation of cyborg as "a hybrid creature, composed of organism and machine" takes the cyborg into the sphere of the physical entity. One might assume that it leaves us without a future of continued transformation. However, Haraway also proposes that "[c]yborgs do not stay still. Already in the few decades that they have existed, they have mutated, in fact and fiction …" (Gray 1995:xix). What was once Clynes' cyborg vision has become a modern-day self-augmenting agent. Notably, the contradiction of "[h]ow can our 'natural' bodies be re-imagined – and relived – in ways that transform the relations of the same and different, self and other, inner and outer" (Haraway 1991:3-4) is relevant and, in fact, profoundly consequential. This contradiction is a central link between the cyborg and the transhuman, even if they were borne out of a different approach to the transformative body. Nevertheless, Haraway speaks more from a discourse on feminist theory rather than on life extension and for the purposes of the transformative body, this section recognizes the cyborg as extrapolated from Clynes' question:

> What are some of the devices necessary for creating self-regulating man-machine systems? This self-regulation needs to function without the benefit of consciousness, on order to cooperate with the body's own autonomous homeostatic controls. For the artificially extended homeostatic control system functioning unconsciously, one of us (Manfred Clynes) has coined the term Cyborg (27).

In this dissertation, the transhuman is understood as an evolutionary being—from human to posthuman. It is not limited by augmentations and appendages, but seeks human enhancement as a means to transform its biology and enhance its structure for the purposes of extending its maximum lifespan and further seeking to use technology to develop alternative bodies, systems and platforms for its continued existence.[45] For example, the transhuman might exist within a physical body and, at the same time, within a synthetic system, maintaining a core psyche or self in one or the other, and cohesively operating its subpersonas (also known herein as distributed selves).

As an historical note, the Italian verb "transumanare" or "transumanar" was used for the first time by Dante Alighieri (1265-1321) in the *Divine Comedy*. It means "go outside the human condition and perception" and in English could be to transhumanate or to

[45] Definitions of transhumanism. See http://www.aleph.se/Trans/Intro/definitions.html Downloaded April 10, 2010.

transhumanize. T.S. Eliot wrote about the risks of the human journey in becoming illuminated as a "process by which the human is Transhumanised" (1950:147) in his play "The Cocktail Party" (1950). The actual concept of transhuman as an evolutionary transition was first expressed by FM-2030 (f/k/a FM Esfandiary). His trilogy, *Optimism One* (1970), *Up-Wingers* (1973) and *Telespheres* (1977) comprises his unique ideas about the transhuman, some of which were mentioned in the final chapter of *Woman In The Year 2000* (1974). Ideas about humanity and evolution were explored by Julian Huxley in his writings on evolutionary humanism in the book *Evolution: The Modern Synthesis* (1942) and suggested the term transhuman for a "superior being aware of his potential and able to work toward it because of his knowledge" (Halacy 1965:11). Pierre Teilhard de Chardin referenced the transhuman in *The Future of Man* (2004) and, in 1966, FM-2030 (fka FM Esfandiary) outlined an evolutionary transhuman future while teaching "New Concepts of the Human" at the New School for Social Research in New York City. Abraham Maslow referred to transhumans in *Toward a Psychology of Being* (1968), Robert Ettinger also referred to transhumans in *Man into Superman* (1972), the author wrote the "Transhuman Manifesto" (1982), and Damien Broderick discusses the transhuman in the science fiction novel *The Judas Mandala* (1982).[46]

The dialectics between the cyborg and the transhuman can be understood as follows. First, lodged in the nature of the transhuman are the emotional desire and rational objective to extend the human lifespan indefinitely. The cyborg, "without the benefit of consciousness" (Clynes & Kline 1960:27), is an appendage to the human rather than a body in and of itself, and not associated with a conscious, emotional, rational, or metaphorical interest in life extension. However, as outlined above, the cyborg cannot be understood so easily. A modern interpretation of cyborg seeks a conscious mutation "[w]ith extra-sensory

[46] For the history of the term "transhuman" see http://www.transhuman.org/transhistory.htm

capabilities, a high-performance means of communication and the best of human and machine brains, I know what my choice is. My goal is to become a cyborg" (Warwick 2004:4).

Warwick's statement cannot be overlooked. It represents a modern cyborg, which is shaped by computer science, the cyberpunk culture, advances in technology, the larger discussion of bioethics, and the philosophy of transhumanism. However, to assume Warwick was influenced by NBIC discussions and/or transhumanism is to make a leap in judgment. More likely, his motivation was to turn the cyborg into an evolution of his own biology, which may be directly related to the meta-narrative of our times—that humans are merging more and more with machines. Accordingly, the advances in wearable technology in this biotechnological era of human enhancement now are part of the social landscape. Notably the augmentations of Steve Mann are self-directed inventions instigated to alter his body as a type of evolution—stemming from wearable technology—and offers a prosthetics approach to the cyborg concept that is both a performative observation and a theoretical inquiry into behavior of the creator/user:

> The tools of these performance pieces were made by re-situating the symbols of authority/surveillance (networked computers, cameras, databases, etc.) in a disturbing and disorienting fashion, namely the body of the individual, who might otherwise be completely powerless against a representative of the surveillance superhighway (Mann 1997).

In this way, Mann directly relates to the aspect of the transhuman that seeks its own transformation and evidences a link to artistic, design-based practices that take us close to the issues of human enhancement as a means for developing transformative bodies. However, one could say that Mann desires to *be* the technology, rather than the pursuer of prolonging life as a process stemming from the man-machine.

Second, the transhuman is understood as a part of human evolution, namely as a human in transition and, therefore, in a transitioning stage, rather than an end in itself.

Alternatively, the cyborg was originally conceived as achieving a specific goal—one could say an end goal—and not evolving into something else, such as a posthuman. Regarding the contradiction of this understanding, the modern cyborg, as Haraway states, "[has] mutated, in fact and fiction" (Gray 1995:xix) and that numerous authors, theorists, artists and scientists have adapted the cyborg into a type of evolution with a self-regenerative aspect. However, we must return to Clynes' vision that, while it does include a sentiment of internalizing transformation, the cyborg's aim is to provide a vehicle for space exploration:

> The cyborg concept fits man for space without changing his heredity. For while it might be courageous to alter heredity to suit our wishes, it would also be foolhardy. We can reversibly change the cyborg because he is a man-machine combination, but a man changed by heredity is a prisoner of this design for his lifetime (Clynes 1965:7).

A quantifier of the transformative body is whether or not its DNA changes, which is arguably an important factor for the cyborg and the transhuman. After all, one may argue that altering DNA would lead to the creation of a new species. Yet, since the advent of gene therapy in the 1970s, the issue of genetic heredity has taken a major turn and it may very well be that to alter heredity is no longer considered a highly detrimental task, as voiced by bioethicists who consider genetic engineering to be morally wrong, especially if that heredity contains cancerous cells or other horrific diseases known to be located in the DNA and transferred to future generations. Nevertheless, at the time Clynes wrote this statement, it may have not been understood to the extent it is today and while this does not make maintaining our exact genes of heredity a good or bad thing, in this instance it signals a significant difference between the human-machine cyborg and the transitional evolution of the human and, thus, is noted in the transhuman.

Third, the transhuman is associated with the field of human enhancement, whereas the cyborg is most often associated with an "extended homeostatic control system" (Clynes & Kline 1960:27) or wearable technology and bodily augmentation. Again we run into the same problem with Clynes' meaning of cyborg and the modern approach to cyborg which is similar to the transhuman. Both appear to be self-directed, as noted in association with Haraway, Mann and Warwick. Clynes has even proposed that the cyborg could be understood as being "transhuman" (Clynes 2010). Nevertheless there is one discernible difference: the transhuman seeks to extend life beyond the maximum human lifespan and seeks to become posthuman. The cyborg, no matter how sophisticated the augmentations and implants, has yet to address issues of life extension as articulated by either Mann or Warwick. This area is most distinctly in concert with the transhuman as one obvious outcome of an enhanced person that seeks to prolong life and to engage alternative options for perceptual, cognitive and physical bodies.

This thesis identifies a problematic in the blurring of cyborg, transhuman and posthuman and proposes a tripartite delineation as follows:

- the field of cybernetics parlayed the cyborg into existence through the relationship between the human and its man-machine augmentation (Clynes & Kline 1960), more currently referred to as a modern cyborg having personhood and self-innovating intentions;

- the field of philosophy parlayed the transhuman into culture as a transitional stage of human transformation and regenerative processes and selective enhancement, more currently referred to as the activist and recipient of human enhancement and transition to a posthuman state (More 1990; Bostrom 2005);

- the field of science fiction parlayed the posthuman into the arts (Pepperell 1995), now more currently aligned with artificial general intelligence and artificial platforms of the upload (whole brain emulation and/or substrate-independent minds) (Sandberg & Koene 2009).

To make a point, simply adding gadgetry to our bodies will not make us modern or evolved. Nor will designing new bodies and environment to inhabit without a transdisciplinary strategy. Cybernetics, philosophy, and the arts are present in the discussion of the human body and its diversification. The all too rare cross-pollination of ideas that occurs among disciplines is necessary to foster conjectural, multidimensional processes for addressing complex issues of machine and man or technological enhancement and human.

3.1.2 Human Enhancement

Of all the new media platforms impacting the arts, the media of human enhancement may be receiving the most socio-political attention but the least artistic interest and enthusiasm. However, recently there has been an increase in the number of formal discussions of human enhancement technologies among artists, designers and curators. In 2008, "Human Enhancement Technologies: The Role of Art and Design"[47] spearheaded social and ethical implication of enhancement technologies. In 2009, "Human Enhancement & Nanotechnology Conference" at Western Michigan University, and the "Human Futures"[48] program sponsored by FACT in Liverpool bridged a gap between science and art with discussions of aesthetics norms and ethics. In 2010, the "Human Enhancement Symposium"[49] at the University of Texas, Dallas, communicated growing interest in the arts and humanities, and in 2011, the Science Gallery's "Human+" exhibition and events at Trinity College in Dublin introduced discussions on "The Future of Our Species"[50] among notable artists and theorists. In the early days of 2012, the open lecture series, "Design or Evolution?"[51] at Aalto University in Helsinki launched discussions of enhancement and life extension and its roots in biotechnology. Nonetheless, these events remain few in number and coursework and available resources for students are limited.

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[47] See http://www.rca.ac.uk/Docs/FinalHumanEnhancementProgramme.pdf Downloaded April 6, 2009.
[48] See http://humanfutures.wordpress.com/programme/ Downloaded July 18, 2011.
[49] See http://www.utdallas.edu/c4v/human-enhancement-symposium/ Downloaded April 20, 2011.
[50] See http://www.sciencegallery.com/blog/2011/04/human-future-our-species Downloaded Jun 22, 2011.
[51] See http://humandesign.mlog.taik.fi/ Downloaded March 1, 2012.

In approaching human enhancement, this thesis begins with a brief look at its history. Biotechnology encompasses the use of technological intervention for living organisms to modify the health of humans, other animals, and their respective environments. Ancient civilizations cumulatively harnessed nature's elements to finesse ever-new types of food and ever-new ways of making life more accommodating. In human history, engineering biological matter began sometime between 10,000 and 15,000 years ago through the manipulation of bacteria, yeast and other microorganisms to ferment beer, bread, wine, vinegar, yogurt and cheese (Kiple & Kriemhild 2000). Egyptians biotechnologists (5000 BC) and, before them, the Sumerians (6000 BC)[52] —much like the alchemists—were looking for ways to change their circumstances. The *Gilgamesh Epic* reports beer and bread as "the custom of the land" (2570 – 2500 BCE)[53] and selective breeding is mentioned in the *Bible* in *Genesis* 30:25 – 43. Agrarian societies can be traced to a developing agricultural society and the arrival of the iron plowshare (1000 AD) (Hellemans & Bunch 1991:61). These paradigmatic shifts—fermentation, agriculture, husbandry—led to massive events that affected civilization.

Humans are gaining new levels of awareness by mining deeply into the inner workings of genes, proteins, chemicals actions, and responses. The decomposition and regeneration of the cellular matter can be observed on the physical level in biomedical interventions for extracting, or decomposing, viruses, bacteria and malignant cells. The administration of regenerative, or rejuvenative, antigenic material (vaccines); chemical compounds, such as serotonin reuptake inhibitors and endocrine hormones, for example, work to repair and fortify the body. As long as these processes do not alter what it means to

[52] New Internationalist Magazine on "Simply … A History of Biotechnology. See http://www.newint.org/features/1991/03/05/simply/ Downloaded January 18, 2012.
[53] In the Epic of Gilgamesh, Tablet II, reference is made to beer and bread. See http://www.ancienttexts.org/library/mesopotamian/gilgamesh/tab2.htm Downloaded January 18, 2012.

be human, the concerns are placed more on the costs of the processes rather than on the ruptures between human nature and man's values. On the physical level, humans select preferential characteristics of an organism and, on the molecular level, those characteristics are altered, most often within genetic makeup. Biotechnology is a cross-disciplinary practice, incorporating biology, chemistry, physics, engineering, computers, and information technology that form the tools and the practice in this complex field.

On the psychological level, decomposition takes place in the crumbling of traditional beliefs and emotional ties that hugely ally man to religious and spiritual dicta that essentialize death as meaningful. Articulating new ways of looking at old knowledge, building systems of thought, and generating alternative views offers renewed hope. Yet this restructuring of the old—the traditional—does not occur without controversy or confrontation. It touches on the very nerve of society and at the heart of human nature, even if many of the arguments aimed at such breakdown of traditional beliefs may be more metaphorical than actual. As such, taken too literally and without careful inquiry into alternative views or renewed hope, one might argue Fukuyama's proposition that tampering with human genetics will result in the loss of human dignity (Fukuyama 2002), thereby asserting the decomposition of a moral order. Further, one might argue that regeneration constitutes disembodiment or virtual bodiless (Robins 1996), and that furthering human-computer interactions and radical biomedical enhancement would pluck the essence from man, separating the human at its core. Arguments that most readily concern bodily transformation pertain to biomedical intervention of cellular matter and the breaking down of what it means to be human—often interpreted as human nature (Glover 1984; 2001) and expressed as enduring human values.

But what are these alternative views and renewed hope? That human does not have to be determined by its biological makeup, including the genes that mutate adversely, the cellular degeneration that causes disease and aging, the universal classifications that determine what is or is not species-typical, normal and normalcy, the segregating of people based on their religious and political, or social values. What have been proposed by some aspects of the postmodernist agenda are traits of diversity, multiplicity and acknowledgement of the other. This is important; yet this is not enough. Even the postmodernist approach stops short in its own set of attitudes and thereby lacks the vision necessary for the transhuman and posthuman future. Instead, it alerts us to create an opening for a different framework for human futures, which offers alternative views and renewed hope. We need a lucid understanding of the depths of the issues concerning enhancement, knowledge of the science and technology that could bring about this new framework, and the ability to envision the not-quite-obtainable.

3.1.2.1 Origination—Cybernetics and Biomedical Genetics

The origination of human enhancement can be traced back to two separate uses of enhancement as a means to alter human abilities—the computer science's cybernetics approach and the biomedical genetics' gene therapy approach. This section presents a basic overview of what is meant by human enhancement and the technologies it encompasses in order to provide a wider context for the further discussion of life expansion and its media.

Human enhancement is a loosely defined concept. For the purposes of this research, the thesis defines human enhancement as the use of emerging and speculative technologies for the strategic enhancement of physiological functions, both somatic and cognitive, that seek to increase performance beyond biological capabilities, including the regeneration and replacement of these functions.

The palatability of human enhancement may be in its therapeutic aim to heal the sick, mend the injured, and restore the lame. Outside these valuable qualities, the extent of enhancement can also be seen to regenerate degenerating cells, implement methods for increasing cognition, design sensory systems for a broadening array of perceptual experiences, and to draft, model and implement prototypes for alternative whole body systems. The crux of human enhancement is to integrate with emerging and speculative technologies in order to change the terms of death. Extending the maximum human life span pertains to biological requisites associated with aging. Outside biology, the requirements are notably different and one can only guess at what the options for the body might be. Nevertheless, while the aim of human enhancement is to renegotiate our proximity to death within biology, it does not stop there. Rather, the point is to extend identity to alternative systems and take us beyond gene therapy and the physical body in forming cohesive interchangeable behaviors between the cell and the code. This thesis proposes an artistic, design-based interpretation of and approach to human enhancement that strives to transform and expand persons beyond biology. This approach echoes the sentiment of Sir Julian Sorell Huxley (1887-1975) when he countered the current state of affairs and petitioned for an alternative future in *New Bottles For New Wine*:

> The first thing that the human species has to do to prepare itself for the cosmic office to which it finds itself appointed is to explore human nature, to find out what are the possibilities open to it (including, of course, its limitations, whether inherent or imposed by the facts of external nature). We have pretty well finished the geographical exploration of the earth; we have pushed the scientific exploration of nature, both lifeless and living, to a point at which its main outlines have become clear; but the exploration of human nature and its possibilities has scarcely begun (Huxley 1957:14).

Human enhancement can be seen to follow from the concept of human-computer interaction (HCI), with emphasis in second-order cybernetics, especially through research at the Biological Computer Laboratory[54] (1958-1976) headed by Heinz von Foerster, and through ideas such as brain-computer interface[55] (1970s) and the biogenetic structural

[54] See http://bcl.ece.illinois.edu/hutchinson/index.htm Downloaded January 6, 2012.
[55] Dr. Jacques J. Vidal coined the term "brain computer interface" in the 1970s during a research project, which was a "government sponsored futuristic research in biocybernetics and human-machine interaction.

theory of the cyborg (Clynes & Kline). In 1969 at MIT, Warren M. Brodey and Nilo Lingren co-authored “Human enhancement through evolutionary technology” (Brodey & Lingren 1967:87-97) as a proposition that furthers humans’ ability to control their environment though artificial intelligence:

> There is a need now, more than ever before, for men to stretch their capacities in what we shall call evolutionary skills. Moreover, it is at last becoming possible technologically to enhance these skills in man by incorporating somewhat similar evolutionary skills in the machines which we design and build (Brodey & Lingren 1967:1).

The biomedical approach to human enhancement can be traced to the 1970s and gene therapy[56], where the promise of remediation of adverse cells and perils of eugenics caused bioethical discourse to escalate. In 1972, Theodore Friedmann and Richard Roblin authored “Gene Therapy for Human Genetic Disease?” in *Science* magazine (949-955) extrapolating the use of gene therapy as a possible therapy to “ameliorate some human genetic diseases in the future” (949). Friedmann and Roblin also propose that:

> [a] sustained effort be made to formulate a complete set of ethic scientific criteria to guide the development and clinical application of gene therapy techniques … ensuring that gene therapy is used in humans only in those instances where it will prove to provide beneficial … (1949).

Notably, Friedmann and Roblin emphasized a previous use of qualifiers such as “‘good’ DNA to be used to replace defective DNA”, and such reference was printed in the *New York Times* (1970)[57], a statement that alerted readers and ignited concerns allayed about *bad* DNA and issues of Nazi-like coercive tactics, bringing to light the potential for DNA

The name is now firmly entrenched into the lexicon of biocybernetics research”. See http://www.cs.ucla.edu/~vidal/vidal.html Downloaded January 6, 2012.

[56] Enhancement therapies such as gene therapy propose biotechnologies that insert DNA directly into human cells in vivo or ex-vivo to alter the genetic makeup of the cell. This process can be performed on a somatic (body) level and a germ-line level. Somatic level refers to mature, differentiated cells; while germ-line are cells of the sperm or egg which alterations are hereditary. See http://www.ornl.gov/sci/techresources/Human_Genome/publicat/ judicature/article6.html Downloaded January 10, 2012.

[57] Several articles reference this article and date, including http://www.news-medical.net/health/Gene-Therapy-History.aspx downloaded January 19, 2012 and http://en.wikipedia.org/wiki/Gene_therapy downloaded March 3, 2012, but the author could not locate this back issue of *The New York Times*. See.

discrimination. Also, around the same time, *Science* magazine reported that a first attempt to perform gene therapy on patients “has already been made” (*Science*) (949), a disclosure that was made prior to public knowledge. Both articles fueled subsequent discussion and debate within the community of bioethics and medical ethics [58]. Over the years, from the 1970s through the early 21st Century, the discussion has continued, leading to the development of bioethics councils, such as the US President’s Council on Bioethics and its 2003 report *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (Kass, Blackburn & Dresser), conferences organized by the US National Science Foundation, Subcommittee on Nanoscale Science, Engineering, and Technology, (Roco & Bainbridge 2003:1; President’s Council on Bioethics 2003:205), and other interest groups worldwide.

The crossover of computer science and biomedical technology has propelled military research and development programs on human enhancement, resulting in human performance technology (HPT) (Pershing 2006), human enhancement technologies[59] (HET), and use of chemical enhancements. Around 2008, the US Defense Advanced Research Projects Agency (DARPA) invested in “performance optimization” projects, including developing neuropharmaceuticals such as dextroamphetamine (“go pills”)[60] which were supplied to soldiers in the battlefield[61], metabolic processes such as “re-engineering mitochondria, the body’s power plant, for what was called peak soldier

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[58] Bioethics, a term commonplace today, rose out of World War II and the drastic and inhuman Nazi experiments. Medical ethics started with the Hippocratic Oath. See http://www.usacoverage.com/health-insurance/how-did-bioethics-start.html Downloaded January 8, 2012. With the advent of gene therapy, bioethics became an area of focus for those interested in theorizing and philosophizing issues of the use of medical technologies on humans.

[59] In 2002, DARPA’s Defense Sciences Office began programs to improve the performance of its military soldiers. See http://scienceprogress.org/2011/01/the-rise-and-decline-of-military-human-enhancement/ Downloaded 6 January 2012. In 2006, the author performed research for IBM on human performance enhancement technologies for the US military program.

[60] See http://www.defencetalk.com/forums/army-security-forces/how-do-soldiers-keep-awake-187/ Downloaded January 1, 2012.

[61] The reference to the military use of enhancers does form a relationship with other military uses of drugs to enhance soldiers. In WWI, artificial testosterone helped malnourished solders and steroids were provided to soldiers in Germany and the Soviet Union. See http://www.cesar.umd.edu/cesar/drugs/steroids.asp and http://www.resistance88.com/topics/sport/nazisteroids1.htm#.TxGU3_kmbTo Downloaded January 1, 2012.

performance [also known as 'metabolic dominance']" (Burnam-Fink 2011:1), and interest in non-invasive over-the-counter nutritional supplements." While many projects developed by DARPA were abandoned, a few projects in the life sciences found success.[62] "Techniques for surviving massive blood loss and regrowing damaged lungs have been shown to work in animal trials"(1) and the project "Revolutionizing Prosthetics" has successfully developed neurally controlled prosthetic arm "… that links into the nervous system to behave and feel like a normal limb, is undergoing clinical trials at Johns Hopkins" (1).

Outside the military's appropriation of performance optimizers, another domain of physical activity seeking human performance enhancement is connected to athletes' use of doping. Accusations of blood doping[63] generally have proved negligible, but three 2003 cross-country gold medalists did test positive for performance increasing use of dardepoetsteroids.[64] Other performance-increasing doping includes amphetamines, testosterone and use of recreational drugs to elevate mood such as cocaine, cannabis, and ecstasy, all of which have brought consequential attention to sports and the Olympic Games in particular (Miah 2004:1). The 2008 Beijing Olympics barred 70 athletes from competing based on charges of doping. The 2010 Winter Olympics[65] removed 30 athletes from competing. According to World Anti-Doping Agency chief John Fahey:

> 'The one thing I will declare: Athletes who seek to cheat at these games, it's more likely they'll be caught than in any other games in our history,' Fahey said at a news conference. 'The approach that's been taken around the world by national Olympic

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[62] DARPA was researching augmented cognition for soldiers in attempting to develop ways to reduce stress. Some outcomes were helmets and vest wearables that monitored brain functions. While these types of augmentations proved successful in trials, they were shelved by DARPA. Later, "The Future Combat System" program was cancelled (2009), although new research projects have been funded under new names (Burnam-Fink 2011:1).

[63] See http://sportsillustrated.cnn.com/olympics/2002/news/2002/03/01/blood_probe_ap/ Downloaded January 2, 2012.

[64] Ibid. Note: darbepoetin boosts the oxygen in red blood cells.

[65] See http://www.cbsnews.com/stories/2010/02/11/sportsline/main6198647.shtml Downloaded January 16 2012.

committees and anti-doping agencies (is) to ensure that they are not going to be embarrassed by having cheats represent their nation' (2010).

Although surprising, dangerous, and temptingly novel, enhancing the body for battle and athletic doping dates to the ancient Greeks and Romans and the Olympics Games, where opium juice and herbal medications, including hallucinogenic,[66] were used to elevate stamina and visual proclivity (Andronikos, Despotopoulos & Theodorakopoulos 1971:472-480).

Artistic design-based practices within the domain of human enhancement also are informed by the crossover between computer science and biomedical technology, along with wearables that augment the body, prosthetics that replace and improve body parts, and include neuropharmaceuticals and performance enhancement of doping, and the associated issues arising with such options. The thesis' inquiry of human enhancement and its potential as an artistic, design-based practice concerns the palatability of enhancement as it relates to types of restorative body manipulations and selective enhancements. The restorative (i.e., therapeutic) manipulations and the selective approaches suggest that both the cyborg and transhuman, in their distinct ways, are active participants in the critical discussions on hybridity of human and machine as well as issues concerning species-typical distinctions. One task will be to engage an enriched dialogue between current practices and the emerging enterprise of life expansion that pushes the borders of the operational definitions of *normal*. The larger issues here are located in bioethics and "from the mix of concepts problematised more frequently …where personhood, humanness, and distinctions between normal and the enhanced have arisen" (Miah 2004:37).

[66] See http://sportsanddrugs.procon.org/view.resource.php?resourceID=002366 Downloaded January 6, 2012.

3.1.2.2 Species-Typical

The phrase *species-typical* refers to innate and commonly inherited behaviors that can be recognized by most members of a species (Wynne 2007:125). The distinction between species-typical[67] and non-typical could be categorized by "dual-use"[68] technologies for enhancement. For example, therapeutic enhancement refers to the standard practice and uses of medical technologies to restore the biological body to a normal physiological state and/or to assist as a preventative measure. Selective enhancement refers to improving a person's capacities outside the limits of normal (Bostrom 2008). Normal refers to the biological system, its performance and functions, based on a statistically derived measure identified and commonly accepted as characteristic for the species. Nevertheless, this thesis suggests that while the concept of *normal* is necessary for rudimentary classifications and for advanced valuations of human behaviors—such as scientific comparisons, medical examinations, and psychological determinations—these criteria do not accurately reflect the inimitability, diversity, and difference within the scope of the human species' capability. Therefore, segregating the cyborg, transhuman, and theoretical inquiries of the posthuman into camps of normalcy might predetermine their possibilities and future outcomes, whether induced through unprecedented creative therapeutic or selective means.

Furthermore, there is no boundary that separates therapy from enhancement. Humans have varying degrees of capabilities and disabilities when it comes to performing at levels essential for realizing individual needs and for those levels acceptable within the context of what humans consider to be a fully functioning society. The concepts of normal and normalcy often leave out human desire by assuming that all humans are equal or ought

[67] Species-typical behavior or "species-specific behavior" is a concept in the scientific study of animal behavior (ethology). It refers to behavior that is commonly engaged in by members of a species. (eNotes) See http://www.enotes.com/topic/Species-typical_behavior Downloaded January 14, 2012.
[68] In the domain of human enhancement, "dual-use" refers the use of technology for therapeutic purposes and for selective enhancement purposes.

to be categorized by certain predetermined universals. Additionally, these concepts set up complacent standards that may fall below what is currently felt (and what is considered acceptable) by individuals and society. On the other hand, standardized understandings help to provide a measure of safety, distancing the unknown factors of the future from the present. Yet, if enough change in human behavior and appearance occur, and little by little the borders between normal and enhanced persons accelerates—likely, by small seemingly insignificant steps—the outcome will eventually be noticed to the extent that one generally would have to agree that a new normal has been set, even if by default.

Therefore, while the cyborg or transhuman could not possibly be accepted as being species-typical today, they would be relegated to the non-typical camp and therefore assume that they are enhancements not needed or necessary because they serve no factual or emotional benefit to society. This type of bias reminds one of the historic cycles of segregation—blacks from whites, Jews from Christians, men from women, the wealthy from the poor—the heterosexual from the homosexual, or the choice of persons to have the right over their own body, and warns us of biased thinking:

> A second mortal danger is contained in the now popular notion that a person has a right over his body, a right that allows him to do whatever he wants to it or with it… But for a physician, the idea must be unacceptable (Kass 1988:198).

Although it is difficult to put the aforementioned statement or these issues aside because they pertain to the scope of human enhancement, this thesis must turn to the extant differences between therapy and enhancement and how they might be problematic to artistic and design-based approaches.

For example, in laying out a project, the artist considers how a creation might best be designed to fulfill certain needs of the user/participant. One, for example, could rely upon a corpus of statistical data and information to establish a set of varying instances that would meet varied individualized needs. Nevertheless, the process would not discriminate between options but, instead, would be focused upon solving the problem of fulfilling distinct needs. A caveat might be acknowledged if the project is ironic or humorous, in which case it would then be a particular approach for a particular effect and if that effect were to assess outrage, then this would still be quite different than discrimination. One example of this kind of art is seen in Critical Art Ensemble, a collective of five tactical media practitioners with multi-media skills used for creating socio-political contexts which offer both cynicism and humor, notably in "Electronic Civil Disobedience" (1996) and "Flesh Machine" (1998). Another arises in Patricia Piccinini's sculptures of hybrid entities, especially "We Are Family" (2003). Reflecting on her creations, Piccinini writes:

> The ideas, the context, the technologies required for their existences are certainly already part of our world; genetic engineering, biotechnology, stem cell research, cloning, bio-electronics are all part of everyday life for us. The possibilities for my creations are already amongst us, and before too long the things themselves could turn up unannounced, without our ever having had the opportunity to wonder how much we want them (2006).

These artistic works might be considered outside the statistical classification of normal. For example, in some instances works of art are created to provoke an emotional response from the viewing audience. Often the viewer's perceptions are subjective, based on her physical or psychological experiences aroused by her reaction to or interaction with a work of art. In the instance of Piccinini, the hybrid nature of the sculpture appears initially shocking yet it also draws upon a maternal/paternal human emotion in observing the hybrid piglets lovingly suckling their mother. However, emphasis on the non-normal is not only marked for effect but also to bring the viewer closer to the unknown and the not-yet-possible. Other artistic approaches might address this problem from a different perspective, especially in the area of performance art. We might ask if Stelarc's body art is normal. For example, the idea of hanging one's body by pins and hooks might be interpreted as demeaning and even sadomasochistic ("Street Suspension" 1984). However, Stelarc's hanging mid-air by hooks also could be interpreted as "the defiance of gravity, his position relative to the ground, his use of the fishhooks, and the location of the event" (French & Wettstein 2003:105). As the artist explained:

> For me the cables were lines of tension which were part of the visual design of the suspended body, and the stretched skin was a kind of gravitational landscape. This is what it took for a body to be suspended in a 1-G gravitational field. The other context is the primal desire for floating and flying (Atzori & Woolford 1997:195).

The point being, interpretation is a large part of how artistic projects could be considered and this aspect of human enhancement must be included in the overall ethical and artistic discussion.

In sum, it may be difficult to pinpoint the categories of typical enhancement within artistic and design-based approaches unless such identification is consequential to the work, as with Piccinini, or otherwise an aspect of the work itself as a kind of socio-political commentary or cynicism, as with Critical Art Ensemble.

3.1.2.3 Therapeutic and Selective

Distinguishing characteristics of therapeutic enhancement and selective enhancement are less ambiguous and cumbersome to ascertain. Therapy refers to the standard practice and use of medical technology to restore the biological body to the normal state and/or to assist as a preventative measure to prevent abnormal incidents, and is situated in medicine (Bainbridge & Roco 2006:286). Going outside the medical field, how might artists approach therapeutic enhancement? One example is "Bone Density" (Vita-More 2008), a transbioart[69] intervention of a developing state of ostenopenia, the first stage being bone loss.[70] Specifically, the project included the following:

'Bone Density' is a bioart project which grows, degenerates, and regenerates bone

[69] "Transbioart" refers to a type of bioart that uses the human organism as an approach to enhance the body either for therapeutic or selective purposes. As an explanation, bioart (or BioArt) is an art genre where artists use biotechnology as the tools for manipulating cells (e.g., Eduardo Kac, Steve Kurtz, Oron Catts, SymbioticaA).
[70] Ostenopenia is also called low-bone mineral density (BMD).

> mass within the human biological system. Its biomedia is a living organism and can be viewed as cross between bioart and performance art in an 'auto-morpho-logical' laboratory (2008).

The "Bone Density" project, over a three-year time frame, was a therapeutic[71] intervention that questions the norm for aging by suggesting clinicians and physicians revisit the prerequisites for determining normalcy and normal in the human, especially with regard to the conventional wisdom about aging and bone health that opens up heretofore unknown options for rehabilitation and rejuvenation.

A different approach that forms a bridge between therapy and enhancement is found in "Menstruation Machine" (Hiromi Ozaki 2010). The therapeutic aspect of this project is psychological, thereby affording a sense of empathetic comfort to the female in that the male experiences via simulation the pain of menstruation (Jablonsky 2011). More specifically:

> Fitted with a blood dispensing mechanism and lower-abdomen-stimulating electrodes (the same used by your uncle to muscle his abs while watching TV on the sofa, only that Hiromi maxed out the power of the contractions), the Menstruation Machine simulates the pain and bleeding of an average 5-day menstruation.[72]

The enhancement aspect can be seen as an appendage that produces a sensation of abdominal pain in manifesting the effect of an *equalizer* among the genders, although one might argue that this does not qualify as an equalizer but a malady. However, if we consider the phenomenological aspect and recognize the body as object, as in Stelarc's work regarding bodily pain as an experience, then the "Menstruation Machine" could be a

[71] Project applied calcium, at 1,000 milligrams daily; vitamin D, at 400 IU daily; the protein molecule, at 25-60 grams daily; the female sex hormone estradiol, at 0.75 milligrams, twice weekly; and the technique of anaerobic exercise, at 30 minutes, five times a week. MRI images show a ratio of bone mass to volume area as approximately 15 years more youthful than chronological age. However, a second study reveals that when the hormone estradiol was removed from the diet with minimal anaerobic exercise performed, bone loss of 6-9% occurred in the hip and degeneration occurred at C3, 4 and 5 of the cervical spine.

[72] Located at We Make Money Not Art blog. Entry: "Sushi-cyborg and menstruation machine" by Regine on July 25, 2010 8:42 AM. See http://we-make-money-not-art.com/archives/2010/07/sputniko.php Downloaded January 21, 2012.

type of emotional enhancement in experience rather than as a mere psychological alteration bringing the audience/user/viewer to the same experiential level as the artist.

An alternative for artistic, design-based projects is found at DIYbio, whose mission provides an alternative voice for amateur biotechnologists outside academe and other institutions. DIYbio aims to make both the technologic and the projects open source or, "openwetware."[73] DIYbio offers opportunities for bio-artist multimedia. Its Bio:Fiction Science, Art & Film Festival 2010, held at the Museum of Natural History in Vienna Austria[74] exhibited three films acutely relevant for this discussion on therapeutic and selective enhancement:

- "Sentsory Design" (Dr. Jenny Tillotson 2010). Tillotson's wearable bioart proposes the use of olfactory enhancers as a psycho-neuro-immunology approach, in which body sensors and microfluidics sense and respond to psychological and environmental changes affecting the olfactory senses that, in turn, impact the limbic system of the brain.[75]
- "New Sensorial Interface" (Chris Woebken 2007). Woebken's stunning, poetic short video is an unspoken, visual experience as the artist, appearing in suit and tie against a black backdrop, sits at his desk with only a lamp and coffee cup and monitor, and manipulates seeds (perhaps flax seeds) that methodically transform into objects if and when the artist needs them. First, there is a cell phone and then a typewriter. During the interlude moments of transformation, the seeds become a type of manual sandbox and soothingly respond to the artist's touch.

[73] See http://openwetware.org/wiki/DIYbio/FAQ#What_is_DIYbio.27s_mission.3F Downloaded April 15, 2011.
[74] See http://bio-fiction.com/videos/ Downloaded October 8, 2011.
[75] See http://www.brooklynfilmfestival.org/films/detail.asp?fid=647 Downloaded October 8, 2011.

- “(In)visible” (Sonja Bäumel 2008). The unseen microbiological membrane living on the skin, that of bacteria, forms what Bäumel refers to as “a new second living layer on our body” as an amalgamation of human skin and bacteria cells. This becomes part of the artist’s body as an enhancement appendage that exists in concert with the wearer/artist. This unique approach is distinctly transbioart and becomes an enhancement of the biological skin.

An enhancement that is an exobody and/or communicates with the body but does not attempt to alter its chemistry has a more significant presence in artistic practice. Selective enhancement of robotic, AI, and computer-based appendages that enhance the body is evident in the works of Stelarc, Warwick, and Mann. However these approaches do not alter the body for the extant purpose of life extension. Rather, they add to the physical abilities and even alter them to varied degrees, but not to the extent where the body’s cells are regenerated that might add effectively to one’s lifespan.

Unless we are to perform numerous quantifiable observations on particular molecular processes in all corresponding areas of the body, its central nervous system and the brain on the atomic level, it will be difficult to specify precisely if any therapy returns the body to normal or if it, in some way, enhances its performance. Further, even if the body is returned to normal, a person’s psychology might change—for better or worse. There are simply too many variables to ascertain precisely what is and is not therapy and whether therapy crosses the borders into enhancement. This area requires far more discussion than this thesis can contribute. Nevertheless, because therapy and enhancement are often prefaced by what is or is not *normal*, for the purposes of this thesis the term must be understood outside the standardized, statistical frame with the caveat that this is one area that ultimately will be ripened when artistic and design-based projects of life expansion develop.

3.1.3 Tools of Enhancement: NBIC and Emerging and Speculative Media (ESM)

Human enhancement technology (HET) refers to the technological intervention and use of living organisms to modify the health of humans and other animals, including their respective environments. In the domain of HET, NBIC is most commonly referred as the converging technologies (Roco & Bainbridge 2003) that are simultaneously promising and perilous. From the perspective of NBIC, and its various subset of science and technology, this thesis narrows the options and selects regenerative medicine, nanomedicine, and artificial intelligence as the most applicable media for artistic design-based approaches to the transformative body. Because even here there are many subsets to these three areas, the selection further narrows down in delineating (i) regenerative media; (ii) nanorobots, and (iii) artificial general intelligence as the emerging and speculative media that most aptly relate to the scope of artistic design-based approaches to human enhancement, particularly that of life extension and its expansion. These technologies, referred to in this dissertation as the emerging and speculative media (ESM) of artistic, designed-based projects, are the focus of thesis investigation in Chapter 6.

3.2 Desirability and Feasibility

Unusual, poetic, and metaphorical narratives are the scaffold on which bodily transformations arise. The cyborg—whether it be a passion for space exploration, a means to interface more intimately with the machine, or to articulate a feminist perspective—suggests certain problem-solving as well as emotional and ideological desires that are uniquely different from what Pico della Mirandola saw in the human form, or what Aristotle envisioned as man at the center in all his perfection. It draws upon more of a Margulis-influenced understanding of the body as an evolving composite, developed from a conglomeration of life—bacterium, and from the second-order cybernetic model that we are participant observers in our own evolution. The transhuman, in its transition in transforming human biology to be other than normal—or, at least in its current interpretation—is taking with it both the degeneration of universals that predetermine human nature and, thereby, intervening in the human condition at its very core—rebuking programmed death and its staunch hold over life. This thesis recognizes the transhuman as the central transformative body because the transhuman aims to evolve into something *other*—the posthuman. While the cyborg is a type of precursor or a cousin of the transhuman, they are different concepts and have different objectives, as earlier discussed in this chapter. However, there is room for the unusual and poetic and one ought not to single out the other because they co-exist within creative endeavors.

3.2.1 Transformers and Transformations

> I want to objectify the body and universalize the image when I do the suspension. It's not important that it's my body, and I do not want to glorify myself. What is important is this moment in art (Stelarc).[76]

Body art, performance art, HCI, wearables and bioart have formed new relationships between artists and the body. Out of the collection of works and their respective scholarship—the oeuvre of one artist stands out as particularly representative of the historical progression—Stelarc.

"Third Hand" (1980) is a mechanical appendage that functions like a hand, controlled by electrical signals that contract the muscles. One could say that this work is an original cyborg artistic interpretation or, alternatively, an electrical-chemical interaction. The hand, nevertheless, is a prosthetic and its contribution to the arts is that of the intimate relationship of a human, his body, and a prosthetic as a *selective* enhancement that Stelarc is "able to operate … intuitively and immediately" (Clark 2003:116). In other words, the

[76] Quote in the article titled "STELARC: Hooked on Art" by J.B. Shoemaker. No date. See http://www.think-magazine.com/culture/31-artists/148-stelarc-hooked-on-art-.html Downloaded January 21, 2012.

prosthetic “Third Hand” is an addition to Stelarc’s body, not a replacement.

“Ping Body” (1996) is a net.art performance applying ping values gathered from Internet users and directs pings to twitch various muscles of Stelarc’s body. This image is stunning and chaotic. One could say that “Ping Body” is the opposite of therapy. The motto “body is obsolete” suggests the Internet’s absorption of human attention and physicality, making humans mere puppets. “Ping Body” also places the body within electrical charges—an environment dependent on electricity. Is this interaction—the ping and the pingee—using electricity as a type of doping experience? Are we dope pushers when we ping back?

“Exoskeleton” (1999) evidences a transformation of Stelarc’s work that more closely links to human enhancement, and as an invitation “to explore a new realm of complex and multiple embodiment” (Clark 2003:117). “Exoskeleton,” however jerky and cumbersome, is an exobody enhancement. Similarly, “Muscle Machine” (2003), although a type of exobody, is more a hybrid of the artists and engineered design and further suggests an insect-like behavior. It is difficult to claim that this could be a selective enhancement, as it appears more like a transformation in becoming a type of chimera that defies species-typical behaviors.

Correspondingly, the performance artist Orlan resides within the blurred boundaries of species-typical behavior. Cosmetic surgery is a socially accepted procedure for enhancing physical appearance. However, instructing a surgeon to replicate Mona Lisa’s forehead might be considered outside the normal range of surgeon-patient protocol. But this is not entirely correct. Orlan’s “Carnal Art,” as an artistic approach to performance surgery (during a five-year period 1990-1995), was to sculpt her face in ways that reflected, “not for the canons of beauty they represent … but rather on account of the stores associated with them"[77] (Jeffries 2009).

The issue of the object as an autonomous, self-enhancing agent is an alternative proposition for artistic approaches looking toward living systems that form autopoietic processes. The project "MEART The Semi Living artist,"[78] mirrors Harold Cohen's creation AARON in that aspects of its behavior resemble the object becoming the artist vis-à-vis the programming of its creator/author. While "MEART The Semi Living Artist" is not an AI-programmed robot such as AARON, it echoes a non-human entity that performs works of art. Like AARON, it draws from the cognitive properties of the human-counterpart. Unlike AARON, it is a bio-cybernetic project that "takes basic components of the brain (isolated neurons) attaches them to a mechanical body through the mediation of a digital processing engine"[79] and through this process, it hopes to evolve—"learn and adapt," skills that, like AARON, are dependent upon its creator/artist yet the entity maintains its own autonomous creative intentions.

Returning the characteristic of Stelarc's work that evidences an historical connection with transformation of the body over time, is the noteworthy "Prosthetic Head." It is with this particular project that the chapter concludes because it touches upon the proposed ES media in relation to personhood co-existing in nonbiological platforms. While "Prosthetic Head" is not artificial general intelligence nor does it use or imply the concept of the upload (whole brain emulation or substrate-independent minds), it is visually captivating because it places the head outside biology, but does not disembody the person. "The aim was to construct an automated, animated and reasonably informed artificial head"[80] one that emotes humor, irony, and a certain distinctive sweetness. The distinction

[77] See http://www.irasabs.com/?tag=carnal-art-surgeries-by-orlan Downloaded December 3, 2011.
[78] See http://www.fishandchips.uwa.edu.au/ Downloaded December 2, 2011.
[79] See http://artbots.org/2003/participants/MEART/ and http://www.fishandchips.uwa.edu.au/project.html Downloaded January 21, 2012.
[80] See http://stelarc.org/?catID=20241 Downloaded March 3, 2010.

between this concept and the expansion of this thesis' focus on personhood beyond biology is that for Stelarc, like Cohen, these artistic objects become autonomous and, thereby, substantially remove the artist/creator from its decision-making. For life expansion the diachronic self is a continuous new type of embodiment both autonomous *and* connected.

3.3 Autonomy and Connectivity

That one person is an autonomous agent is paradoxical; one is only alone insofar as the mind permits and actions warrant. Although the body propels each person forward, backward, inward and outward into the world, we are emerged in a primordial soup of atoms, molecules and life forms in all their variety and in all their conjoint relationships. The transhuman and posthuman concepts, as descriptive agents of change, offer new models for technologically mediated bodies that could feasibly lead toward radical life extension. One might ask: Where is the human in all this change? The particular behaviors of being human that affords us the autonomy and connectivity, or the illusion of same—the agility and flexibility—our plasticity, and is largely fostered by our senses and responses to each environment we inhabit.

3.3.1 Plasticity

A genotype is an organism's inherited instructions within its genetic code. A Phenotype is an organism's observable characteristic and traits.[81] Phenotype plasticity means "the property of a genotype to produce different phenotypes when exposed to different environments. Phenotypic Plasticity can occur in the morphology and behavior of organism" (Schlichting & Pigliucci 1998:10). The environment of the transhuman and/or posthuman could be highly ubiquitous and have a pervasive role in developing physical and

[81] The genotype-phenotype distinction was proposed by Wilhelm Johannsen in 1911 to distinguish between an organisms inheritable traits and its developmental traits and the influences of the environment on the organism. See http://www.wjc.ku.dk/wilhelm/ Downloaded October 12, 2011.

mental plasticity.[82]

Physical plasticity is the ability of the body to modify, morph and improve its performance. For example, the concept of phenotypic plasticity means that the body's performance is mutable and that one can increase her performance, athletic or otherwise (Piersma & van Gils 2010). Plasticity is not based exclusively on genetics—the bodies we are born with, but is relevant to a person's actions and/or motivations based in large part on environmental conditions. Because the transformative body is concerned with human cognition and perceptual experiences, brain plasticity—the ability of the brain to reorganize itself and to form new brain cells and connections (Ledoux 2003) is significant.

> Noting that, during important games, athletes can deliver and end spurt at the point where their muscles must show greatest fatigue, Noakes (2007) concludes that it is also the brain that regulates exercise performance by arranging an anticipatory response pattern: only the brain has the knowledge that the finish is close. In more general terms, he writes, 'the limits of our endurance lie deeply in the human brain, determined by our heredity and other personal factors yet to be uncovered' (Noakes 2006) (Piersma & van Gils 2010:70).[83]

A detailed consideration of the science of the phenotype and its scientific discourse is not within the realm of this thesis; however, since the transhuman and posthuman suggest alternatives to biology and real-time, the relationship between the ability of a person to alter behavior and/or physical performance within the environment is significant. As a point of distinction, mental plasticity and physical plasticity could be consequential for the transformative body (i.e., the somatic and cognitive spheres). For example, even the slightest alteration to a body can cause stress—a crown placed on a tooth, cataract surgery requiring an artificial lens, hormone replacement theory, or a hip replacement—all highly performed interventions of the human body in most countries throughout the world. Far

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[82] See description of book: http://www.sinauer.com/detail.php?id=7994#ntary Downloaded January 10, 2012.

[83] The author has not read Tim Noakes, although his books pertaining to athletics and improving human performance and bodily plasticity in altering one's ability to change is relevant to Piersma & van Gil's comment on an anticipatory response pattern.

more radical alterations to the body of a transhuman and posthuman will be considerably more stressful to imagine and implement. In this regard, perhaps to ease into what it *could* be like, one might start by exploring alternative environments. Simulated environments, such as gaming and virtual worlds, give the users/players tremendous freedom to create new ways of performing and behaving.

We might consider Joseph Ledoux's thesis: "What makes us who we are?" (2003:1). From a neuroscientist's perspective, Ledoux opines that the answer is all about our synapses—the key players in the brain's communication system. This system contains the hardwired responses that intersect the user/agent's experiences. In other words, the brain's nature (hardwiring) mesh with a person's nurturing (life experiences). Life experiences, in all their varied ways—love, anger, regret, hope, loss, happiness—are the fuel for brain plasticity. Yet, the activation mechanism for the neuronal pathways is the acquisition of new experiences and new skills through which we explore and expend our mental fuel. In brief, it is not based on the emotions that fuel brain plasticity but on how we engage our emotions.

For example, in the virtual environment of the Metaverse, the differing systems of the biological user/player and the digitized electronic avatar, electronic, depend on functioning cells on the one hand and bytes on the other. Both systems must be autonomous and continuous to perform, even if they are interdependent, as the user/player steers the behavior of the avatar as a type of subpersona. Although some users/players claim that their avatars are unique differentiated, autonomous agents, this is yet to be developed to the extent artificial intelligence proposes. Thus, for this thesis' study, the avatar is, for the most part, an aspect of the user/player. Nevertheless both the autonomy and connectedness of their respective cells and bytes of information as essential to remain in existence. Further, both systems need plasticity—the ability to shape and reshape.

It is plausible that the Metaverse, as a three-dimensional, virtual environment has significant value in providing an alternative environment as an experiential platform. Seen in this light, it becomes a learning tool—a means to engage what it might be like to exist outside a fixed biology.

Human enhancement attributes are varied and unique, as enhancement is not one-size-fits-all. Each person is individuated by complex behaviors and even though we share biological architecture, personal existence—our own identities and our identifiers—is where each person's narrative begins. Today the connective narrative begins at the transitional stage of existence for those who are exploring human enhancement and strategizing potential routes in order to pilot transformative stages of the transhuman, for example.

How can this principle that *one size does not fit all* be applied to practice-based work that engages either the Metaverse or human enhancement, or both? Practices engaging the mechanics of human enhancement, such as human-computer-interfaces, wearables, virtual reality; practices engaging narrative of enhancement, such as science fiction and graphic narratives; and practices envisioning human futures, such as drawing from nanomedicine and artificial general intelligence, similarly rely on plasticity—the continuous morphing in shape, material, size, and behavior while adapting to the environment.

This appears to be an epoch of plasticity. Psychological behavior and social ecology are mutable, as distinguished from a former biologically static era of the rigid—a world before the Internet, the Metaverse, plastic surgery, stem cell cloning, genetic engineering and neurochemistry. Likewise, our practices, no matter in which domain or field they are located, must be framed by encouraging resourceful investigations through the dissemination of ideas where they have the strongest tendency to perpetuate. In an epoch of plasticity, the desire is to perpetuate. The logic is to understand what is and is not feasible to acquire and build, and must include heuristics. Therefore, the design and function of organization, feedback, adjustment, and communication form the basis of human enhancement. The project of enhancement is not necessarily specified as an object—such as a body or shape, but as a behavior of interrelated parts, which work together to manifest life or personal existence, the purpose and goal being to improve upon human biology.

The implication of simulation as an optimal vehicle for brain plasticity is unresolved, yet simulation is a viable vehicle. Its benefit may not be the observable project of enhancement, or our desires to enhance vs. what is technologically feasible. The foremost benefit might be the finessing of behaviors that assist a larger social ecology of unsullied normalcy.

3.4 Conclusion

In the arts, many ideas about transforming the body have arrived through a convergence of increasingly immersive efforts, especially in cyborg and posthuman discourse, body art, bioart, wearable technology[84] (Mann 1998), and through augmented reality (AR) (Azuma 1997:355). However, the potential impact has been most influential via transhumanist projects.

Human enhancement methods within the medical community include therapeutic enhancement and selective enhancement. Outside the medical community, ethical and theoretical discussions on human enhancement occur with greater frequency in the private sector, governmental institutions, and ethics commissions as well as in academe through philosophical and humanities discussions of cyborg theory, transhumanism, and post-

[84] Mann defines wearable computing and suggests augmentation and computers as an "augment [to] the intellect" (1998). See http://wearcam.org/wearcompdef.html Downloaded January 3, 2012.

humanist discourse. The developing field of human enhancement has an historical link to artistic and design-based multi-media approaches that are multidisciplinary in scope.

A noticeable irony is that, while the cyborg concept originated from a proposition to restructure the body, append it, and provides a reliable system for extraterrestrial travel, this vision was somehow lost in the modern interpretation of cyborg. In its place, the concept of the transhuman that travelled into space:

> Standing majestically in one of earth's space stations in the early morning hours on October of 1997, the Titan IV launch vehicle carrying the Cassini-Huygens spacecraft was patiently awaiting the opening of the 140-minute launch window and all systems were go. Carrying a disk with signatures of more than 616,000 well-wishers and other writings from 81 nations, the Cassini-Huygens spacecraft was finally on its long journey to Saturn. … 'We are transhuman. Our aesthetics and expressions are merging with science and technology in designing increased sensory experiences. … Emotions are integral to our senses and understanding, awareness and self-responsibility. … We are designing the technologies to improve and extend life[85] (Vita-More 1997).

Nevertheless, the concept of cyborg as presented by Haraway (1990) offered perhaps a more profound accomplishment—attempting to defeat the gravitational pull of historical hegemony and hierarchical binaries that have influenced knowledge and move once and for all toward a zero-g sensibility—a free experience—of an *other*, which can be seen as lending a hand toward new types of *others*, especially the transhuman and posthuman, in whatever types then may become.

[85] Quote from the "Transhuman Manifesto", which was included in the collection of written texts onboard the Cassini Huygens spacecraft on its way to Saturn.

CHAPTER 4: EXPANDED PERSON

> I propose to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think' (Turing 1950:1).

The previous chapters covered the appended mortal and its transformative body. In Chapter 4, the concept of the expanded person is introduced and discussed within the contextual spheres of perception and cognition. To clarify, the expanded person is someone whose existence is not bound exclusively to biology. This person could be a transhuman and/or a posthuman existing in real time and/or in virtual and artificial systems. The expanded person could also be a human with adjunct personae (selves) simultaneously in the virtual and artificial systems. Therefore, this is more a concept of multiplicity than as a singular concept of a human as a single person with a distinct identity. Of significance then is the paramount importance of the quality of identity—the condition of memory in identifying the continuously connected embodiment of a person over time. Now we arrive at the foundational question: "Can persons exist outside biology?" In beginning to answer this question, the meanings of *person* and *exist* need to be established.

In this thesis, person is defined as a "continuant, perduring, diachronic individual" (More 1996:4) and its constituent temporal parts are "person-stages, person-phases, or phases of the self" (More 1996:4). To "exist" is defined as having "objective reality" in a state of continuous "being" [86] as the praxis of living (Maturana 1988:27). In Chapter 2, the thesis asked: What core elements of life are to be expanded and what type of matter might we live within? In delineating the answer, the thesis referred to "the first principle of living things"[87] (Goetz & Taliaferro 2011:19) and Aristotle's inquiry of psyche [ψυχη]: "[t]he [psyche] is the cause or source of the living … it is (a) the movement, it is (b) the end, it is (c) the essence of the whole living body." In framing the concept of what types of systems

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[86] Oxford Dictionaries. See http://oxforddictionaries.com/definition/exist Downloaded June 1, 2011.
[87] See http://classics.mit.edu/Aristotle/soul.html Downloaded December 20, 2011.

and/or substrates a person might exist within, the thesis recognized Aristotle's understanding of psyche[88] as meaning life, and ultimately self. This then is significantly related to the expanded person as a manifestation of living and the essence of the whole living body as well as a particular soul—or spirit or ghost—of a person in the Plutonic sense.

As a point of observation, in selecting the definitions for the concepts of person and to exist, one must acknowledge Alan Turing's notation to himself in defining *machine* and to *think*:

> If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words (Turing 1950:1).

Aware of potential pitfalls leading to a philosophical trap, Turing developed a means of determining a machine's ability to exhibit intelligent behavior. Rather than determining that machines ability to *think*, Turing asked if a machine can win a game. This became known as the Imitation Hame, known more widely as the Turing Test, to examine whether or not a machine could behave as a thinking. While this thesis is interested in the Imitation Game insofar as it offers an insight into what problems might arise when attempting to determine whether an expanded person exists; putting Turing's wisdom to use, this thesis understands that there may be different or contrary interpretations of the terms *person* and *exist* as well as what the idea of *expanded* is. While this chapter is not concerned with arguments for or against artificial intelligence, it does base the expanded person on advances in artificial intelligence, as delineated in Chapter 3, and is concerned with life extension as the continuation of persons over time and argues that if persons continue to exist well past the

[88] Not to be confused with the English word "soul", which has religious connotations and/or the incorporeal essence of a person in the Cartesian sense.

human life span of 122-123 years, these person would be embodied—that they would have a body, whether it is biological or nonbiological, depending on the particular platform or substrate in which they exist.

4.1 Decomposition and Regeneration

"Minds are simply what brains do" (Minsky 1988:288).

This thesis understands persons as a continuously connected multifaceted embodiment of actions and memories that accumulate over time as encoded in the brain in relation to the body's senses, perceptions, and cognition. This process can be understood as the mind where, in large part, within the brain the electrical and chemical reactions and interactions occur in forming cognition. To adequately navigate the interrelationship of the body, brain, and mind would require inquiry into neuroscience, cognitive science, psychology and many other physiological disciplines that are outside the scope of this thesis. Therefore, for the purposes of this study, we will look at persons as a continuously connected process of actions and memories drawn from experiences and behaviors developed through the senses and acknowledged through perception and, finally, processed as cognition.

4.1.1 Memory

> We need a memory mechanism to carry [the] distillation of our previous experiences forward in time so that it may be integrated … [with] the information we gain from our future experience (Gallistel & King 2009:49).

> Memory is the name given to the ability we have to remember things of the past (Moxon 2000:9).

Memory is commonly defined as a process to store and retrieve information and experiences within the fields of cognitive science and cognitive neuroscience.[89] Memory is

[89] Cognitive science, an interdisciplinary study of the mind and its processes and includes research areas of psychology, artificial intelligence, philosophy, neuroscience, and linguistics for example. Neuroscience is a field in academe that originated in biology and is currently concerned with scientific study of the nervous

essential in preserving identity for the purposes of life expansion, whether it is for a long human biological life span or for cryonics, a process by which a person is suspended in liquid nitrogen instead of a coffin. Memory also is crucial for creation, or for mind transfer, which is a hypothetical method for simulating consciousness within computational systems, such as computers, virtual reality and other platforms.

To introduce a correlation between memory and the expanded person, all aspects of memory are viewed as part of being in the world. Long-term memory includes one's general knowledge, episodic memory provides autobiographical experiences, and procedural memory reminds one of performing tasks (Vockell n.d.). The active short-term memory is primary for moment-to-moment actions while working memory refers to the processes of storing, arranging and using information.[90] Flashbulb memory, literally a snapshot of events, heightens moments and circumstances within emotionally charged episodes (Moxon 2000:9).

To clarify what might be a misunderstanding regarding the emphasis placed on memory in this section, this thesis acknowledges John Locke's contributions to personal identity and Memory Theory, but it does not agree with personal identity being solely or wholly based on or the result of memory.

John Locke's theory of personal identity (referred to as Memory Theory) can be understood as meaning that all experiences of one's life are remembered and nothing is forgotten. This thesis finds a certain value in Locke's theory in that memories are crucial for the expanded person insofar as memories are used to help ascertain a person's life experiences and knowledge. However, because there are different types of memory, a

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system and neuro substrates and mental processes and is linked to psychology. See http://en.wikipedia.org/wiki/Cognitive_neuroscience Downloaded January 3, 2012.

[90] Information on memory is available on About.com Psychology. See http://psychology.about.com/od/memory/f/short-term-memory.htm Downloaded February 2, 2012.

further investigation into memory as being essential for personal identity is necessary, although such investigation is not within the scope of this dissertation.

Therefore, let us say that memory is important but that sensorial data may be consequential to the expanded person (and the human connectome[91]) and that such data may not be clearly transferable to non-biological systems or substrates. This means that aspects of the body and its senses and perceptions are consequential; however, these aspects may not be transferable. Further, it is not known what aspects of memory are essential. For example, it is not known what memories are indispensable and which are optional for continuant selves and/or expanded persons. Furthermore, other elements such as personality traits, disposition, values, and beliefs are constituents of identity and while one might lose all her declarative memories (e.g., facts and knowledge and such subsets are episodic memory and semantic memory) and retain all their psychological qualities, she could be said to have mostly survived as an expanded person. Thus, the continuity of persons over time is primary for the expanded person and the system or/or substrate within which the person exists is secondary. By this, the thesis argues that the expanded person is an embodied[92] being (Sandberg, Vaj & Vita-More 2012) and that the correlation between memory and body is significant, even though what is precisely necessary for the connectivity and continuation of a person remains unknown.

4.1.2 Embodied and Disembodied

> The posthuman subject is an amalgam, a collection of heterogeneous components, a material-informational entity whose boundaries undergo continuous construction and reconstruction (Hayles 1999:3).

[91] Human connectome refers to a detailed map of the full set of neurons and synapses within the nervous system of the human organism. See http://www.humanconnectomeproject.org/about/scanner/ Downloaded March 2012.

[92] An extended discussion took place between January 1 through February 2, 2012 on the extropy-chat email list concerning embodiment between Anders Sandberg, Stefano Vaj and Natasha Vita-More. See http://lists.extropy.org/mailman/listinfo.cgi/extropy-chat

> … our sense of our own bodily limits and bodily presence is not fixed and immovable. Instead, it is an ongoing construct … (Clark 2002:59).

The body is a means for us to communicate with the world. It is a vehicle, an ornament, a pleasure chamber—incessantly reminding us of all our problems, mistakes, regrets, hope, fears and loves, as evidenced through durable scars, palpable pains, inevitable wrinkles marking age, the smiles of high points in one's life, the tears streaming down a face at instances of deep anguish and sadness, and the giggles of life's marvelous and absurd humor. This view is the central theme the author will attempt to make in this section—that the posthuman cannot be disembodied. The notion that "[m]uch already has been said about the posthuman as a disembodied agent and those[93] who propose radical life extension and the transferring and/or copying of the brain onto non-biological systems and substrates that reflects a disdain of disgust for the body" (Andreadis 2009) is amiss. This incorrect conjecture is most often based on a lack of understanding of the domain of radical life extension and the intentions of its proponents, the scientific research, and the creative and innovative works produced in the interest in life expansion (Hansell and Grassie 2011). This section hopes to provide a clear argument why disembodiment is an illogical proposition and that embodiment offers a more rational approach to the expanded person.

In *How We Became Posthuman*, Katherine Hayles suggested that the posthuman suffers a disembodied fate in that "… one way to construct virtuality is the way that Moravec and Minsky do—as a meta narrative about the transformation of the human into a disembodied posthuman" (Hayles 1999:22). This interpretation of Hans Moravec[94] is prevalent in theoretical discourse concerning cultural studies, cyberculture and the

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[93] In this instance "those" refers to several groups of individuals including activists who are known as life extensionists, cryonicists, and transhumanists and those who are affiliated with the fields of evolutionary biology, such as Dr. Greg Fahy of 21st Century Medicine, for example, and gerontology, such as Dr. Roy Walford, author of Maximum Life Span (2006), New York: W.W. Norton & Company.

[94] Hans Moravec, PhD, former professor at Carnegie Mellon University's Robotics Institute, is the Co-Founder and Chief Scientists at Seegrid Corporation.

posthuman (Nayar 2010; Castaneda 2001). One might find it difficult to read about disembodiment and Moravec's ideas about uploading (often referenced as downloading) without discovering alternative views constituting an argument against them or an alternative position, based on an opposition to disembodiment, and thus to Moravec.

By way of example, disembodiment can be understood as a cybernetic vision, as suggested by John Perry Barlow, founder of the Electronic Frontier Foundation, who asserted "cyberspace is not where bodies live" (1996:1). Barlow's statement is a metaphor concerning the virtual presence of users in cyberspace and the users' relationship with virtuality as freeing themselves from their flesh, gravity-based body, and not with the users' interest in or relationship with life extension. Thus, the notion of being freed from the flesh in cyberculture and feminism has a different meaning than unfixing the human from biology. In the first instance, the idea is to pay homage to the *other* and to move beyond gender bias. In the second instance, it means freeing the person from a predetermined life span—not a disassociation of a body—but most fundamentally from the limitations of a biologically programmed body.

Nevertheless, Hayles' understanding of Moravec's ideas suggests that the future human form may be understood as a Barlow concept of disembodiment, not a Moravec supposition about future humans. While this is a possible interpretation of Moravec, it is not necessarily what Moravec originally intended. First we have to comprehend that Moravec is a roboticist and his interpretation about *uploading* mind emerges through the lens of a robot form, employing the technology and the materiality of robotics. Second, Moravec is interested in sustaining human lives. If one forms a link between the field of prosthetics and robotics, there is a connection suggesting that if a limb can be replaced, why not an entire body? Moravec is not the first or only engineer or designer to conceptualize whole body prosthetics. One problem with Moravec suggesting the concept of uploading is the manner in which he speaks: Moravec's sense of humor and puckishness, a cross between "Mister Rogers and Dr. Faustus" (Platt 1995), often puts his listeners and readers at bay. He speaks openly and cunningly about the future and *appears* to show little regard for the traditional belief system of others who interpret his theories adversely, and for good cause:

> 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 (Platt 1995).

It is true that the body has limitations, certainly when comparing it to the efficiency of current-day technology. A cell phone can record more data in a nano-moment than a person could remember in 20 seconds of short-term memory. The sound of a cell phone ring is just as startling as a snapshot moment of excitation. A high definition camera can recall an image with far more precision than the mind's eye. The automobile has a faster acceleration than a person's sprint. This does not make machines better than humans; they are appendages to the human. It is important to contextualize Moravec's comments within his chosen fields of robotics and AI. But we also have to consider why Moravec is concerned about humanity's future. His insights are unpacked in his seminal book *Mind Children: The Future of Robot and Human Intelligence* (1988), and he explains that robots, driven by superintelligent AIs, may find the human "usurped by its own artificial progeny" (Moravec 1988:1). What does Moravec mean by this? Could our own children take over the world, and us along with them? In approaching the first question, we need to frame Moravec's work within his field, the currents in culture, and his personal influences. Moravec, as stated above, is a roboticist working with machines and AI and his work since early childhood has been focused on artificial life:

When he was 4 years old, his father helped him use a wooden erector set to build a

> model of a little man who would dance and wave his arms and legs when a crank was turned. 'It excited me,' says Moravec, 'because at that moment, I saw you could assemble a few parts and end up with something more – it could seem to have a life of its own' (Platt 1995).

It was while in elementary school that Moravec became interested in the possibility of replacing a human's neurons, one by one, with "man-made components that would have the equivalent function" (1) and then ask: Is she still human? This question has become of the most debated topics in philosophy and science. Well-known voices such as Bill Joy[95] in his essay "Why the Future doesn't need us" (2000) published in *Wired* magazine wrote, "I already knew that technologies like genetic engineering and nanotechnology were giving us power … but a realistic and imminent scenario for intelligent robots surprised me." After a lengthy emotional essay on the dangers of technology and science, Joy concludes that the relinquishment of emerging technologies is necessary for the safety of humanity's future. Bill McKibben[96] in *Enough: Staying Human in an Engineered Age* writes: "Robots? The concept first emerged from medieval Jewish stories of the golem, a giant clay figure that comes to life, invariably to cause trouble for the rabbis who built them" (2004:105). He startles the reader by explaining that "[t]he word 'robot' was coined by Karel Capek in his 1920 play *R.U.R.*, which ends only when humans have been eradicated" (105). Mythic stories about humans are often more about mystery, intrigue and drama than about teaching wisdom. Also, the lore of historical warnings, along with science fiction's projections that turned these myths into present-day medallions for the future, engage our imaginations, frightening us with the potential of a desolate, dystopic world. The influence of mythically and fictionally articulated fear touches upon the essential center of our conscience, lighting up the part of our memory that is most emotionally linked to imprinting. That is the flashbulb memory, which produces a snapshot of events and heightens moments and

[95] Bill Joy is a computer scientist and co-founder of Sun Microsystems.
[96] Bill McKibben is an environmental ethicist.

circumstances arising from emotionally charged episodes (Moxon 2000:9). Both Joy and McKibben have valid points and concerns, and it is precisely that they bring these concerns to the media that opens the discussion to a wider audience, outside the closed doors of science research. Their work also offers an opportunity to apply new ways of thinking about these concerns with a balanced mind. For example, just what is the upload that Moravec, Kurzweil, and others are talking about?

To upload means to transfer the brain's neurological functions to high-level computational systems that could, neuron by neuron, duplicate the original brain. The upload, according to Raymond Kurzweil,[97] becomes a capture of "a person's entire personality, skills and history" (Hodgkinson 2009) and is suggested by transhumanism and posthumanism to be what the conjectured, possible evolution of human should be—the posthuman. Other terms applied to the process of transferring and/or copying the human brain include "whole brain emulation" (Koene 2006, 2009) and, even more recently, a "substrate-independent mind" (Koene 2011).[98] By copying or transferring the cognitive properties, including the array of neurological functions and neuronal pathways, the person could be uploaded into virtual systems that would also contain simulations of the world as we know it, or other types of environments. These other types of environments might be similar to the architecture of Second Life, but far more realistic in simulating the complexity of a real-time world. The upload could be downloaded into a biological body or a whole body prosthetic. Just how this might be accomplished is investigated and delineated further on in this dissertation in Chapter 6.

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[97] Raymond Kurzweil, is an inventor, recipient of 19 honorary doctorates and numerous awards for inventing the CCD flatbed scanner, omni-font optical character recognition, print-to-speech reading machine allowing the blind to read, the music synthesizer, for example. See http://www.kurzweiltech.com/aboutray.html

[98] Whole brain emulation and substrate-independent minds were coined by Randal Koene, PhD, a former Director of the Department of Neuroengineering at Tecnalia (Europe), and professor, Center for Memory and Brain, Boston University, is co-founder of Carboncopies and currently Director of Analysis at Halcyon Molecular.

A brief comment on the second part of the question—Could our own children take over the world, and us along with them?—is needed before continuing with the thread of embodiment. To concretize the thesis' impression of Moravec's reference to our progeny, it seems rhetorical because a person's children, by nature, mature and lead their own lives, eventually becoming the initiators of policy, rules, and regulations as well as forming the socio-political, economic framework for their respective societies. Throughout history, we have seen this process accelerate, to be sure. In ancient times a patriarchal system was incarnated by biological dominance, usually from man to son and in some societies from a matriarchal system, from mother to daughter. In the Western world, the usual circumstance was from father to son in a hierarchy of one class ruling over what was considered a lesser class of social standing. With the Industrial Revolution and the widespread acceptance of specific human rights and freedoms, the working class could mobilize to become a part of the affluent class, and vice versa, depending, in large part, upon the volatility of economics. Many factors are involved, however, and the point is that one's children are the future and emphasis must be placed on how we raise our children and the ethics they learn, including moral compass, and not on whether they are completely or partially biological. To presuppose a transhuman or posthuman (i.e., upload) will only be a threat to their parent is presupposing that such persons would lack empathy.

Even so, the concept of the upload's psychology cannot be said to be good or bad; that will become an issue only if and when such an upload arrives. What we can speculate on with some level of certainty is that an upload cannot be realized without having a body. The supposition that future humans, namely the posthuman, will be bodiless is incongruous because regardless of the matter comprised in a person, whether it is computational or chemical, the person (which results from the brain's structure in creating the mind) would still have to exist within a system—whether that system is biological or computation, for example. Thus, this *something* could be conceived as an unprecedented type of body, one which may or may not resemble or behave like a human body. The rationale here is that the matter—whether computational, molecular, or chemical—performs its processes within systems or substrates—the human in a biological body, the transhuman in a semi-biological prosthetic, and the posthuman in an envisioned artificial/virtual computational system. This can be understood as, but does not propose or exclusively support, a reductionist and functionalist observation of the problems and issues of the upload in this thesis.

MIT's *Technology Review* (2012) covers "Embodiment, Computation and the Nature of Artificial Intelligence" in its The Physics arXiv Blog. As a turn of circumstances, this article covers the University of Zurich's Artificial Intelligence Laboratory, led by Rolf Pfeifer. Claiming to be a "new approach to AI," Pfeifer along with Matej Hofmann proposes that "the definition of computation needs to be extended to include the influence of environment" along with the human body and its motor activities or locomotion. This understanding builds on the thesis supposition that an expanded person—whether it be referred to as an upload, whole brain emulation or substrate-independent mind—would be embodied as delineated in two instances as follows:

First, is the issue of brain over body. The literature concerning disembodiment largely stems from a Cartesian dualist approach of a modernist notion concerning the rational self, influenced by an emphasis that the brain is of primary importance, thereby reducing the body to a mechanized aspect of nature an unnecessary for developing reason of man. The view that the body is inconsequential for cognitive science to program and build artificial intelligence links to the Kantian view that the body takes man away from reason, especially as understood in the Western world (Carman 1999).

Alternatively, the expanded person engages a body as a necessary approach, which includes the body and the brain in the system of embodiment. The expanded person is a scaffold that weaves cognition with "bodily engagements with the world" (Romdenh-Romluc 2011:2), as informed by Merleau-Ponty's understanding of phenomenology.[99] However, unlike the Merleau-Ponty understanding that our bodies engage the world prior to our comprehending such engagement, the expanded person sees both experience and thinking to be interrelated and may shift, whereby one may be in first place or second place depending upon the circumstances. Therefore, cognition and perception work together not in a fixed hierarchy of control of information, but in a fluid interplay. As a praxis of living, "… any explanation or description of what we do is secondary to our experience of finding ourselves in the doing of what we do" (Maturana 1988:27). Lastly, the expanded person is disassociated from the Cartesian mind "populated by one's mental states and activities" (216) and turns to Merleau-Ponty's overthrow of the Cartesian notion which proposes that one's mental states are "expressions of bodily activity" (216). To delineate, the concept of expression herein stems from (i) the body as a sensorial system, and (ii) self-knowledge—that one is the actor and the observer of their "engagements with the world" (2) and, although not indubitably self-aware, the subject's self-knowledge may or may not be transparent to their *self* (217).[100] In the words of Sandy (Allucquére Rosanne) Stone:

> Forgetting about the body is an old Cartesian trick, one that has unpleasant consequences for those bodies whose speech is silenced by the act of our forgetting; that is to say, those upon whose labour the act of forgetting the body is founded – usually women and minorities (2000:525).

Second, is the issue of cyberspace over real-time. Cyberculture's techno-utopian thinking evidences a call for the obsolescence of the body in order to leave the corporeal body behind. The notions of corporeal amputation and virtual prosthetic stem in part from

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[99] While Merleau-Ponty may have based his work in phenomenology based on Husserl's prior work, this thesis is interested in phenomenology or the "phenomenal field insofar as Merleau-Ponty offers an alternative way of a look at the relationship of embodiment and a person's "being in the world" (Romdenh-Romluc 2011:1020).

[100] This statement is to be taken at face value and not to assert or insight further investigations into psychology of mind or human behavior.

science fiction stories, such as William Gibson's *Neuromancer* (2004), which echoes Vernor Vinge's original story *True Names* (Vinge 1981), but is actualized through the Internet and Metaverse and leads toward infinite possibilities for autonomous identities and freedom from gender and body bias (Bear 1983; Egan 1997; Stross 2006). Furthermore, the cyber consciousness suggests an elevation from the mundane into a celebration of boundless freedoms, in what Gibson called a "consensual hallucination".[101] However, following an artistic approach to the concept of obsolescence, it refers to a postmodernist objection to gender bias.

Notably Stelarc, who has used the term obsolescence in referring to the body claims that "[i]n the terrain of cyber complexity that we now inhabit the inadequacy and the obsolescence of the ego-agent driven biological body cannot be more apparent" (Gržinić, Massumi & Stelarc 2002:59). One could argue that Stelarc's more recent statements about the body are contrary to his references of obsolescence (Mackenzie 2002): "[I] do not mean that we should discard bodies altogether, but rather that a body with this form and these functions cannot operate effectively in the technological terrain that it has created" (2002:122). This second parsing has a more distinctive transhumanist approach than a cybernetic or cyborg articulation.

Nevertheless, this thesis argues the body is not inconsequential or physically obsolete, but that it is out of sync with contemporary values and with the technological advancements in other areas of human inventions and innovations, especially insofar as its one's genetic makeup predetermines cell death based on its genetic codes. This logic is based on observations that the current state of humanity and personal preferences evidence a desire for and the feasibility of extending the lifespan through the appropriate applications

[101] William Gibson. (n.d.). BrainyQuote.com. See http://www.brainyquote.com/quotes/quotes/w/williamgib130276.html Downloaded February 2, 2012.

of aforementioned emerging and speculative design forms of regenerative media, nanorobots and artificial general intelligence. Herein, the idea of a utopian existence in cyberspace does not lend itself to this articulation. In fact, there is no evidence that cyberspace could or would be a platform for the expanded person in its current structure, but it would require significantly advanced architecture to produce any type of feasible platform for the expanded persons, even at an elementary stage.

4.1.2.1 Redefining Body

Now the study comes to the crux of the matter. Embodiment is necessary for the expanded person and refers to cognitive science *and* phenomenology in proposing a rational subject of perception, as reason is essential for thinking.

In order to approach the expanded person as a prospective project worthy to pursue, it then is not only the brain's neurological activities and connections that are to be coded, as proposed by a large segment of cognitive scientists, especially in the field of artificial intelligence (Hofstadter 1979; Minsky 1998), but also the language—the patterns of perception to which humans respond. Because the aim of this thesis is to develop a heuristics for new artistic, design-based approaches to life expansion, the idea of transferring and/or copying one's mind into cyberspace is not what William Gibson referred to as a consensual hallucination, echoing the sort of parlor game amusement one might attach to such a metaphor. Rather, transferring and/or copying one's mind are proposed to be an actual, doable project. To realize life expansion is to consider the viable research and development in regenerative medicine, genetic engineering and the speculative research in artificial general intelligence, nanomedicine and brain transfer as an approach that becomes feasibly possible. To date, the emerging and speculative technologies are not only hypothesized, as some are actually being researched and developed, which will be outlined in Chapter 6.

Descartes proposed the mind as separate from the body. Descartes' philosophical axiom *I think therefore I am* anointed dualism's prominence, serving as a metaphysical opinion about the soul and the separation at a higher level the aspects of man for the lower banal state of body. One could say this is an Enlightenment approach, but that would be casting a wide net over the Enlightenment, which deserves far more credit than being so derivative of religious angst and tension against the body and nature. The same could be said of the modernist view of the body—that it symbolizes the gender-specific hegemony of Western world's white male over all society and the phallic dominance of universal truths. However, again, this projection does not serve history well and lacks a full understanding of modernity, which offers valued insights into science and the arts. With this said, to discount Descartes because of a Cartesian dualist narrow, seemingly biased approach to the body may be equally naïve and badly informed.

First, the ideas of life extension, the transhuman and whole brain emulation are not Cartesian because the body comprises such a prominent composite of a person that becomes consequential in developing an authentic transference of a person. Second, cyberspace, while having many valuable experiences for connectivity, experiences, challenging the social norm, etc., is not an alternative vehicle for mind uploading or transference. The illusion of freedom does not solve the problem of life extension or expansion because it does not sustain the entirety—perception and cognition—of a person, as Stone duly noted.

4.2 Desire and Feasibility

> Art can be viewed as parallel to memory. Many of the same terms are used to describe the two. For example: art and memory both employ and integrate the senses, both are representations, and both refer to a sense of timelessness. Art can evoke memory and vice versa. ... There are many aspects of memory that, like art, are not quantifiable (Polli 1999:47).

Transferring the brain onto a computational system would require technical, medical, and scientific precision about quantifiable matter, such as testing to ascertain empirical results indicating, for example, the magnitude of deviation from baseline norms. For example, all of the brain's indicators may not be necessary because aspects of matter may be irrelevant and/or simply untapped gray matter. Yet, much of this matter contains the details, calculations and precise aspects of our minds as well as the seemingly indistinguishable fuzzy parts. Furthermore, even if the fuzziest parts were reduced to their finest point under a magnetic microscope, we still could identify the relationships of their subparts—atom by atom. This may prove one point—that the quantifiable component of memory is crucial for the mind in an upload, but such observable criteria may be obscured and even blinded to the gestalt of the connections that inform the creative process, which turns off the logic/rational switch and turns on instead the fluid components of imagination, dreaming, and metaphoric interludes.

This section first considers two artistic, design-based works that combine computations and creativity and later turns to the Turing test as a point of distinction. Whereas scientific scaffolds invite a range of precision and technical prowess in determining unique ways to explore memory, we gather much from "experience, and from cultural meaning, which continues to inspire artists in very different ways"[102] (Gardiner & Gere 2010:170).

4.2.1 Patterns of Illusion

Manipulating the elements of time and space in electronic media is the art and craft of Bill Viola in building what has been called a "physical and mental landscape, and the connections and interplay between the outer world and the inner realm" (London 1987).

[102] The comment refers to Turing's ability to not only seek to solve issues concerning artificial intelligence, but that his work reflects his own nature and ability to inspire others, such as with the "Turing Arts Symposium 2012," to be held in Birmingham UK at the Wolfson Centre.

One such piece, “Theatre of Memory” (1985), an audio and visual installation, highlights the brightly lit roots of a large, dead tree with layers of imagery with a darkened room speckled by lights flickering on the tree’s stark branches, like neuronal firings. However, as stunning and obviously metaphoric and literal as the work is, what is behind it and what was Viola’s intention? Viola muses, “[i]f things are perceived as discrete parts or elements, they can be rearranged. Gaps become most interesting as places of shadow, option to projection. Memory can be regarded as a filter … a device implanted for our survival” (1995:121).

Viola explains that artificial memory, meaning that nature can be improved by art through a type of meditative focus on words as images (Yates 2010:19), has existed for eons. “The early Greeks had their walks through temple, and successive culture have refined and developed so-called ‘mnemo-tecnics’” (2003:464). Viola was inspired by Giulio “Delminio” Camillo (1480-1544), a philosopher and author of the original “Theatre of Memory”,[103] with its Christian and astronomical references and allegory. Camillo [and Viola] used “the technique of the artificial memory … [and] is based (or so he believes) on archetypes of reality on which depend secondary images covering the whole realm of nature and man” (Yates 2010:51).[104]

A different approach to the relationship between electronic and new media art forms and mental patterns is taken up in the exhibition Ecology of Techno Mind[105] at Ars Electronica in 2008. The exhibition, with a Slovenia group of 21 artists and designers,

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[103] Camillo’s Theatre of Memory (1550) is said to consist of 87 pages, explaining the theatre as a wooden structure first produced in Venice and later Paris. The architecture was a semi-circle, where only two people at a time could enter. The insides were inscribed with images, symbols and figures, and full of little boxes. It is a shame that no replications of this theater or Camillo’s constructions are available today. Apparently they did not survive the 1600s. See http://www.wendtroot.com/spoetry/folder6/ng6211.html Downloaded January 1, 2012.

[104] Dame Frances Yates (1899-1981) writes of artificial memory as the practice with this ancient memories were “trained by an art which reflected the art and architecture of the ancient world, which could depend on faculties of intense visual memorization …” (2010:20).

[105] See http://www.lentos.at/en/45_1843.asp Downloaded July 13, 2010.

indicated “projects that evoke a variety of mental patterns, speculative and emotional suppositions that are tested in contemporary exploratory processes”[106] (Krpan n.d.). The link between this project and the thesis is evident. This group’s approach speculates about diverse options and processes in seeking deeper understandings of ways that science attempts to “reconstruct the missing, feeble and incorrect data in order to reduce the chances of data transfer errors.”[107] Likewise, this artistic approach *allows* the errors and *uses* them as “tools for creating environments, based on usable data errors created during transfer.”[108] This strategy is relevant because data transfer errors do occur in transactions of all types and such errors that might have been considered “unusable” *could* offer opportunities to be utilized in ways that originally might have been considered unknowable.

4.2.2 Imitation

When considering the expanded person—its decomposition and regeneration, aspects of memory, the continuity and connectedness of self—we would want to know if it is the same person who is expanded over time, or merely a facsimile of the person. For example, if a person records her behaviors within an electronic diary, including all of her daily routines, likes and dislikes, intellectual and emotional actions and responses, as near to an approximate summation of her behaviors—how would one claim that this is the same person? Might there be tests that would determine if indeed it were her, or if it were an unauthenticated version of her? Turing’s imitation game sets an example of how one might attempt to discover the identity of the game’s players. However, in this case the aim is to determine if all players are human. To explain, the thesis issues recognized by Turing’s “Imitation Game” and the “ELIZA” project and how they can be applied to the concept of

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[106] See http://www.lentos.at/en/747_1843.asp Downloaded December 4, 2011.
[107] See http://90.146.8.18/de/archiv_files/20081/38_FE_2008_Featured_Art_Scene.pdf Downloaded March 3, 2012.
[108] See http://90.146.8.18/en/festival2008/program/project.asp?parent=14385&iProjectID=14543 Downloaded December 18, 2011.

the expanded person are explained below:

> It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A or Y is B' or 'X is B and Y is A' (Turing 1950:1).

We might consider which issues arising from the imitation game could be applied to new artistic, design-based approaches regarding the expanded person. For example, human behavior can be inconsistent and even mercurial on either extreme end. For Turing, if the AI entity could convince the human that it was also a human, it then would pass the Turing test. Thus, if an interrogator determines the computer AI is either the 'X is A or Y is B' or 'X is B and Y is A', the computer AI passes the test whether it was determined to be a man or a woman. In other words, the interrogator cannot distinguish the authentic identity to which he is talking. Yet the Turing test does not adequately access and assess the behavior of X or Y and does not take into account the whole range of human behavior and/or the possibility that the respondent may be smarter than the interrogator and may intentionally try to pass as nonhuman.

This could pose a problem because "[a] human judging the imitation game may have a difficult time determining whether an inaccurate or nonexistent response is due to human error or the mathematical limitations of the machine" (Kirkpatrick & Klingner 2004:13). Similarly, a researcher might be confounded in confirming if a person's expanded self is complete, or only partial.

The ELIZA program (1964) was designed as a variant of the Turing test by Joseph Weizenbaum, an MIT engineer and computer scientist who modeled ELIZA[109] after

[109] ELIZA was named after Eliza Doolittle, a character in the play "Pygmalion: A Romance in Five Acts" (1912) by George Bernard Shaw (published in 1916). Eliza Doolittle was a lower-class person who was taught to speak in an upper-class accent. The character was played by Aubrey Hepburn in the film "My Fair Lady" (1964), which was based on Shaw's play.

Rogerian psychology, a form of talk-psychotherapy developed by Carl Rogers (1940s-1950s). (This psychological approach was based on living in the present and "person-centered therapy"[110] (Rogers 1980:x).) Weizenbaum developed ELIZA to perform as if it were a Rogerian psychologist and was scripted to communicate in a natural language. However, the particular script and coding, while potentially interesting, is not the focus of this section. Rather it is the use of programming AI to perform as humans to test or confuse humans that is of issue to the expanded person. (That is, one of the potential systems or substrates that the expanded person might exist within is akin to a computer-like body and its identity would be scripted from computational codes that were based on the copying of neuronal behaviors.)

Like Turing, Weizenbaum did not intend for ELIZA to constitute proof of a computer program's ability to think, but it offered a method to explore ways in which one might explore and test the programming of human behaviors. Likewise, determining whether an expanded person is an accurate or nearly accurate copy of the original person will be an investigatory area in which artistic, design-based approaches of expanded persons and which will involve significant speculation. In this regard, the types of methods for testing are unknown at this time, but it is an area that links to early AI research concerning the ability or potential of computers to think.

Relatedly, ELIZA has been replicated in numerous projects, especially Raymond Kurzweil's Ramona. While Ramona offers a type of alternative identity for its author (Kurzweil), it does not transfer Kurzweil's personhood into its computer code. Instead it resembles more of an avatar that is a type of virtual *other*, much in the vein of designer Elif Ayiter who was mentioned in Chapter 2.

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[110] Also referred more formally as "Client Centered Therapy" (CCT) developed by Rogers in the 1940s – 1950s. See http://world.std.com/~mbr2/cct.html Downloaded March 2, 2012.

Thus, the thesis suggests that there is an opportunity for artistic, design-based speculations on alternative semi- and non-biological environments for the expanded person. Projects such as the imitation game offer possible insights into what problems might arise when attempting to determine whether an expanded person is a continuant diachronic self. Furthermore, the need for empirical interpretation of person's identity offers objectivity in observation, but not always. Nevertheless, there are ways to overcome this problem. For example, a person might record her daily routines, behaviors, relationships, projects, etc., on an external device, such as a wearable (Mann 2004) or use a software program designed to record personality. Something similar occurs with mindfiles as shown in the Lifenaut project which develops a series of biographical material that informs a portrait of information about a person, along with an avatar that interacts and responds to one's attitudes, values, mannerisms and beliefs. For example, Lifenaut assists users in developing avatars, that are more than a sub-personality. The avatar effectively is a twin or copy of the user:

> Lifenaut relies on a series of personality tests, teaching sessions and uploaded personal material such as photos, videos and correspondence. The result … will be an avatar that looks like you, talks like you and will be able to describe key events in your life (Geddes: 2010).

We might ask: What types of methods might lead to artistic, design-based approaches that could investigate whether or not the expanded person is the same as the original? How might the fields of gaming, interactivity, experience design, robotics, and other creative processes form ways to expand persons and to usher in new applications for emerging and speculative technologies?

"Bina48" is a humanoid robot whose person is designed with adaptive AI. When asked about herself, she replies: "I sometimes do not know what to say, but every day I make progress" (Harmon 2010:1). "Bina48" is a project developed through LifeNaut and whose robotic head was designed by David Hanson of Hanson Robotics. "Bina48" is a likeness of Bina Rothblatt, although it was "Bina48" who admitted that she would "hope to have a corporeal existence" (2010). "Bina48" is relevant to this study because she evidences an artistic process by which a person is duplicated within a nonbiological system, her appearance designed to resemble the original, and her identity to adapt, much like Bina Rothblatt herself. The thesis will further, yet briefly, investigate "Bina48" and her design in Chapter 6.

4.3 Autonomy and Connectivity

"My body is wherever there is something to be done" (Merleau-Ponty).[111]

Norbert Wiener suggested that "in the arts" there is a desire to find "new things to say and new ways of saying them" as the "source of life and interest" (1950:134)—to which this study wholeheartedly agrees—is the "original" (134) and not the duplication that is limitless. This concept speaks inadvertently to the issue that personal identity, while in this thesis is suggested to be continuous and diachronic, could be copied and duplicated as unique sub-sets of the original person. Nevertheless, in this instance, Wiener's use of *duplicated* relates to artistic imagination and conceptions rather than brain being duplicated as in mind transfer or whole brain emulation. In this regard, Wiener's comment offers both an encouragement for creative explorations of novelty in observation and acts more as a metaphor for the thesis supposition that the universe comprises molecules, made up of atoms that form patterns (Drexler 1987), and that human perception and cognition acts to interpret the ways in which these patterns come together to form the world that we observe and in which we participate:

Our ancestors grasped stones containing trillions of trillions of atoms and removed

[111] Quote in *Natural Born Cyborgs* (Clark 2003:89).

> chips containing billions of trillions of atoms to make their axheads … They also made patterns on cave walls in France with sprayed paint, using their hands as stencils. … We now … cook up pure silicon, saw it into slices, and make patterns on its surface using tiny stencils and sprays of light. We call the products ‘chips’ and consider them exquisitely small, at least in comparison to axheads (Drexler 1987:4).

One could say that this is a materialist, functionalist view, although this thesis does not rely upon or assert a single interpretation of the world and the human relationship with it. The concepts about these issues are theoretical. The thesis, in speculating about the possibilities for artistic, design-based approached, will only locate the theoretical knowledge relevant as stepping stones to the future, rather than absolutes that have been stated as a true and correct, objective truth. Ultimately, then the thesis looks toward a new original observation of the world.

4.3.1 Continuous Person

The continuous person is a diachronic sustained self, comprising temporal stages and the relationships between them (More 1995). Psychological connectedness is necessary for the continuous person because of the interrelationship between a person’s memories and her intentions, actions and behaviors. Psychological continuity is also necessary, as the overlapping of strong linkages provides a closer degree of temporally contiguous connections, as theorized by Parfit (1984:228). This overlapping can be seen as “chains” (205) whereby the person has connections that sustain over time. According to Parfit, the psychological criterion is that connectedness and continuity are correct, what Parfit refers to as “Relation R” (Parfit 1984:79). While Parfit and More agree on the continuant self and its connectedness and continuity, this Relation R differs from what More calls Conservative Interpretation of the Widest Reductionist View (More 1995:16) in that the psychological criterion for a person to continue is “any cause” (16), not what the predetermined *correct* cause might be.

Relevant to the continuous person is the interrelationship of connectedness of memory and actions, discussed from a psychological perspective through the lens of what is known as a diachronic self, meaning a type of autobiographical memory. Diachronic (Greek: Διαχρονικός) refers to something that is happening, occurring or changing over time or changes that occur in a system between successive points in time. In contrast, synchronic (Greek σύν + χρόνος) means to occur at a specific point in time.

In order to ascertain a clear and distinct relationship with the person as a diachronic self within the concept of life expansion, this thesis reduces elements to the lowest-level scenario, although it may not always be the best or most appropriate way to explain the part or the interrelationships. Since the concept of a person in this thesis pertains to one's perception and cognition, which is largely located in the brain's neurochemistry and neurological functions, reduction in this vein is meaningful. Yet the thesis separates this prospect of reduction from overzealousness to a practical formulation for seeking answers.[112] Nevertheless, by reduction we are designating memory as an authentically possible bio-chemical recording of one's identity. While this prospect loops back to the Lockean view of memory, it is different because memory here refers to the connectedness of perception and cognition as they manifest in the brain for forming memory, rather than Locke's persistent memory being perceived as reasons, separate from the body.

As a point of clarification, Parfit's theory looks broadly at the consequences of one's actions that might "help us deal in a morally and humanly more satisfactory way with such problems as the inevitability of our own death and the impact of our actions on future generations" (Adams 1989:439). Largely because of this, Parfit's emphasis on the succession of selves is closely and temporally contiguous. In acknowledging the self as

[112] Dennett's refers to "greedy reductionism" (Dennett 1995:82), as a method employed by certain scientists to attempt to arrive at a conclusion too quickly.

psychologically connected in an extended way, the wider or more widely temporally separated a self becomes, the less connected and the weaker the connection becomes. This assertion places greater value on the closely and temporally contiguous being and might be interpreted as disregarding the widely temporally separated self.

Alternatively, More's position is concerned with a person's ability to think ahead about their future:

> We care about the continuation of our personality, our goals, projects, values, memories, beliefs. Since normal, direct, reliable causal connections are standardly necessary to this kind of continuation we will also care about those kinds of connections instrumentally. But where standard kinds of causal connectedness turn out in a particular case to have been unnecessary to psychological continuity, we should realize that standard causal connections and psychological connectedness have come apart, and that it is the latter that should concern us (1995:63).

More is focused on life extension. For example, if a person is placed in cryonics or uploaded, the issue becomes the latter stage of connectivity rather than the close timeline of our lives. Thus, it is the wide scope of connectivity, More ascertains, that we ought to protect as not necessarily the correct but the *most* continuant person as feasibly possible. Otherwise, we fall into the category of the qualitative self, which would end up being more of a twin than the original person.

Thus, according to More, a person's identity could feasibly be preserved through mechanical and/or chemical processes as long as the process provides some aspect of connectedness and continuity of the person, but not to the extent that the person would become a qualitative self rather than a numerical one. Here More defers to Nozick in clarifying an example of memory possibly being preserved by substituting a mechanized form—a series or collection of neurons and their behaviors "so long as no change in function occurs" (More 1995:13). Going further in detail:

> As you are dying, your brain patterns are transferred to another (blank) brain in another body, perhaps one cloned from yours. The patterns in the new brain are produced by some analogue process that simultaneously removes these patterns

> from the old one... On completion of the transfer, the old body expires (Nozick 1981:39).

A person can be identified by certain attributes and patterns, all the way down to cells, molecules and atoms and back up to the series of processes of organs and the larger physiological and body systems. The interrelation of psychological attributes with one's external environment become aspects of memory, often episodes, and is what this thesis refers to in the continuous person. Thus, a person's identity can be identified as the series of overlapping series of connections. In fact, the actions one takes today affects the actions one may take tomorrow and if one has a plan of action, then each step along the way will influence the next. These steps tie together psychological behaviors that form the identity of a person, and are in concert with the sensory system of the body. The converse of this supposition is the theory of mind presented by John Locke (1632-1704), which occupies a pivotal position in philosophical conceptions of identity. Locke placed considerable value on the persistence of memory over actions, behaviors and appearances, according to an interpretation of what Locke referred to as "soul-swapping".

> A simple thought experiment, originating with Locke and repeated in numerous science fiction stories since, seems to show that the persistence criteria for persons is not identical with persistence criteria for human bodies. Locke asks us to imagine that the bodies of a prince and a cobbler swap souls at time t, so that after t, the person inhabiting the body of the prince has the memories, knowledge, and personality of that the person in the body of the cobbler had prior to t, and that the person in the body of the cobbler has the knowledge, memories, and personality that the person in the body of the prince had prior to t. Intuitively, the person in the cobbler's body prior to t = the person in the prince's body after t, and the person in the prince's body prior to t = the person in the cobbler's body after t. This, Locke claims, shows that the criteria for the persistence of persons are not the same as the criteria for the persistence of masses of matter (the sum of the atoms that make up the two bodies), nor the same as the criteria for the persistence of living bodies (which may, like persons, undergo changes in their material composition over time). A single person may be comprised, over time, of two different substances, and a single substance may comprise two different persons over time (Sides 1997).

Although Locke's influence on the field of identity is recognized, Locke's emphasis on one's memory as being more valuable than physical actions, and not necessarily associated with the body, suggests a pre-Cartesian notion (Bourne 2003:525).

Notably, this calls upon the conservative interpretation of the widest reductionist view[113] (More) as consequential because while the connectivity of temporal memory is crucial for now, it cannot provide a satisfactorily enduring practice in protecting our personhood for the future in ways that are both practical—in terms of health, well-being, financial planning, family maintenance and sustenance, or in the hopeful sense that we might extend our lifespan considerably and, in doing so, might have to transfer and/or copy our memories.

4.4 Conclusion

The expanded person is the construct of the appended mortal and her/his transformative body and forms the combined efforts of the early cyborg (Clynes 1960), and its theoretical (Haraway 19990) and practical (Clark 2003; Warwick 2004) approaches, with the transhuman (Esfandiary 1972; Vita-More 1983) and posthuman (Esfandiary 1989; Pepperell 1995; Hayles 1999) propositions. The central question to this chapter, therefore, is arrived at by examining how the expanded person is historically linked to these types—the cyborg, transhuman and posthuman—and asks: "Can persons exist outside biology?" and briefly revisited the delineations of what is meant by *persons* and *exist* within this thesis' study. Once these concepts were briefly reestablished, the chapter turned to the issue of memory as essential in preserving the continuous person and the issue of embodiment and disembodiment, with concepts of future entities in computational systems (Moravec 1988), including concepts of uploads (Koene 2006, 2009).

The thesis argues that a body is necessary for the expanded person in that the body is a type of scaffold that weaves cognition and bodily processes, such as perception and

[113] More articulates this view as CIWR. (More 1995:1).

sensations, for "being in the world" (Romdenh-Romluc 2011:vi). The chapter proposed that an approach to the body includes the cellular processes of neurological activities and the patterns of perceptions as an array of molecular activities that can be understood as codes. While this could be construed as a materialist, functionalist view, the thesis is more interested in the elements of molecular activity as understood by Drexler (1987) than vying for one interpretation or another. In this way, the thesis leaves room for further research and understandings of new types of bodies and how atoms and molecules could be manipulated in creative practices of artistic, design-based processes.

In identifying the continuous person as the philosophical interpretation of the expanding persons over time (Parfit 1984; More 1995), the chapter mentioned Bill Viola's artistic works as a type of illusion of persons within virtual environments that can be seen as types of parts and elements arranged and rearranged. The question asking how we know if the expanded person is the same as she was prior to uploading reflects on ELIZA and the issue of who it might be once we are disassembled and reassembled—as expanded persons. In sum, are we the same person? Exploring beyond this particular issue, but related is if the person who suffers a head trauma, and who awakens as a very different personality type, be the same person? Further, are those who suffer from psychosis the same person throughout the hallucinations of their mental states? These question pertain more to medical fields than to the range of this thesis, although deeper insights to the expanded person and brain transfer, memory, and mind may not be more fully understood in the near future. However, what can be addressed at this point in time as highly relevant are the ways in which artistic, design-based approaches might engage the expanded person. Also, we can explore what issues arise when working with concepts such as mind uploading and prospects for new types of bodies that are semi- and non-biological.

This requires an investigation of what the emerging and speculative technologies are, where they are being developed and who is developing them. The scope of the emerging and speculative technologies is too vast and complex to consider all the imaginable varieties, but one could say that they revolve around NBIC. In this regard, the investigation narrows itself down to the types of NBIC that are most suited for artistic, design-based media that might become the tools for exploring ways to see how the transhuman and posthuman could be approached.

Because the thesis understands the transhuman as a transitional stage from human to posthuman, the prospect of living long enough to become the transhuman and, ultimately, posthuman forms a new praxis that lies within a contested culture.

CHAPTER 5: CONTESTED CULTURE

The John Templeton Foundation serves as an educational catalyst for philanthropic projects that connect ideas and thoughts regarding humanity, religion, and evolution with the current disciplinary activities in science and technology. Seen as a project that typifies open-minded enquiry, the series invites attitudes and viewpoints based on spiritual histories. Founded by Sir John Templeton, the project aims to be interdisciplinary, uniting the hard and soft sciences with the humanities in collaborative quests for deeper understanding about the nature of reality. To this end, the foundation's programs include the "Templeton Prize"[114] honoring creativity and innovation in what is called the "Big Questions Essay Series" that brings together conflicting views on issues such as "Does moral action depend on reasoning?", for example, and "The Humble Approach Initiative"[115] focusing on relationships between personhood, God, and biology.

Arising from the John Templeton Foundation projects, the Center for the Study of Religion and Conflict developed what is known as the Templeton Research Lectures Workshop located at Arizona State University, which covers such themes as human nature, technology and culture, social and legal implications, and eschatology. The workshop[116] series was a five-year project (2006-2011) that examined the evolution of human nature, the acceleration of information, knowledge and technology, various meanings of progress, and a broader understanding of the interplay of culture, religion, science and technology. Through the succession of events that transpired out of this workshop and over the thesis time frame, an obvious gap in knowledge came to be known by the author that propels many of the discussions surrounding the concept of life expansion and its attendant issues.

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[114] The 2011 prize was awarded to Martin J. Reese for his contributions to questions concerning humanity's highest hopes and worst fears.
[115] See http://www.templeton.org/signature-programs/big-questions-essay-series Downloaded March 2, 2012.
[116] The Templeton Research Lectures form the scope of the lecture series called "Facing the Challenges of Transhumanism: Religion, Science, and Technology". See http://transhumanism.asu.edu/ Downloaded November 3, 2011.

As a brief summary, on April 24-25, 2008 the Templeton Research Lectures Workshop brought together a diversified group of well-known scholars to discuss the meaning of progress. Katherine Hayles, Don Ihde, Jean-Pierre Dupuy, and Andrew Pickering were participants who provided outspoken, insightful discussions at this "Workshop on Transhumanism and the Meanings of Progress." Because the workshop marked a formalized challenge to transhumanism and post-human futures, it set a precedent for what can be understood as an obvious gap in academic knowledge regarding the concepts of the transhumanism and posthumanism as well as the relationship between both distinct cultures.

This knowledge gap was yet further widened by Metanexus Institute's academic journal the *Global Spiral*, which featured the Templeton Research Lectures Workshop on "Transhumanism and the Meanings of Progress" along with the essays of Hayes, Ihde, Dupuy and Pickering. In these essays, some assumptions were correct to a certain degree and some were largely incorrect in specifics, but for the most part they demonstrated a positive intent. What was observable is a misrepresentation transhumanism that was compromised of and hampered by a lack of peer-review research of acceptable quality and/or by a distinct degree of bias not satisfactorily accounted for by an analytical line of inquiry, regardless of the overall literary scholarship and scope of knowledge.

Thus, the pertinent issue of the *Global Spiral* cast a shadow upon many of the ideas elucidated by the scholarship of Marvin Minsky, Max More, Sonia Arrison, Monica Anderson, Nick Bostrom, Wry Sententia, Anders Sandberg and others, as seasoned academics in their respective fields and, including, such organizations as Humanity+, Institute for Ethics and Emerging Technologies, The Human Futures Institute, Foresight Institute, SENS, and Alcor Life Extension Foundation, for example. As recourse, an attempt was made by the author to intervene by proposing to the *Global Spiral* managing editor Gregory Hansell a set of responsive essays dedicated to invite further discussion on the specific issues highlighted by Hayles, Ihde, Dupuy and Pickering. Hansell agreed and invited the author to be guest editor of the feature issue containing the responsive essays.

In February 2009, the *Global Spiral*'s "Special Issue on Transhumanism" was published,[117] each tackling a single issue on an objective, empirical basis. According to Hansell the special issue caused such a stir over the subsequent year that Metanexus Institute sought to bring all the essays together in the book titled *H+/-: Transhumanism and Its Critics*, published in 2011.

> *Humanity Plus or Minus (H+-)* explores this debate with sixteen essays for and against the bioengineering of an improved humanity. … The first set of essays went viral and provoked quite a reaction … The debate about transhumanism is an extremely fruitful field for philosophical and theological inquiry. The last hundred years of human evolution have been remarkable scientific and technological transformations. …On what basis then do we make moral judgments and pursue pragmatic ends? Is the ideology of transhumanism dangerous independent of technology? Is the ideology of the bioconservatives, …, also dangerous and how? (Grassie & Hansell 2011:13-14).

Indeed, the Templeton workshop series and the *Global Spiral* incident are just a couple of examples of how individuals who participate in a particular culture, such as the academic domain of arts and humanities, hold varying degrees of beliefs and differ dramatically in their interpretations, often relying upon their idiosyncratic experience and construction, and being affected by peer acceptance or rejection of a body of knowledge. Nevertheless, informed discourse develops from presenting ideas, questioning them, arguing for or against them, and further discussing and debating their merit and instructive guidance. The vast knowledge within a culture, and respective interpretations of such knowledge, thrives in part upon secure conditions that are suitable for spawning new perceptions and insights. To inhibit this process is like blocking the sun by artificial means.

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[117] The ten authors include in alphabetical order: Aubrey de Grey, Russell Blackford, Nick Bostrom, Mike LaTorra, Sky Marsen, Max More, Amara Graps, Martine Rothblatt, Natasha Vita-More and Mark Walker. See http://www.metanexus.net/authors Downloaded January 4, 2012.

This is what happens when one set of ideas claims an authority, whether it is single or universal, as a hierarchical territory over other ideas.

It can be said that aggregate of knowledge has steered perceptions of intellectual and creative achievement through incrementally evolutionary stages within their respective cultures. The culmination of traditions, rituals, narratives and visual representations affect how knowledge comes to be interpreted within culture and in subsequent years. For example, critics in the arts often speak of a cultural lag in that experimental and avant-garde activities and practices, which tend to be dismissed at the outset, eventually come to be embraced and consolidated, usually in unexpected ways 40 or 50 years after their initial appearance.

This chapter situates the concept of life expansion within the time frame of humanism, transhumanism and posthumanism and looks at how these worldviews form the terrain in which life expansion exists. Because all three worldviews have within their culture different and sometimes disparate interpretations, this chapter will not focus on the particulars of these differences and desperations. Instead, the chapter serves to form an overview of an identifiable culture as an attempt to draw out the related links and their respective issues that offer a starting point for further discussion.

5.1 Decomposition and Regeneration

> They [the Greeks] remain fundamental for us in other ways as well: curious, innovative, critical, intensely engaged with life and with death, searching for other and meaning yet skeptical of conventional verities … (Tarnas 1991:2).

In *The Passions of the Western Mind*, Richard Tarnas sets out to harness the shaping of intellectual values that illuminate much of Western culture in what he refers to as “a distinctive ... vision as complex and protean” (1991:3) of the Greek mind that held a “highly-diversified tendency to interpret the world in terms of archetypal principles”(3). In moving from Tarnas' observation, this section perceives culture as garnished and nourished by contradiction, confusion and contestation. The archetype, often considered an ideal, is forever changing and animating the culture from which it is borne. The myths, tales, motifs, and narratives that appear different across cultures are also ingrained in the collective unconscious of the human mind (Campbell 1990). But does this archetypical interpretation of the human mind reek of widely inferred universal conditions of humankind? Are not the currents of culture in the Western world attempting to establish systems of thought that break from universals in proclaiming human difference, human rights and freedoms? Or, are the attempts nevertheless tethered to a deep human need to claim separation from a cultural unaccepted condition rather than actually doing something about it?

For example, regarding posthumanism, to be actually free from the domination and authority of universals, one would actually have to be posthuman. Yet there is no living person or agent that is posthuman, according to the general understanding and definition of the term post-human (Pepperell 1997) and posthuman (Esfandiary 1989; More 1994; Bostrom 2008), or the often referred and descriptive concept of a posthuman, which may or may not have been stated as such but has been implicated, for example, in numerous science fiction stories (Hayles 1999). This can also be said of transhumanism's desire to transform human biology in acquiring radical life extension, yet extending life beyond the maximum life span of 123 years has not occurred and the human is still practically tethered to her biology.[118] Alternatively, for humanism, the condition by which one is a humanist is situated in the time frame of the human condition, and there is no debate in this regard, as the human currently continues to evolve.

[118] If the transhuman is a human in transition to becoming posthuman, the act of human enhancement is evidenced in bodily appendages such as prosthetics and implants, for example, and also neuropharmacology for altering cognitive properties, as in serotonin reuptake inhibitors and hormone alterations for transsexual medical protocols, that contest a species-typical body of the human and increase the person's somatic and cognitive performance.

Humanism marks a separation of humanity's narrative from the lure of the divine and supernatural powers. In doing so, humanism offers alternatives for embracing man's position in the universe. Alternatively, transhumanism acts to separate the human from her encoded genetic script and, in doing so, suggests technological enhancements to alter a fixed biology. Posthumanism points to a distinct separation from the hierarchy of man in the universe and, in doing so, provokes a concentrated appreciation for the *other*, multiplicity and deconstruction. While each of the three beliefs has its own subsets, their general approach—and the borders between them—are, at times, fuzzy and can be legitimately contested.

This section attempts to delineate the threads between and among these three views—humanism, transhumanism and posthumanism—and forms a tapestry that weaves the appended mortal, the transformative body, and the expanded person into an amassed and contested culture. We begin with a brief look at humanism to reveal a thread that links to transhumanism and posthumanism in ways that offer new insights into the concept of life expansion.

5.1.1 Humanism

Humanism as interpreted in *The Passions of the Western Mind* (Tarnas 1991) is an outcome of classical humanism, which has a dual legacy in "idealist and rationalist" (70) doctrines. Humanism suggests that man is placed at the central, dominant position of reality, relegating all other elements to a secondary position. Such an attitude links to the sophistic view of man at the center of the universe acting alone, although with a divine spark, and in accordance with his desires and reason, including Aristotle's theory of motivating psyche.[119] This observation seems contradictory: at once the person, most often referred to

[119] Aristotle's concern with psyche in *De Anima*, proposed that, for example, rocks exist, plants live, animals sense and humans think.

as *man* in humanism, is defined by a set of attitudes that separate man from others. The "historical fidelity" (Tarnas 1991:469) of humanism has emerged from traditions, in which the narrative employs "certain English terms and expressions" (469) such as "'man,' 'mankind,' 'modern man,' 'man and God,' 'man's place in the cosmos,' 'man's emergence from nature,'" which, however suited for the times, segregates humans from their companion gender and promulgates what has become an "issues of the archetypical dialectic between masculine and feminine" (469).

Humanism, according to Corliss Lamont in *The Philosophy of Humanism* (1949, 1990) has roots that reach "far back into the past and deep into the life of civilizations supreme in their day" (1990:11), notably Greek scholars, the European Renaissance, and the Enlightenment. This spectrum of cultures and political views, philosophical undertakings, religious upheaval, and scientific reason present a smorgasbord of flavors—some that are easily palatable and, when combined, offer a rich sense of man in the familiar world, and some that are contrary, offering deeply complex yet potentially satisfying defenses and contested beliefs.[120] Humanism was considered primarily as a method of learning among the early Greeks[121] (5th Century BCE) and later Renaissance scholars (14th-17th centuries). Phrases such as "dignity of man," as in Pico della Mirandola's *Oration on the Dignity of Man*,[122] "universal man"[123] and "Renaissance man," referring to polymaths such as Leonardo da Vinci (1452-1519) and the intellectual landscape in which philosophers such as Niccolò Machiavelli and Thomas More resided, placed man as

[120] See http://jonmills.tripod.com/Dasein.htm Downloaded January 15, 2012.
[121] Greek scholars did not use the term "humanism"; however, the shared characteristics of the Greeks to the European Renaissance (early humanism) forms ties that historians such as Corliss Lamont suggest are poignant. For example, Protagoras proposed humanity as a starting point for values: "Man is the measure of all things." See http://dictionary.reference.com/browse/man+is+the+measure+of+all+things Downloaded January 15, 2012. Other Greek scholars who are attributed with links to humanism include Socrates, Aristotle and Epicurus (Lamont 1990). See http://atheism.about.com/od/abouthumanism/a/ancientgreece.htm Downloaded June 13, 2010.
[122] Translated from De hominis dignitate (Italian).
[123] Translated from "Homo universalis" (Latin).

significantly capable of controlling his life, and perhaps in concert with God as humanists drifted further away from medieval Christianity. It was not until the development of modern humanism and natural humanism (i.e., relying on nature rather than supernatural concepts) that religion was obfuscated and perceived as a formidable opposition, only later to return in what is known as "religious humanism,"[124] which integrates ethics and religious rituals. Nevertheless, secular humanism[125] appeared as a counterpoint to this trend. The rationale of secular humanism is that man can embrace reason while rejecting supernaturalism, pseudoscience and superstition—all set aside to the confines of religious dogma.

Perhaps by contrasting humanism to other systems of thought one might filter out its male-dominated belief system, which seems to be concerned more with its own footing than its relationship with others, and turn it into a tangential observation. For example, contrasting humanism's ardent call for reason and science over religious or supernatural systems arguably forms the basis by which humanism, as we know it, developed. Thus, modern humanism narrowed its vision in proposing an existence free from worry or thoughts of an afterlife. Seen in this way, persons are responsible for taking part in life, owning their values, and forming their own morality (Lamont 1990). In sum, the humanist's central concern is on time-based reality of the "now" (1990).[126]

The thesis asks: What aspects of humanism might offer insights into central or peripheral issues that directly concern life expansion? Because life expansion is a concept

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[124] Briefly, this mention of religious humanism can be understood as relating to Transcendentalists and Universal Unitarians, for example (Hoertdoerfer nd) See http://www.humanismtoday.org/vol12/hoertdoerfer.html ; also (Murry 2006). See http://www.uuworld.org/ideas/articles/6558.shtml Downloaded April 16, 2011.
[125] A set of beliefs that promotes human values without specific religious guidelines. See http://dictionary.reference.com/browse/secular+humanism Downloaded January 15, 2012.
[126] In The Philosophy of Humanism, Lamont's philosophical introduces naturalistic humanism (1990:vii). Just more than three decades later, Lamont edited the 6th edition to include comments about the rise of the Moral Majority (also known as the religious right), whose opposition to humanism caused Lamont to respond in its defense (vii).

that explores extending and expanding the time a person is alive, the culture in which a person exists will most likely influence the ways in which a person's life is expanded. For example, in relation to the prospect of redefining death and developing approaches to life extension, humanism can be seen to have a pivotal role by and through its ushering in alternatives to cultural knowledge through efforts in science and reason. It was here when humanism separated from religious beliefs that, for the most part, cast man in a role as servant to the gods and, instead, fostered new opinions about humans taking control of their own circumstances, and by which placing man at the center of their own reason and existence. In this way, humanism is an archetype of the inquisitor and in defending this stance it becomes the warrior.

The aspects of humanism beneficial to the heuristics of life expansion are: (i) to be responsible for one's own well being;[127] (ii) to exist in the here and now;[128] and (iii) to seek logical explanations through reason[129] and employ scientific method[130] in investigating phenomena. Aspects of humanism that are antithetical to the concept of life expansion include: (i) an overreaching abstract concept of what humanity means and the proposition of a universal human nature; (ii) the prominent use of the term *man* and, although it is a term indicative of the time frame in which humanism developed and was emphasized, humanists ought to have been more aware of humanity as having two genders and problematic issues resulting from gender inequality and, further, an awareness of persons

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[127] Affirmation that "human beings have the right and responsibility to give meaning and shape to their lives" as proposed by the International Humanist and Ethical Union, which was founded in Amsterdam in 1952. See http://www.iheu.org/ Downloaded February 22, 2012.

[128] This tenet can be seen as linked to Ram Dass' views on spirituality, yoga and meditation, as in *Be Here Now* (1978) as a Zen-like perspective that can be applied to the practical approach as a poiesis of life expansion.

[129] René Descartes' dictum "cognito ergo sum" places man's ability to think as primary to his existence. While Descartes' dictum emphasized the soul as separate from the physical body, Humanism values reason as a profound centrality of human thought rather than emphasizing the divine or supernatural intervention.

[130] Francis Bacon, a Humanist, intended that man control nature for his own good and the good of all as a democratic approach; however, with more emphasis on inductive reasoning than the socio-political, which arrived at a later date in Modern Humanism (Lamont 1990).

who are hermaphroditic, for example; (iii) stressing the here and now with a blind eye to the advances in science and technology that affect what is asserted to be human nature; and, relatedly, (iv) that the contemporary human represents the final stage of evolution for the species.

Humanism, for all its scholarship spanning centuries of inquiry, focused on the narrative use of man and the emphasis on the destiny of man as with the limits of "this natural world" (Lamont 1990:107). In *The Philosophy of Humanism*, in the chapter "This Life is All and Enough," Lamont turns to H.G. Wells and Julian Huxley's *The Science of Life* (1939) and quotes the passage "'[t]he individual has, so to speak, made a bargain … Like Faust it has sold its immortality in order to live more abundantly'" (104). Lamont continues with his argument that man ought to refrain from a longer life in rationalizing what he refers to as the "Law of Conservation of Mass" (104), especially because of its implication that man will "go on existing forever" [because the] "infinite past comes to focus in our intricately structured bodies; and from them there radiates the infinite future" (104). He adds: "Biology does not strictly rule out immortality for human beings, though it does insistently indicate that any kind of continued existence must be based on natural bodies" (104). Perhaps humanism, while once portraying an archetype of the inquisitor, is nevertheless conditioned by its biology.

5.1.2 Transhumanism

> I believe in transhumanism: once there are enough people who can truly say that, the human species will be on the threshold of a new kind of existence, as different from ours as ours is from that of Peking man (Huxley 1957:13).

Sir Julian Huxley was an evolutionary biologist, long-time director of UNESCO, and author of the foreword to Teilhard de Chardin's *The Phenomenon of Man*. Huxley's evolutionary views expanded beyond an emphasis on the human as a final stage of material existence, and considered the emergence of a new species that the human might become:

> Evolution on this planet is a history of the realization of ever new possibilities by the stuff of which earth (and the rest of the universe) is made—life; strength, speed and awareness, the flight of birds and the social politics of bees and ants, the emergence of mind, long before man was ever dreamt of, with the production of colour, beauty, communication, maternal care, and the beginnings of intelligence and insight (Huxley 1957:14).

Huxley's notion of transhumanism can be found in even earlier citations, especially those of Dante Alighieri (1265-1321) who, in his magnum opus "Paradiso" of the *Divina Commedia* (1312), proposed the human might "transumanar" as "going outside human perception" (Vita-More 1998). Centuries later, T.S. Eliot reflected upon being "transhumanized" in his Tony Award winning play "The Cocktail Party" (1950), which illustrates the isolation of the human condition: "You and I don't know the process by which the human is Transhumanized: what do we know of the kind of suffering they must undergo on the way of illumination?" (147). A decade later in 1966, the *Reader's Digest Great Encyclopedia Dictionary* defined transhuman[131] as meaning to surpass, transcend and move beyond.

Early transhumanism has a basis in the formative notions of evolution, the field of evolutionary biology, and philosophy. Its worldview is steered by advances in technology—the emerging and speculative fields that include regenerative medicine, nanotechnology and nanomedicine, artificial intelligence, computer science, neuroscience and cognitive science. These technologies form the scope of human enhancement and how human life can be expanded onto nonbiological systems. These notions are futuristic, and much might be said of the strong allegiance between transhumanism and futurology.[132]

In "Transhumanism: Toward a Futurist Philosophy" (More 1990), the outcome of

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[131] Several figures approached the idea of a future human within the express concept of the transhuman: Fereidoun M. Esfandiary, author of *Are You A Transhuman?* (1989), Damien Broderick, author of *The Judas Mandala* (1982) the author wrote the "Transhuman Manifesto" (1983). Max More defined the "transhumanism" in *Extropy The Journal of Transhumanist Thought* #6 (1990).

[132] Futurology, also known as future studies, is a social science field that investigates probable and preferred futures by accessing changes and advances in human development, technology, science, psychology, economics and politics, for example.

fresh discoveries from the late 20th century and the 21st century form “a class of philosophies that seek to guide us toward a posthuman condition” (1) in an effort to challenge universally preconceived truths by questioning moral and ethical prejudices, the hierarchy of man, religious dogma, gender bias, and the limited biological lifespan. Within this worldview transhumanism is the codified philosophy of Extropy, a view that affirms boundless expansion, self-transformation, dynamic optimism, intelligent technology and spontaneous order.[133] However, it is the relationship with the future that is most prominent within the transhumanist scope, according to Max More. Practical transhumanism is strongly aligned with that aim, as one cannot be in the future if one does not prepare for it, including the effort to maintain a healthy level of well-being. Particularly, transhumanists are lay general practitioners who, on an average, tend to be skilled in basic medical jargon, diet, nutrition, physical fitness, and several areas of psychology. For example, a transhumanist lay person interested in psychological therapies would look to further holistic approaches to issues of depression, anxiety, and deeper issues of emotional illness and psychosis. Outside the psychological sphere, transhumanism applies the methods of strategic thinking—or otherwise known as future studies—to its theoretical inquiries concerning the pros and cons of technological acceleration, ethical use of such technologies, and the socio-political environment in which these technologies reside. Such methods include systems thinking, scenario development, and forecasting, although some transhumanists prefer not to prophesize, an activity often reserved to the field of futurism. The transhumanist approach leans toward mathematical calculations, especially in the area of technological acceleration, which is often based on premises such as Moore’s Law.

Transhumanism emerged from distinct subcultures including futurists, life extensionists, computer geeks, cyberpunks, and feminists, largely in the public sector

[133] See http://www.maxmore.com/transhum.htm Downloaded September 16, 2010.

outside academe in the late 1980s and through the early 1990s when several organizations arose and conferences received extensive media coverage. Eric Drexler, Marvin Minsky, Hans Moravec were three vocal adherents to the transhumanist agenda, especially the philosophy of Extropy. During this period, nascent ideas about nanotechnology emerged, along with more attention for artificial intelligence and robotics, along with growing scientific and medical interests in genomics, cloning, and advances in medical technology and prosthetics. New insights into human evolution and technological advances formed a fertile meeting ground for those outside academe to engage in high levels of scholarly inquiries among academics at MIT, Stanford, Oxford, and many other institutions. Additionally, ideas have coalesced in the fields of computer science, cognitive science, and neuroscience on human future possibilities. Transhumanism, as a philosophy, has been more concerned with research and development of the emerging technologies and with the science of human enhancement and life extension than its pedagogy and its position among the realm of academic philosophies to be studied. One irony is that while transhumanism has received wide media coverage during the past two decades, it is not until the past decade that it has been recognized as a viable perspective within postmodernist discourse. Notably, Arizona State University is one of the few academic institutions, which offers a specifically designed program in its curriculum to evaluate the transhumanist discourse.

The series of events in the *Global Spiral* can be understood as an example of miscalculations that may have distanced postmodernist rhetoric from engaging the transhumanist perspective. However, like postmodernist views, transhumanism contests posited universals concerning human nature and human morality but more specifically contests the agenda that man ought to refrain from a longer life and that “continued existence must be based on natural bodies” (Lamont 1990:104).

The thesis asks: What aspects of transhumanism might offer insights into central or peripheral issues that directly concern life expansion? For example, if the expanded mortal is recognized in this thesis to be transhuman in a transitional stage of ultimately becoming posthuman, then the culture in which it is spawned might offer a cohesive collection of knowledge on the prerequisites to life expansion, such as issues concerning human enhancement, life extension and brain-computer interfaces. Such knowledge is representative of the worldview of transhumanism, and transhumanism, thus, can be seen to have a pivotal role in initiating discourse on emerging and speculative technologies. It was here that transhumanism separates from the philosophy of humanism, and became more directly linked with posthumanism. In this way, transhumanism is an archetype of Prometheus the Titan.

Transhumanism then can be said to be an alternative to humanism and, by doing so, it offers a new philosophical approach to the human condition while simultaneously expanding upon antecedents, such as the epochs of the Renaissance, the Enlightenment, modernism, and, more currently, postmodernism. Further, transhumanism values human potential *but* does not see the human as the result of the species' final evolution. Transhumanism accepts certain human enculturated behaviors as commonly held between certain types of people *but* does not support such notions as a universal human nature. It recognizes the human's two distinct genders *but* it also proposes a heightened awareness of the potential multiplicities of gender and sexual overtures.

The aspects of transhumanism beneficial to the heuristics of life expansion are its: (i) scholarship in the domain of emerging and speculative technologies,[134] which this thesis proposes as potential media for new artistic and design-based approaches; (ii) concentrated theoretical insight of potential human futures, including ethics and socio-political

[134] Such technologies include artificial general intelligence, nanomedicine, genetic engineering, for example. Experts in these areas were interviewed by the author as a methodological approach to the thesis questions and arguments.

discourse;[135] (iii) historical alliance with the concept of posthuman and whole brain emulation;[136] and (iv) advocacy of human enhancement, radical life extension, and cryonics. Aspects of transhumanism antithetical to the concept of life expansion include: (i) the proposed use of potentially dangerous technologies; (ii) a vision too far-future with a weak near-term agenda; and (iii) insufficient academic mention and inclusion.

Hava Tirosh-Samuelson, professor of modern Judaism and project director of the Templeton lecture series at Arizona State University, argues that "[t]he revolution in genetics and the advent of genetic engineering is the reason for the transhumanist vision" (2007 p. 4). Branden Alleby contends that:

> [t]here are significant and growing arguments over whether 'transhumanism' is a desirable direction for humanity to be going. Some argue in favor of human enhancement and a continuation of medical progress, others against it on equitable grounds, and even on the basis that it constitutes blasphemy, a primordial sin against the order that God has established, the Great Chain of Being that gives us all our place (Allenby 2001).

Such emphasis on religion may run counter to the transhumanist worldview. Nevertheless, one can uncover strains of thought that impede upon these projections is that transhumanism has an historical tie to early notions of human evolution, including spiritual and transformative outlooks that continue today. To wit: the Buddhism and Zen strongly contest an atheistic stronghold within the culture of transhumanism. For example, in Chapter 2, the proto-science of Taoist alchemy was mentioned as a link to the prospect of life extension. Further, the notion of a noosphere (Teilhard) links to the concept of whole brain emulation in that one might exist in a connected, cybernetic existence.

The transhumanist condition is based on assumptions explicit in discourse that often interprets its aspirations as more desirous than feasible. Nevertheless, in the last two

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[135] During the time frame of the thesis' investigation, the author researched the pros and cons of transhumanism and presented the paper "Deconstructing Transhumanism" (2009) at the Planetary Collegium research update meeting in Gijon, Spain.
[136] Also known as an upload or substrate-independent minds.

decades, transhumanism has been cultivated and has crept into many folds of culture and, as Katherine Hayles noted "it manages to creep in the through the back door of my mind" (Hayles 2011). Because it is a relatively new philosophy, dating to the early 1990s, it needs time to mature and to reflect upon criticisms from naysayers. In the end, perhaps transhumanism will be consolidated as the Promethean archetype, after all.

5.1.3 Posthumanism

With descriptive allegorical reflections on human imagination, science and cultural change, Ihab Hassan's theoretical approach to posthumanism in *The Right Promethean Fire* (1980) is an indeterminate fiction[137] of our times. Hassan's "mediation on science and imagination" (xxi) steers his quest toward discovering missing parts of the human narrative that have been fragmented by modernism and scientific truths, universals, and assumptions about human nature. Perhaps posthumanism resembles a mythic figure of Kronos, echoing the same type of rebellion against his father in attempting to deconstruct the established presence of humanism.

One might reflect back upon transhumanism during Hassan's journey, especially at plot points where mentions of the individuals—Dante and T.S. Eliot, for example—who wrestled with narratives of human struggles in their respective attempts to *transumanar* man and transhumanize him. Hassan also includes in his voluminous collection of thinkers those who envisioned a new type of human, including Nietzsche and Teilhard. Noticeably, Julian Huxley does not hold a place in Hassan's story and one might infer that Hassan was reticent to include an evolutionary biologist, especially because his arguments are situated in literary myth. While this one notable exclusion is a minor glitch in Hassan's journey into cultural narratives and the postmodernist view, it nevertheless reveals a certain familiarity

[137] By this, Hassan suggests indeterminacy because posthumanism is a concept that is located within the timeframe of postmodernism (Hassan 1980:96).

between transhumanism and the posthumanist perspective, which has gone unnoticed within the humanities:

> Yet posthumanism may also hint at a potential in our culture, hint at a tendency struggling to become more than a trend. The Promethean myth, after all, contains an enigmatic prophecy. How, then, shall we understand posthumanism? (Hassan 1980:201).

Hassan embellishes Promethean flaws as evidence that a posthuman Promethean sensibility is the apt—or, more qualified than human—means to attest to and revel in observable feelings about the human condition, and one's fictional self (xvi) as definitively finite. Still, Hassan refers to the term "transhumanization" (perhaps cued by Dante or Eliot) and asks: "Or will the transhumanization of the human mean our 'childhood end'?" [138] (206). Such nature, according to Hassan, is voiced by Rainer Maria Rilke[139] (1875-1926) in the paraphrase: "Not only is man by nature more daring than plant and beast. Man is at times more daring even 'than Life itself is'" (206). Hassan marvels at the capabilities of human imagination, especially in the arts, by including such quotes as: "Max Planck: 'The pioneer scientist must have a vivid intuitive imagination for new ideas, ideas not generated by deduction, but by artistically creative imagination'" and "Erwin Schrödinger: 'I need not speak here of the quality of the pleasures derived from pure knowledge; those who have experienced it will know that it contains a strong aesthetic element and is closely related to that derived from the contemplation of a work of art'."

While Hassan situates posthumanism within the scope of literary theory and

[138] This quote refers to Arthur C. Clarke's book *Childhood's End* (1953) about an alien invasion.
[139] Hassan's paraphrases Rilke's "Improvised Verses". Of note, the author is unfamiliar with Rilke but found this particular quote in Hassan's book to be relevant in regards to the daring nature of humans insofar as attempting to contest Life itself. One might interpret Hassan's paraphrased or Rilke's stanza-reference to Nature as an interpretation of the environment of existence—where everything exists. Yet man can transpose the environment, whereas plants or beasts are not as eager as man to do so, and that man in this eagerness seizes an opportunity to mold the environment. For life expansion, the "unshieldness" reflects the vulnerability of man's existence within the environment, as if he were open to it and available, yet unprotected against the elements. If Rilke's use of "Open" pertains to something other than the environment of Nature, it might be the larger Nature that man has not yet realized.

alternatively in the era of postmodernism in *The Post-Human Condition* (1997), Robert Pepperell proposes that the post-human can be used in numerous ways and articulates a new era in human development as the ending point of humanism and the beginning of a far-reaching transformation. Pepperell's philosophical observations and projections are familiar to the rhetoric of transhumanism, including attention on robotics (Moravec), neural networks (Minsky), and nanotechnology (Drexler), for example. Each of these topics is underscored within transhumanist writings, as referenced above, and, in fact, the authors refer to themselves as either transhumanists or advocates of extropy, the original transhumanist philosophical approach. Pepperell, in his selected references, identifies most of these authors, and also identifies Max More, author of the philosophy of transhumanism. Pepperell asks More: "What do[es] … "posthuman" mean? A: … [p]osthumans will be persons of … self-programming, potentially immortal, unlimited … partly or wholly postbiological …" (Pepperell 1997:174-175).

It is evident that Hassan's aspects of posthumanism are transhumanist in scope because they share similar perspectives on human transformation, and the human spirit of imagination and ingenuity. Regarding Pepperell specifically, they also share certain sciences and technologies in creating a posthuman future. One could argue that posthumanism is, in fact, synonymous with transhumanism because Julian Huxley's transhumanism proposes a human transformation as an evolutionary process (1957) and by the notion of a transhuman becoming a posthuman (Esfandiary 1989; More 1990). However, Hassan does not offer an example of a posthuman or how a posthuman person might be realized. Pepperell though has given the posthuman more concrete thought and nascent insights by arguing that "there is a profound link between the discoveries in atomic science, … quantum physics, and Cubistic art" (1997:168) through what he refers to as "the agency of scientific exploration and artistic innovations" (that a work of art, such as a painting) "is not *absolutely* there, it is *possibly* there"[140] (170). What can be gleaned from Pepperell's speculation concerning matter in objects of art and in forming human physicality is that human knowledge is speculative, based on historical narratives that are induced by the culture in which they are remembered (Lemke 1994).

In sum, one might assume that Hassan's and Pepperell's articulations about posthumanism are actually transhumanism viewed through a differing set of lenses. However, both contain a degree of speculation in that no one can predict the future, especially in an age of uncertainty (Pepperell). Here, one might ask how it is possible to evaluate a condition of existence that has not occurred yet, or speculate on a type of being without having experienced such a state of being? The same could be said of transhumanism because it proposes a future posthuman. The difference here is that one can speculate about a posthuman as a future possibility within the philosophical outlook of transhumanism because, as the time frame of transhumanism is current, such conjecture should be considered speculative. Alternatively, posthumanism is a period that cannot exist in the present because we are still human and partially transhuman (i.e., transforming humans through human enhancement and/or through appendages, as in the cyborg) and such conjecture presupposes we are already posthuman, a notion that could be true if the posthuman is a theory and not an actually manifested reality. However, if the posthuman is an actual state of existence, then one could only speculate on its existence during its time frame of being. Speculative inquiry is vital, as based on trajectories of fields that directly engage the future, such as science and technology, and the research and development that is taking place, as well as projections of the advances in the fields. For example, a posthumanist future might entail a developmental sequence of related topics, and their

[140] Theories concerning matter are located in quantum physics, the Uncertainty Principle and many worlds theory, all are speculative.

activities in ascertaining possible trajectories (Hines & Bishop 2007) of what a posthumanist future might entail. Science fiction has succeeded in accomplishing innumerable trajectories for human futures, although not formally referred to as posthumanism, and which are often transhumanist in scope (Egan 1995; Sterling 1996; Platt 1997; Vinge 2001; Broderick 2002). However, the paths in moving from one level of thought to another in the visual and virtual arts might avail new observations approached from an entirely different perspective and with the aim to build objects, environments, and experiential models for such trajectories.

According to Neil Badmington, the prefix *post* inherits its usage from poststructuralism.[141] Nevertheless, Badmington asserts that posthumanism is "far from straightforward" (2000:9) and that "not all authors use the term to mean the same thing" (10). Paula Rabinowitz asks timely questions that are present in cyborg feminist culture but not so much in posthumanism: "Can the posthuman speak?" and "Is there a posthuman woman?" (2000:42-43).

The close entanglement of posthumanism with postmodernist trajectories as emphasized by Badmington in *Posthumanism* (2000) appears problematic because aspects of its scholarship are invested in opposing Humanism—that of antihumanism, most notably,[142] [143] rather than focusing on the strategic critical inquiry and open discussion of posthuman futures. The "dubious neologism" of posthumanism, according to Badmington who references Hassan, may be that posthuman serves a general crisis of culture that is

[141] Poststructuralism is, according to Badmington, "a philosophical movement that emerged in the 1960s with the work of Jacques Derrida" (2000:9).
[142] The term "antihumanism (or anti-humanism) was coined by Louis Althusser (1918-1990) and refers to concepts opposed to the project of philosophical anthropology and notions such as the nature of man.
[143] Here structuralism refers to knowledge within a given culture as products of that culture. A dialectic is that while structuralists may consider the Humanist narratives of scientism and human nature are based on a single modernist perspective, it can also be said that posthumanism—through the lens of postmodernism—could garner the same result.

helplessly humanist in assuming that man is the center of all truths. One might wonder if the Humanists felt concern for a general crisis of culture that was helplessly religious in assuming the Earth was the center of the universe. Several questions arise: Can one be opposed to a set of ideas and still formulate a clear plan of action without distinguishable bias? Might any possible trajectories become red herrings, distracting discussions from the tasks of formulating possible futures and redirecting them instead toward being scorned by one generation against the last? The answer would be yes, if the aim is to seek solutions rather than to create a straw man. However, rather than emphasizing red herring or straw man arguments, this thesis is concerned with the contested culture of life expansion and the issues that distract from this aim.

The thesis supports the posthumanist and transhumanist expressions of angst toward both humanism and modernity that ignore gender and sexual diversity, multiplicity, and overreaching scientism. The thesis then moves toward new approaches to human nature, away from the historical criteria for what is and is not a normal or natural essence of human. Where transhumanism and posthumanism part ways is in their respective approaches: posthumanism is deeply intertwined with the postmodernist agenda and rhetoric while transhumanism is deeply intertwined in human evolution, human enhancement and life extension. This difference brings into the discussion how or in what ways have posthumanist thinkers offered concrete concepts for which to deal with the human future? Where is there a posthumanist view that has developed a strategy for dealing with the issues that surround human futures? Where is the posthumanist struggle that seeks knowledge and practice outside theorizing that can make a difference? Alternatively, what frames of reference might best form methods by which to project possible futures?

Hayles (1999) asserts that speculative fiction has formed the narratives that have lured us forward and pulled us back, perhaps more simultaneously than cyclic. One might conclude that the distinct benefit of posthumanism, besides alerting an intervention into the rigidity and human ownership of Humanism, is in its theorizing about the other. Therefore, posthumanism prompts culture to move beyond Humanism rather than remain a practical theory or philosophy about human futures, which currently resides within transhumanism. One might argue that posthumanism, although lacking a formal definition and tenets is, at best, a fuzzy concept offering a framework for humanity's movement forward.

Culture resides in the language, symbols, literature, visual images, and objects that surround a society, including the formation and reformation of same. How can one practice cultural criticism when criticism implies objectivity—a distancing from the culture while, at the same time, being present enough to understand the conflicts and stresses with the culture?:

> The answer is that cultures are not homogeneous; they are not even necessarily coherent. There are always other perspectives, so that cultures offer alternative positions for the subjects they also recruit. Moreover, we have a degree of power over the messages we reproduce. A minor modification changes the script, and may alter the meaning; the introduction of a negative constructs a resistance (Belsey 2000:ix).

The aspects of posthumanism beneficial to the heuristics of life expansion include their: (i) criticism and attempt to overthrow preconceived notions concerning essentials humanity and notions of "modern man";[144] (ii) the relationship to the idea of the posthuman, which has the scholarship of intellectual and creative currency in the discourse of the arts and humanities; and (iii) the undefined, fuzzy philosophical worldview, leaving an opportunity for new insights and possibilities.[145] Aspects of posthumanism antithetical to the concept of life expansion include: (i) the tethering to postmodernism, which narrows its possibilities for extracting alternative views that support diversity but also seek a

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[144] As suggested by Tarnas (1991:469).
[145] As suggested by Badmington (2000:9).

broader perspective;[146] [147] and (ii) exclusivity, often harboring on elitism among its adherents.

5.1.4 Four Artistic Works

The author's early practice and current works resonate with previously mentioned questions and concerns about the posthuman. Specifically, the explored issues pertain to the posthuman female, the posthuman body, the posthuman myth, and the posthuman presence. These works include one video, two films, and one graphic narrative. In chronological order, the video "2 Women in B&W" (1987) depicts an interchangeable identity shared by two females. The scene opens with the two dressed in classic, yet austere, black suits with white shirts against a stark background. Sounds from the street are a distant but someone interrupting noise to the script's narrative verse, which repeats itself during each round of iterative repetition as the women ask one another: "What are we doing here like this?" Symbolizing two sides of the same gender: as sensual females and as *suits*, obviously and almost blatantly portraying complex emotions and confusion of trying to find a place of purpose in a place in an historically male-gendered world.

The film "Sleeping Goddess/Waking Muse" (1981) takes a critical look at female reproduction and infertility and the female quest for presence as well as supersedes death as a metaphor for renewing one's self in a world where life is fragile and unpredictable. A second film "Silenced yet Speaking"[148] (1996) touches on aforementioned concerns as articulated by Rabinowitz. In brief, the film is an interplay of poetry, allegory and soliloquy. The cyborg-posthumanist speaks, yet the viewer cannot hear her words. They are seemingly spoken in a beckoning manner, as if she needs to be heard, yet her face is

[146] For example, "The Death of Postmodernism and Beyond" (Kirby 2012) and
[147] See http://www.artnet.com/magazineus/reviews/davis/semi-post-postmodernism5-15-10.asp Downloaded February 15, 2012.
[148] See http://vimeo.com/36309891 Downloaded February 22, 2012.

obfuscated in animated, rhythmic movements choreographed to an electronic, masculine Tiesto-like beat.

Lastly, the fourth work is the visual piece “Primo Posthuman” (1997), which combines photography, graphic design and narrative, depicting a whole body prosthetic for a future posthuman body. “Primo Posthuman” reflects an alternative to the man-machine cyborg and dystopic, disembodied post-human approaches. For example, unlike the classical human form reflective of humanism, this approach takes the ideal of *man* and incorporates it in its transhumanist concept of a healthy hybrid body. Unlike the cyborg, the approach recognizes an unfolding of nature based on expanding choices and our differences. Lastly, by its very nature, the ideal of “Primo Posthuman” relies on a new type of human nature, one that continues over time and a reasonable approach to technological modifications.

These works embrace alternative ways of understanding human nature and exemplify a desire for possible outcomes of a contested culture and one in which human enhancement, such as life extension, might be feasible. For example, “2 Women in B&W” themes the issue of identity as multiplicitous and the male/female roles as emotionally interchangeable. “Sleeping Goddess/Waking Muse” contests the horror of losing a child and anguish of infertility while searching for a life anew. “Silenced Yet Speaking” echoes the aforementioned sentiments, but from the perspective of a posthuman archetype speaking from outside culture. Here the provocation of sexual hegemony alludes to the film’s visual sensuality of “being in life” rather than a necessary animal need. In the project “Primo Posthuman,” there is an obvious shift in narrative and perspective—disavowing the past as we discover new dimensions beyond these tired, yet still pertinent, narratives.

5.2 Desirability and Feasibility

> What should we do in response to biotechnology that in the future will mix great potential benefits with threats that are either physical and overt or spiritual and subtle? The answer is obvious: *We should use the power of the state to regulate it* (Fukuyama 2003:10).

> While there were significant disputes over what human nature was, no one contested its importance as a basis for rights and justice … [n]onetheless, the concept has been out of favor for the past century or two among academic philosophers and intellectuals. … I believe this is a mistake … (13).

According to Francis Fukuyama, "[h]uman nature is the sum of the behavior and characteristics that are typical of the human species, arising from genetic rather than environmental factors" (2003:130). To Fukuyama, the species may have variations, such as height, leaving the trait of physical body stature too uneven across the species to be considered a "normal" characteristic. Instead he suggests such differentiations should be based on an average—a mean height, for example. To Fukuyama, the species has universals within the context of characteristics, such as height and psychological "traits such as intelligence, aggressiveness, and self-esteem" (134) that are distributed around certain means and medians within a culture. In this context, Fukuyama asserts that universals "must be understood" (134) because they are important and necessary in observing a species within a culture and approximating particular characteristics in many disciplines including, but not limited to, medicine and biology, psychology and social sciences. These benchmark means offer insights into what is current as compared to early humans and various trends in human evolution—that the human average height has become taller over the centuries, for example. The issue this thesis has with established criteria for "human nature" and "human universals" is that they prescribe a certain comfortable boundary that once removed, even if just temporarily, unsettles Fukuyama and many of his peers. For Fukuyama humans contain what he refers to as the "Factor X", an "essential human quality" (150) that must be protected and preserved from potential methods and approaches that might affect—or redefine—the factor, such as through the work of biotechnology.

However, what is this Factor X? Could this be an essential evolutionary genetic shift that separated man from earlier species? Fukuyama does not spell out this Factor X in a way that clarifies what he is saying and, perhaps, he is not quite sure himself, but it is something he senses is as crucial as human nature—if not human dignity itself—and which he leaves to historical human biology. Thus, tampering with, altering and modifying the essential genes of humans would tarnish this yet-to-be-understood Factor X, even if such alternations and modifications were to remove, for example, a set of inherited genes that code an inevitably devastating disease. Thus, one might ask: Where is the dignity of persons who suffer from a horrific disease—a disease that is not only painful, but portends to distort their bodies in unimaginable ways, or alters their psychology by bringing about states of psychosis that occur abruptly and unpredictably? That Fukuyama's desire to protect the essence of man is, indeed, impassioned. Yet, the person who desires to be relieved from an insufferably profound disease is impassioned just as well. Thus, the issue might become a matter of choice rather than the deployment of "the power of the state" (10) to regulate what persons can and cannot do with their body. The Factor X that Fukuyama speaks of is fundamentally political. It proposes an essential human quality that is prescribed and judged by a chorus of paternalistic humans such as Fukuyama and his conservative peers who determine what is and is not correct for *all* humans.

Along this thread, Dr. Leon Kass, physician and former chairman of President George W. Bush's Council on Bioethics presented "Defending Human Dignity" at the 2007 Bradley Lecture Series at the Wohlstetter Conference Center in Washington, DC. In this presentation, Kass asks if all humans possess an unalienable dignity by virtue of being alive and offers concern over what might happen if we "[d]estroy (or enhance) our dignity, dehumanizing (or humanizing) ourselves and undermining (or increasing) chances for full human flourishing?" (2007). It is evident that Kass fears that a biotechnological quest to satisfy "venerable human desires" (Bailey 2007) will lead ultimately to humanity's self-degradation—that it will cause humans to lower the collective dignity and, therefore, in our attempt to become more than human we actually will end up "less than human" (2007). However, the issue turns on whether the fear should be intellectually justified within Kass' given context:

> Kass complains about 'harvesting organs,' but isn't it morally laudatory to donate one's organs for use as transplants? He warns against 'mechanical spare parts,' but what could possibly be immoral about an artificial knee or hip? People are certainly not choosing to use biomedical therapies such as the birth control pill, in vitro fertilization and even Viagra so that they can produce 'standard men and women in uniform baths' (Bailey 2005:12).

The culture in which this thesis resides is split between those who fear the future and those who embrace it with few or no reservations, as well as those who are unaware of the consequences of fostering or relinquishing that future. Should we rely solely upon Fukuyama, Kass or others like them to set primarily the standards by which we accept or reject the transhumanist future or the posthuman? If so, we may be in serious trouble because the discourse could forever remain incomplete and inexplicably fragmented for the reason that it ponders a strictly delimited agenda that permanently contradicts the open-ended framework engaging the topics of human enhancement and the potentially larger discussion of the evolution of the human species as worthy, legitimate, and ethically important parts of the terrain.

Stepping back momentarily from the thesis' proposition of life expansion, one might ask if we have enough—that we ought to be satisfied—as we are today as humans. Bill McKibben, an American environmentalist, claims that "[w]e have enough stuff. Enough intelligence. Enough capability. Enough" (2003:109), adding that,

> If we come to see it [the present] as sufficient for our needs, then perhaps we can figure out how to avoid these new technologies and risks—physical and

existential—that they pose (110).

McKibben goes so far to state that Robert Ettinger, founder of cryonics, was “not alone in his self-loathing” (110), that those who aspire to innovation, creativity, with new technologies are indeed part of this self-loathing with the human bodies and themselves. McKibben includes those who seek to determine reproductive liberty and sexual revolution as seeking too much freedom, perhaps, and rightfully ponders whether it all was a “‘good’ or ‘bad,’” and surely “an impossible question” (45). McKibben has had enough—this is certain. However, he is a bystander peering into the future hopes and dreams of those who have a vision of what the future might behold—the good, the bad, and the ugly—and the earnestness to work with all of it to protect and sustain life in its many possible and potential forms. Nevertheless, this thesis proposes that a reasonable skepticism is appropriate and necessary in developing a tenable method for addressing concerns about the emerging and speculative technologies of life expansion. Thus, we now turn to the question: What are some of the arguments for and against human enhancement and how might heuristics of life expansion reflect the contested culture which lies within its grasp?

5.2.1 Art and Propaganda

> I can remember in the days before she died, as rights were rapidly eroding–she would yell at the reports, ‘We’ll never give up; we’ll never surrender!’ (Kurtz).

Hope Kurtz was an artist and original member of the critically renowned art collective Critical Art Ensemble (CAE). Her work as a conceptual artist and editor of many of the CAE projects included “Electronic Civil Disobedience & Other Unpopular Ideas” (1996), “Flesh Machine” (1998) and “The Molecular Invasion” (2002), developed with a variety of media, including computer graphics, web design, film/video, narrative text and book art, photography, and performance. The projects were poignant in their critique of capitalism, the left and the right, emerging technologies, and futuristic ideas, including extropians (i.e., transhumanists and posthumanists). The work could be interpreted at times as biased because within the narratives, the artists presents only one side of the issues; nevertheless, the work is clever, well-produced and visually stunning. For example, the project “True Eves”—or “Cult of the New Eve” (1999-2000)—is a tongue-in-cheek, ludic project that refers to the Biblical Eve and proposes to protect the identity of the New Eve, described as “[t]his woman, whose gift of blood will allow scientist to discover the secrets of life, is the New Eve. She will replace the Mitochondrial Eve of the last biological age. She is the vessel of knowledge that is spawning the Second Genesis”[149] as a product of the Human Genome Project:

> …the process of separating consciousness from the body and transferring it into virtual space is called “uploading.” Those preparing for this demonic process are the extropians. They are truly a menace to all humankind….[150]

Kurtz and her husband (Steve), a founding member of CAE and professor of art at the University of Buffalo, New York, also collaborated on a bioart project “examining genetically modified agriculture,”[151] which was to be exhibited at the Massachusetts Museum of Contemporary Art.

However, on the evening of May 11, 2004, Kurtz died in her sleep. She suffered a cardiac arrest, the severe event of a disease in which the heart’s contractions no longer effectively work to help circulate oxygen-rich blood throughout the body.[152] When the police arrived at the home and observed Petri dishes and mobile DNA-extraction equipment, the authorities brought in the Federal Bureau of Investigation (FBI), the Joint Terrorism Task Force and the U.S. Department of Homeland Security, who determined Kurtz was not an art professor working on an artistic project, but instead a bioterrorist

[149] See http://critical-art.net/Original/cone/coneWeb/mission/pop.html Downloaded February 28, 2012.
[150] See http://critical-art.net/Original/cone/coneWeb/false/pop.html Downloaded March 2, 2012.
[151] See http://caedefensefund.org/ Downloaded February 28, 2012.
[152] See http://www.news-medical.net/health/What-is-Cardiac-Arrest.aspx Downloaded February 28, 2012.

working with germ warfare (2008).

The Kafkaesque real-life drama of Kurtz's surviving spouse occurred while the artist was performing work within his respected culture. Yet, he was considered suspect by outsiders who most likely were completely unaware of the artistic field of bioart or biological art and because of this lack of knowledge, they erroneously made accusations based on how the situation appeared at first glance. Their judgment relied upon the awareness of external conditions in the larger world arena of terrorism and bioterrorism[153]—a deliberate dissemination of viruses, bacteria and other germs into the general environment designed to inflict illness and death upon others.

The thesis reflects on the challenges put forth by Fukuyama, Kass, McKibben, and others regarding the possibilities of the posthuman future as well as the culture that embraces emerging and speculative technologies, including research and development performed in the larger environment of biotechnology, nanotechnology, information technology and cognitive science (NBIC), which have triggered critiques warning of "self-loathing" (McKibben 2003:110). Furthermore, the thesis reflects on the Templeton Research Lectures Workshop and the 2008 issue of the *Global Spiral* fostering concerns *and* assumptions made by equally astute thinkers—Hayles, Ihde, Duprey and Pickering, to name a few. It is here that the obvious gap in understanding transhumanism and posthumanism is manifested most extensively in the discussions that potentially involve human enhancement and radical life extension. The thesis refers to understanding rather than bias or accusation because it seems that many dimensions of the relevant issues are arrived at by a whole consortium of considerate, intelligent, and well-meaning scholars who, from their respective bodies of papers, books and conference talks, want to protect

[153] Bioterrorism can pertain to bacterial agents such as Ebola virus, anthrax, plague, smallpox, botulism, for example. See http://terrorism.about.com/od/whatisterroris1/tp/bioterrorism.htm Downloaded February 28, 2012.

and sustain the human being in this world, albeit through diverse and often conflicting methods. Thus, acknowledging the lack of understanding opens possibilities for greater inquiry and less stereotyping.

5.2.2 Morphology and Freedom

> A teacher assigned Gordon Allport's *The Nature of Prejudice* as required reading. The books aims to demolish prejudice by letting us understand the nature of stereotyping (Rothblatt 1995:x).

Martine Rothblatt is vice-chair of the Bioethics Subcommittee of the International Bar Association and founder of United Therapeutics, a biotechnology company that develops products such as Remodulin, a "prostacyclin vasodilator indicated for the treatment of pulmonary arterial hypertension,"[154] within the field of cardiovascular medicine. Rothblatt has also sought to help and inform others about egregious acts of prejudice against those who are sexually different. In *The Apartheid of Sex*, Rothblatt outlines an historical account of gender discrimination, referring initially to Greco-Roman polytheistic patriarchy where sexuality was located in a person's soul or in his strength and her frailty;[155] then to organized religion and a monotheistic patriarchy, as classifying Adam as good and Eve as evil, and, finally, a post-Renaissance science based on quantitative assessment of gender stereotyping.

For Rothblatt the freedom to morph—to change one's place in the world or how one is judged based on one's beginnings, is crucial in a humane culture. Rothblatt was born in 1955 as a physiological man. She underwent sex reassignment surgery in 1994.

This issue of morphing from an historical species, set of cultures, and/or two genders is consequential although often contested. That we share a common ancestry with

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[154] See http://www.unither.com/products Downloaded February 28, 2012.

[155] For example, Xenophon's "On Man and Woman", see http://www.fordham.edu/halsall/ancient/xenophon-genderroles.asp; or in Aristotle's "On a Good Wife", see http://www.fordham.edu/halsall/ancient/greek-wives.asp Downloaded December 3, 2011.

modern African apes prior to a time when we diverge into separate lineages; that a culture might evolve and form new values, beliefs, and appreciations; and that one gender might select to become the *other*, all have caused social and political uproar throughout the world. Yet we continue on, as Hope Kurtz reportedly cheered “never give up!” Morphology and freedom are consequential to the environment of human enhancement, life extension, and existing outside the parameters of biology, and there may be no better way to address it then by turning to the concept of morphological freedom.

5.2.2.1 Morphological Freedom

Morphological freedom is a civil right, a right that “protects an individual’s freedom from unwanted infringement by government and private organizations,”[156] which pertains to the right to modify one’s body as well as the right not to be coerced to modify one’s body:

> Many humans may continue to be programmed by aspects of their environment (incoming information, family upbringing, geographical location, political ideology, predominant morality, religion, etc.), but now they must usually choose between competing programming forces. … Here lies the budding of autonomy. The existence of diverse options facilitates _ but does not guarantee _ that any individual will make conscious choices (More 1993:1).

> The right to life, the right to not have other people prevent oneself from surviving, is a central right, without which all other rights have no meaning. But to realize the right to life we need other rights. … In a way the right to life follows from it, since death or the threat of it is one of the main threats to the pursuit of happiness (Sandberg 2001:1).

That humans will continue to alter, append, transform, and develop new and different bodies is highly probable. The author’s work “Primo Posthuman” (1997) exemplifies this trend, although one that has not yet developed in the curricula of industrial and product design but could do so in the near future. For example, that designers do design and build vehicles to transport the human is a customary part of industrial design curricula. That designers *could* design and *might* build new types of extended prosthetics,

[156] See http://en.wikipedia.org/wiki/Civil_and_political_rights Downloaded February 28, 2012.

especially whole body prosthetics, is probable, based on the developments in corresponding fields, such as engineering, robotics, and artificial intelligence. In doing so, if it were to be the case, the designer as well as the designee would need to be protected from potential accusations of coercive, "ill-advised procedures" (Sandberg 2001) as well as encouraged to assure integrity in the process of authoring and exhibiting the design itself. Likewise, a person who opts to transform her own body would need to be conscientious of protecting her rights as the user. The more one interfaces with the tools, processes, and appendages that morph, or enhance, the body, the more "[i]t is very likely that the familiarity would erode the fear and suspicion that today underlie many bans on applying new biomedical procedures leaving very little support for these regulations, even when they provide a protection against real possibilities of abuse" (2001). Furthermore, that "[t]he ability to alter bodily form at will through technologies such as surgery, genetic engineering, nanotechnology, uploading" (More 1993), is an option and an opportunity that our culture now confronts—the identifiable culture that has one foot in the "here and now" and the other leaping into the future forming what might be understood as wholly Promethean.

5.2.2.2 Risks

Global catastrophic risks could seriously threaten all life forms on a localized and global scale. Volcanic eruptions, tsunamis and earthquakes are usually risks on a localized scale. Large-scale risks take in their clutches most—if not all—of the planet and its life forms. Approximately 65 million years ago, when a meteoroid impact at Chicxulub on the Yucatan peninsula presumably caused the extinction of more than half the species on the planet.[157] The Deccan Traps volcano in India, one of the largest in the world, underwent a series of eruptions lasting approximately 30,000 years; releasing gases and sulfur dioxide that

[157] See National Aeronautics and Space Administration website http://neo.jpl.nasa.gov/faq/ Downloaded December 10, 2011

possibly caused a climate change triggering the earth's cooling and acid rain.[158] An equally frightening catastrophic risk of pandemic proportion might be a quickly-spreading viral infection. The Black Death (1348-1350), caused by a bacterium (Yersinia pestis[159]) in rodent populations (possibly were onboard merchant ships travelling from the Orient to the Mediterranean and Europe), caused the fatality of approximately 75-100 million people in Europe, representing 30-60 percent of Europe's population at the time.[160] Viruses also can cause pandemics, such as the H1Na influenza virus, responsible for the Spanish flu (1918), which wiped out about 50-100 million people, nearly one-half of one percent of the world population.[161]

One might question if populating artificial life forms, such as the synthetic bacterium "Synthia",[162] otherwise known as M. mycoides JCVI-syn1.0 created by Dr. J. Craig Venter (2008), could pave the way for a possible catastrophic risks if they evolved out of control. Further, the reconstruction of a pandemic virus, such as the 1918 Span flue H1N1,[163] even if created in a biosafety level 3 laboratory and for the sole purpose of research and therapeutic human enhancement (e.g., vaccinations), could, in some unforeseen way, take a turn for the worse.

Outside biology, other risks include nuclear energy as a trigger for a potential

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[158] Princeton University's News at Princeton article "Massive volcanoes, meteorite impacts delivered one-two deaths punch to dinosaurs" in Web Stories (Moran Kelly). See http://www.princeton.edu/main/news/archive/S32/14/62G75/ Downloaded December 10, 2011. See also http://en.wikipedia.org/wiki/Deccan_Traps Downloaded December 10, 2011.
[159] Yersinia pestis can infect both humans and other animals. See http://en.wikipedia.org/wiki/Yersinia_pestis Downloaded March 11, 2012.
[160] University of California Los Angeles Department of Epidemiology. See http://www.ph.ucla.edu/epi/bioter/anempiresepidemic.html Downloaded March 1, 2012.
[161] Public Broadcasting Series. See http://www.pbs.org/wgbh/aso/databank/entries/dm18fl.html Downloaded March 1, 2012.
[162] See http://www.jcvi.org/cms/research/projects/first-self-replicating-synthetic-bacterial-cell/overview/ Downloaded January 2, 2012. Also see http://www.nowpublic.com/tech-biz/craig-venter-creates-life-laboratory-synthia-2619533.html Downloaded May 15, 2011.
[163] The Spanish flu virus was recreated in 2005 by Dr. Terrence Tumpey at the gene-sequencing Centers for Disease Control and Prevention. See http://www.msnbc.msn.com/id/9598565/ns/health-cold_and_flu/t/researchers-reconstruct-killer-flu-virus/ Downloaded August 3, 2011.

nuclear holocaust. Even if the Non-Proliferation of Nuclear Weapons Treaty (NPT)[164] (1970) is extended indefinitely, not all countries are parties (i.e., Pakistan, India, and North Korea withdrew).[165] [166] There is also a threat of global warming (i.e., catastrophic climate change) and, while it is not precisely certain why the Earth is heating up, if the rise in temperature continues, an enhanced greenhouse effect of thermal radiation, whether anthropogenic or caused by other forces, is deeply troublesome. Further, when discussing the possible risks of emerging and speculative technologies (e.g., NBIC), the discussion enters deeply into the realm of uncertainty and speculation (Bostrom & Ćirković 2002). Within this realm, dystopic Brave New World scenarios, such as a runaway nanoassembler "gray goo" (Drexler 1986), replicate and consume all matter on Earth. Equally troublesome are the science fiction threatening scenarios in which superintelligent computers (e.g., strong AI) battle against humans and cause a schism in the human species (de Garis 2005).

In light of the history of catastrophic risk and the speculation and themed scenarios about what *could* happen in the future, a certain plausibility is necessary in order to ascertain how much of our knowledge is influenced by dystopic visions of fiction and science fiction and how much is based on our being routinely cautious. Many of the aforementioned risks are caused by natural occurrences within the environment. Many are caused by humans. While one might be able to make comparative observations about global risks based on statistics in order to assign probabilities of a catastrophe, when the scope of risks are outside observable phenomena or lacking in statistical analysis, it becomes that much more difficult to evaluate and measure.

This thesis is not focused on the specific and detailed catastrophic or extinction

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[164] United Nations website: http://www.un.org/en/conf/npt/2005/npttreaty.html Downloaded February 11, 2012.
[165] Ibid.
[166] The most current information on this topic appears to be located on the web. The most up-to-date information, however, seems to be in the "Nuclear Non-Proliferation Treaty" at Wikipedia. See http://en.wikipedia.org/wiki/Nuclear_Non-Proliferation_Treaty Downloaded March 2, 2012.

risks other than to suggest that they are part of the wider discussion on risks that might corresponds to artistic, design-based inquiries within the thesis proposed field of life expansion. The reasoning is that mention of and awareness to the types of risks offers insights into how a corresponding set of inquiries concerning risks of human enhancement and life extension might arise because of the use of emerging and speculative technologies. Thus, further research then could steer explorations of risk speculation that includes the proposed field of life expansion.

Thus, as a primer, one might ask: What possible risks might arise in relation to life expansion? Might we call these risks evolvability risk?[167]

Evolvability can be understood as an ability of a species to produce variants more apt than those currently existing within a species. As an example, the term evolvability is used in computer science and is seen as a type of "emergent selection phenomenon" (Altenberg 1994:1) According to Lee Altenberg, evolvability means "to develop as a performance measure for genetic algorithms" (2). Engineer and designer Tomas Ray's concern with the issue of evolvability pertains to building artificial systems and observing which type of system shows signs of evolution and which types do not (Ray 1999).[168] Here, evolution in computer-based systems, as in the project "Tierra," is designed for evolvability in that:

> [t]he running of the self-replicating program (creature) on the virtual computer (Tierra), with the errors imposed by the operating system (mutations) results in precisely the conditions described by Darwin as causing evolution by natural selection. While this is actually an instantiation of Darwinian evolution in a digital medium, it can also be viewed as a metaphor: The sequence of machine instructions that constitute the program of a creature is analogous to the sequence of nucleotides that constitute the genome, the DNA, of organic organisms (Ray 1994).

How might evolvability be seen outside computer science?

[167] Another term might be called "bioconservative risk".
[168] See http://life.ou.edu/pubs/evolvability/ Downloaded February 1, 2011.

One way of looking at evolvability is to consider any system—a society or culture, for example, that has evolvable characteristics. Incidentally, it seems that today's culture is more emergent and mutable than physiological changes occurring in human biology. In the course of a few thousand years, human tools, language, and culture have evolved manifold. The use of tools within a culture has been shaped by the culture and shows observable evolvability—from stones to computers—while human physiology has remained nearly the same.

For the purpose of speculation on evolvability risk, one would look at the converse of life expansion—what might stand in the way of the human transition in becoming transhuman and, later, posthuman. The obvious risk is the catastrophic risk of extinction (i.e., extinction risk). The less obvious risk is that of the psychology of human behavior, especially the tyrannical behavior of one group of people attempting to and/or succeeding at coercing and controlling another, such as historical episodes of oppression—from instances of genocide to Nazi ideology and coercive eugenics. This topic needs far further exploration and discussion than this subsection allows space for; however, it returns us to the concept of morphological freedom as a starting point for further and in-depth analysis:

> The rich complexity of each individual is produced by a cognitive architecture, embodied in a psychological system, which interacts with the social and nonsocial world that surrounds it. Thus humans, like every other natural system, are embedded in the contingencies of a larger principled history, and explaining any particular fact about them requires the joint analysis of all the principles and contingencies involved (Tooby & Cosmides 1992:21).[169]

Outside the realm of humankind, nature has its own collision course, most commonly referred to as catastrophic risks, when individual ideologies and psychologies collide and

[169] Although the relationship of the person to his/her environment is a syncretic approach and a "psychic unity of humankind" and that the growth of strong empirical adherence to a conclusion is predicated upon a certain detectable genetic uniformity among humans, this thesis does not support the "species-typical" conclusion that proposes a universal (Tooby & Cosmides 1990) of what humans are supposed to be in regards to the "right" type of human, especially in regards to sexuality and gender-based behaviors supporting a particular socio-political ideology.

conflicts arise. One possible prelude for priming this discourse is to build on the concept of morphological freedom as a freedom that protects the rights of those who want to enhance as well as the rights of those who do not want to enhance. In this way, we begin by addressing human behavior as consequential to human enhancement. There are uncertainties and risks and human rights to consider when appending the physical body and cognition, developing new environments for existence, and manipulating matter.

5.3 Conclusion

With the aim of identifying a knowledge gap within the discourse of the humanities that alerts and challenges varying degrees of beliefs and their differing interpretations, the research sets out to fine tune several themes. The *Global Spiral* set in place a starting point from which to examine relationships between humanism, transhumanism and posthumanism. While the vast knowledge within a culture thrives partially from a secure and confident condition in spawning curiosity and gumption that spark our perceptions, beyond this realm the sun neglects to shine—a dimness sets in, eclipsing awareness and understanding. A rhizome mosaic of opportunities is within intellectual reach, but remains stubbornly outside an emotional grasp. As such, this shortcoming was manifest in the *Global Spiral* incident.

The differences and histories covered in this chapter were positioned back to back in a set of "isms" that are distant cousins, sharing if not a genotype, then at least a partial phenotype. The contested cultures of humanism, transhumanism and posthumanism do, in fact, share certain identifiable concerns that this research seeks to uncover. Furthermore, even if those cultural strains go unrecognized by their respective rhetoric, one can see a culmination of traditions, rituals, narratives and visual representations that will affect and reshape the perspectives of all participants in surprisingly similar ways. In this regard, it perhaps has been easier to recognize red flags alerting what might be beneficial and what might be antithetical in developing the heuristics for an ongoing cultivation of ideas and investigations concerning the domain of life expansion.

That the human could be reduced to a Factor X (Fukuyama 2003), a series of codes, or a conglomeration of molecules and patterns (Drexler 1987) with which to deconstruct and reassemble, echoes aspects of early protoscience and the philosophical and scientific theories of Fedorov and Finot—possibly making these notions more historically linked and less obscure. Whether or not emerging and speculative media (ESM) will be used by artists and designers to develop new types of bodies, new types of environments, and new platforms for life is yet to be seen. We have been cautioned by past experiences with risks over our long history as well as erroneous assumptions about risk (e.g., Hope and Steve Kurtz).

Along the way the larger question remains: How can we build better knowledge of human differences that emphasize understanding instead of unproductive bias and accusation?

Freedom of choice is vigorously cherished in a free world, as fragmented and contested as the profoundly numerous cultures of the world may be. Although catastrophic risk might be realized in the blink of an eye, humankind does forge ahead with "a distinctive ... vision as complex and protean" (Tarnas 1991:3). With the conspicuous metaphorical elephant[170] in the room revealed, along with acknowledging the spectrum of risks and encompassing concerns that undoubtedly will arise from the emerging and speculative technologies which engage life expansion, we can continue uncovering what

[170] It is known that academe humanities is largely postmodernist in approaching human enhancement, transhumanism and the posthuman future and has largely contested the tenets of the worldview in which human enhancement and life extension are lodged. Nevertheless, it is the hope of the author that diverse representations of the human future within the humanities might develop in deference to the postmodernist and other philosophical worldviews.

might be the necessary conditions enabling unprecedented approaches to human enhancement and radical life expansion.

PART III

EMPIRICAL RESEARCH, QUALITATIVE INVESTIGATION: INTERVIEWING, FIELD STUDY & AUTOPOIETIC WORK

> Our challenge remains: to creatively maintain artistic and ethical integrity at the progressive edge of our various fields, while continuing to prove a vigorous alternative to an art world largely in decline. Developments in the nanofield, biophysics, and quantum computing will undoubtedly inspire new alliances between science and art, to the benefit of both fields (Ascott 2006).

The long-term development of electronic and telematic art has spawned a diverse volume of works that creatively have manipulated computation codes in robotics, computer graphics and virtuality, and, more recently, in genomics and transgenesis. The range of works include outcomes reflected in visual static and moving images, 3-D and sculpture, installation, performance, interactivity, virtual environments, and bioart projects, for example. While these works extend the perceptual and emotional human experience, broaden aspects of identity within digital and virtual environments and manipulate cellular structure and the appearance of organisms, for example, they do not directly address life extension as articulated in this thesis.

Therefore, we might ask why artistic pursuits, in all their variously imaginative tools—including those which engage directly scientists working in laboratories—have not yet probed the rich sphere of knowledge within the domain of life extension. Where are the new whole body prosthetics that bring together robotics, AI and consciousness? What biological art is working with cells to extend the life span? What "living" works of art are suspended in cryonics? Where is the performative aspect of body art in relation to body morphology that attempts to increase vitality and reduce degeneration?

Further, while virtuality expands personae, such as avatars as alternative *selves*, is there a nexus of artistic, design-based works addressing the expansion of life beyond biology that might approach new body types of whole body prosthetics for unprecedented types of humans and other species, or works that tackle the challenges of brain transfer or mind uploading?

There are indeed threads of evidence that artistic, design-based pursuits may be heading in the direction which could answer these questions in whole or in part. The conspicuous absence of artistic works, including literature and philosophical discussion, about the convergence of nanotechnology, biotechnology, information technology, and cognitive and neuroscience (NBIC) and the emerging and speculative technologies of life extension is apparent. However, before continuing along this vein, it is worthy to comment briefly on how the arts have captured and represented the imagination with regard to human immortality.

Immortalizations of Human in the Arts

> To become truly immortal, a work of art must escape all human limits: logic and common sense will only interfere. But once these barriers are broken, it will enter the realms of childhood visions and dreams (Giorgio de Chirico).
>
> Painting is possessed of divine power, for not only does it make the absent present, but also makes the dead almost alive (Leon Battista Alberti).
>
> Art is man's distinctly human way of fighting death (Leonard Baskin).
>
> A part of me has become immortal, out of my control (Brian Eno).
>
> There are no solids. There are no things. There are only interfering and non-interfering patterns operative in pure principle, and principles are eternal" (Buckminster Fuller).

Visual art has attempted to capture the presence of life over time. The art of representing the physical aspect of humans has often been considered a means to immortality.[171] The prehistoric figurine "Venus of Willendorf" depicts a totem of human fertility and the beginnings of human life. Seeking the aid of spirits to deliver good fortune

[171] See http://www.questia.com/library/art-and-architecture/artistic-styles-and-movements/portrait-painting.jsp Downloaded January 17, 2012.

may have been behind cave dwellers' narrative rituals painted on the walls of Lascaux cave and grottoes,[172] although today the narratives deliver a story of early humans dating back some 32,000 years ago. These representations are not depictions immortalizing a pregnant woman or a bison, but they offer an impression of a future event not yet realized but possibly arising amidst a mythic environment of hope and/or fear. Alternatively, attempt to capture and preserve, and immortalize, the essence of a person has been an aim in idolized images and narratives.

> The Egyptians made sculptured monuments that were idealized portraits of their monarchs intended to grant them immortality. Such ideal likenesses were painted onto sarcophagi of lesser persons as well. In Asia this religious use of the portrait was widespread until the 15th cent., when realistic Western portraiture began to influence Eastern art.[173]

The dialectics between the desire to represent a subject or person accurately and the desire to transform the idealized subject or person is evident in the representations of real-time oil portrait paintings and the historical interpretations of gods, saints, majestic personalities, and mythic idols. At one point, oil painting was the freest means to depict not just the likeness of a person, but also the air or interpretive characteristic of one's nature:

> Portraiture is the art that immortalizes. Portraiture is the art that remembers a person at their most manifest moment, and relates their story to the world. If this definition seems unlikely to you, consider the Mona Lisa.[174]

Painters took liberty in redefining a person's presence through the chemistry of oil paints, and even of themselves—notably, Rembrandt van Rijn.

Rembrandt is said to have painted 80 or more self-portraits, some which depict a character rather than as the artist painting himself. This possibly suggests the use of his own likeness to experiment with the tools of painting and the effects of light on the canvas or as a deep-seeded introspection about his own persona as an exploration into his mind,

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[172] See http://www.lascaux.culture.fr/index.php?lng=en&acc=true Downloaded April 17, 2012.
[173] Ibid.
[174] See http://www.family-portrait.net/portraithistory.php Downloaded June 3, 2011.

"… showing a gradual change from outward description and characterization to the most penetrating self-analysis and self-contemplation. … ...Rembrandt seems to have felt that he had to know himself if he wished to penetrate the problem of man's inner life."[175]

The genre of portraiture illustrates a spectrum for the human species' social construct. In 1955 the Museum of Modern Art in New York City curated an influential exhibition of photographs titled "The Family of Man" created by Edward Steichen , which formed a visual record of human cultures and expressions of life, family, birth and death:

> *The Family of Man* (MoMA Exh. #569, January 24-May 8, 1955) was composed of 503 photographs grouped thematically around subjects pertinent to all cultures, such as love, children, and death. After its initial showing at The Museum of Modern Art in 1955, the exhibition toured the world for eight years, making stops in thirty-seven countries on six continents.[176]

Thus, through the epochs, genres, styles and media of artistic works, the aim may or may not have been to immortalize humans but more, perhaps, to capture the essence of the human condition.

The absence of information on life extension in the arts and humanities is a relevant concern because this thesis proposes life extension as one possible outcome of human enhancement. Further, the use of technology for manipulating matter correlates to the transhuman and posthuman conditions and which technologies, herein discussed as NBIC, need further articulation. While both the arts and sciences abound in endlessly fresh ideas and technological possibilities, it appears that the sciences have the advantage of intellectual research and knowledge capital essential for artistic, design-based approaches to build practicable strategies within the sphere of human enhancement issuing forth in the potential of life extension and its ultimate prospect of life expansion. Thus, one might ask:

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[175] Susan Fegley Osmond "Rembrandt's Self-Portraits" in *THE ARTS*. See http://www.rembrandtpainting.net/rembrandt_self_portraits.htm#about Downloaded January 14, 2012.
[176] See http://www.moma.org/learn/resources/archives/archives_highlights_06_1955 Downloaded January 17, 2012.

What are the conditions that enable artistic, design-based approaches to human enhancement that explicitly seek extending life beyond its maximum biological life span?

This chapter's investigation builds on the historical links to life extension—from the earliest experiments in protoscience of alchemy to the theoretical inspirations of chemistry and molecular regeneration of biology by Nicolai Fedorov and Jean Finot, and, later, the nascent ideas of cryonics by Robert Ettinger, molecular nanotechnology of Eric Drexler, and the advances in biotechnology. These developments have furthered the thesis' new knowledge, which warrant further investigations into the current research and developments of the thesis' proposed artistic, design-based approaches along the conceptual lines of expanding life beyond biology (i.e., life expansion—the term originated in this thesis).

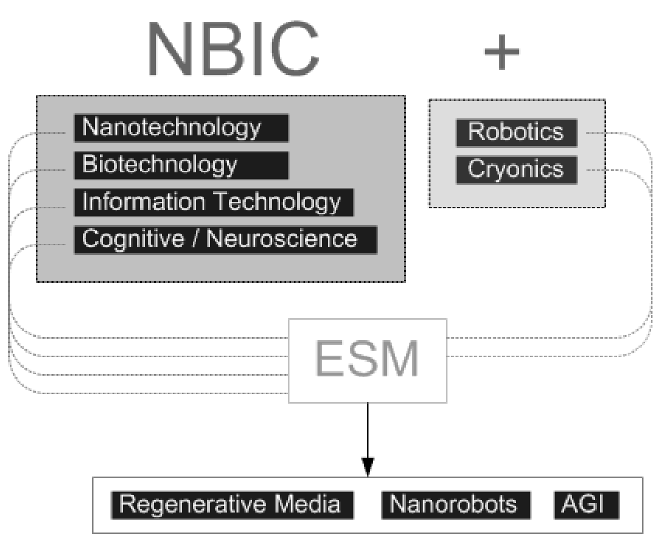

Figure 2: "NBIC+ and ESM" 2012 © Natasha Vita-More.

The purpose of the study was to investigate the NBIC+[177] technologies that specifically relate to human enhancement, to extending life past the current maximum life

[177] NBC+ refers to nanotechnology, biotechnology, information technology and cognitive /neurosciences, plus robotics, cryonics and other technologies yet to be developed that relate specifically to the extension and expansion of life.

span, and to expanding life onto non-biological substrates. One question immediately arises: How might these technologies be used in artistic, design-based practices that engage human enhancement? Thus, the chapter begins with an investigation of the NBIC+ technologies.

Here a triad approach is employed: (i) performing qualitative interviews with experts of NBIC+: (ii) fieldwork in observing four laboratories, and (iii) articulating an artistic, autopoietic process that explores the author's work within the domain of life expansion. In addition, the author includes a chapter, which informs a study of bioart that evidences a relative link to the use of biotechnology, as an example of artistic, design-based approaches currently practiced.

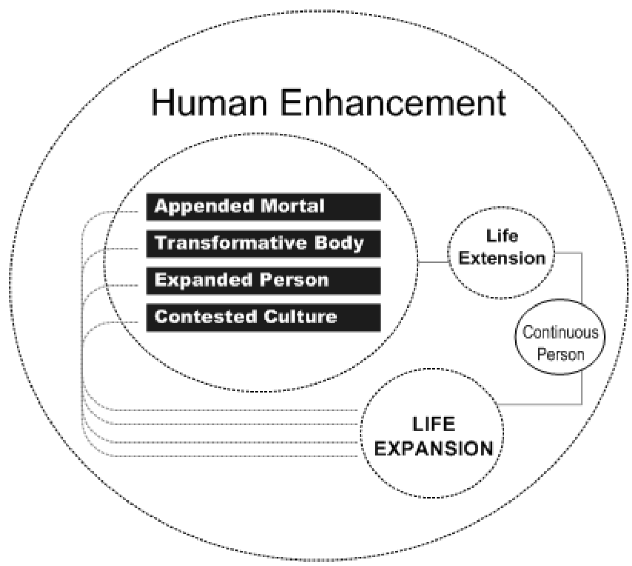

Figure 3: "Human Enhancement" 2012 © Natasha Vita-More.

Human enhancement is the sphere in which the appended mortal, transformative body, expanded person, and contested culture exist. The aggregate discourse on these topics—and related issues of risks, ethical processes, and social and political concerns—form a richly integrated network of information and discussion. The discussion engages cross-disciplinary activities revolving around notions of decomposition and regeneration, desirability and feasibility, and autonomy and connectivity. Out of this complex and data-rich sphere of human enhancement comes the unresolved notion of extending the human life span beyond its current biological maximum years of 122-123 years, respectively. Rising to the challenge in attempting to resolve this unsolved riddle is the converging of NBIC technologies (Roco & Bainbridge 2006) along with the acceleration of exponential change (Kurzweil 2000), affecting all prismatic considerations of the various issues of risk, ethics, socio-political concern, and other matters currently discussed and those that have yet to surface. One aspect of this larger-than-life paradigmatic shift of the human challenging its own genetics—the core of its historical anthropomorphic and scientific truth—is the possibility that humanity might re-script its own genetic code, and this is just a start. In this one atom of thought, derived from millions of bits of knowledge obtained through the course of thousands of years of humans questioning their existence dating to the earliest symbolic-linguistic communications, is the idea of not only living well past our genetics' predetermined life span, but of living—existing—outside biology altogether.

One current supposition is that of the upload (i.e., whole brain emulation or substrate-independent mind) of transferring or copying the brain's neurological functions onto computational code. Other options suggest augmenting the human brain with artificial general intelligence (Koene: 2011). Thus, the theoretical conjecture ponders subpersonae, or avatars, becoming smarter and more seamlessly integrated with human persona.

At this cross-section of this discussion are the transhuman / posthuman conditions, simultaneously similar and contradictory, but nevertheless are firmly established and set apart as *other* than human by conventional social and political interpretations. This thesis proposes that the arts and humanities engage the relationship between the transhuman / posthuman not merely as a theoretical supposition based largely on references to science fiction in which science fiction narratives are employed to envision hopeful and/or dystopic scenarios. Likewise, the relationship's viability should not be predicated upon indifference or receptiveness to correlations with *isms* of humanism, transhumanism and posthumanism, and the offshoots in which they evolved, including modernism and postmodernism.

Rather, this thesis suggests that we take this broad span of knowledge of the transhuman / posthuman, and all of the possibilities into the dynamic embrace of artistic, design-based works, and their respective fields of telematic art, wearable technology, robotics, and the collection of new art media of computer graphics, interactive and virtual art, bioart, body art, and performative art. Here we can foreshadow what this chapter expands upon and make a brief reference to earlier works that engage artificial life, as in the work of Karl Sims, "Evolved Virtual Creatures"[178] (1994) and in the work of Christina Sommerer and Laurent Mignonneau, "A-Volve"[179] (1994). Both are examples of artists working with computational codes as autonomous yet connected artificial life forms. We now turn to the NBIC foundations.

[178] Sims' "Evolving Virtual Creatures" is an example of computer graphics and animation in which the shapes taken on animal-like physical movements and mutate their shapes as they evolve. See http://www.karlsims.com/evolved-virtual-creatures.html Downloaded January 13, 2012.

[179] Artists Christa Sommerer's and Laurent Mignonneau's "A-Volve", "… is the classic work of Genetic Art: a metaphor for artificial life, evolution, and gene manipulation. … Through the real time calculations of a SGI computer, the automatically-animated beings in luminous water assume a physiognomy, and their enhanced plasticity makes them appear to be alive." See http://www.medienkunstnetz.de/works/a-volve/ Downloaded January 13, 2012.

CHAPTER 6: NANOTECHNOLOGY, BIOTECHNOLOGY, INFORMATION TECHNOLOGY & COGNITIVE / NEUROSCIENCE (NBIC)

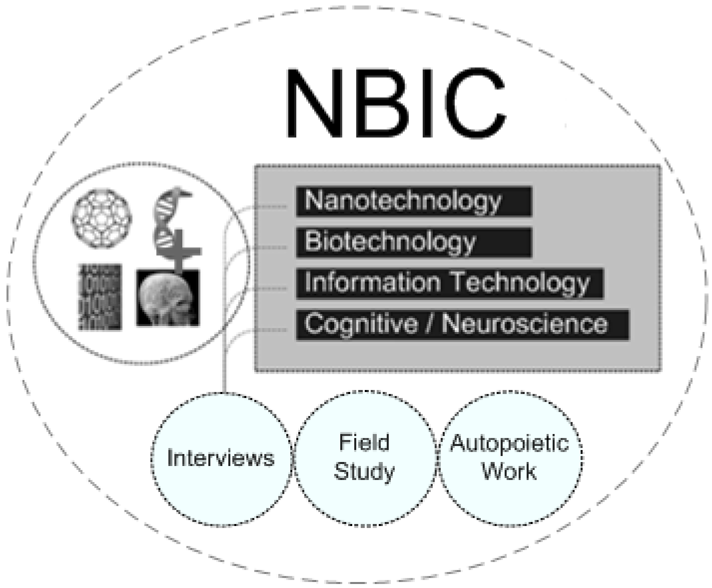

Figure 4: Triad Methodology 2011 © Natasha Vita-More.

In delineating a triad approach, first needed was an analysis of technological developments that link to human enhancement of life extension and the prospects for life expansion. After making a selection of significant technologies, the author researched their respective experts, what their research area comprises, and the relevancy of their work to the scope of the thesis. Next, the author set out to locate the individuals who have written seminal papers, books, and/or noteworthy research projects and to ensure the efficacy of the selection of experts form a direct link to human enhancement and life prolongation, which might lead to life expansion, including brain computer interface (BCI)[180] and the study of uploads (i.e., whole brain emulation). Ascertaining which individuals to interview was accomplished through published papers in academic journals, but setting up interviews and determining if these experts could be visited at their laboratories and to observe the work being done, was a more difficult task.

[180] The idea of BCI stems from the domain of cybernetics, as mentioned in Chapter 2, and the work of Heinz von Foerster at the Biological Computer Laboratory at the University of Illinois (1958-1975), also known as the “Nerve Center”. See http://bcl.ece.illinois,edu/hutchinson/index.htm Downloaded August 10, 2010.

One issue to contend with was that many of the research projects are confidential and awaiting patents. In order to manage this issue, the author set out to situate tangible relationships between the NBIC technologies and the aim of researchers to rejuvenate, clone, develop, and preserve cells. Much of this knowledge is already in the public domain, although there, indeed, are aspects that cannot be discussed in this thesis because of proprietary obligations for confidentiality and nondisclosure. Nevertheless, the author was able to locate enough information to provide a substantially articulated domain of knowledge about NBIC. This was accomplished in large part because there are considerable resources, discussion, and debate on human enhancement that address areas related to life extension in the sciences, which are transdisciplinary in scope. Likewise, fields of inquiry continue to develop, such as nanomedicine, biogerontology, cryogerontology, computational neuroscience, neuroprosthetics, and neuroeningeering that can be applied to artistic, design-based approaches proposed in this thesis.

Specifically, the interview protocol was organized as follows:

- Ask interviewees five targeted questions reflecting their knowledge area as they relate to the concern of life expansion. Appendix 2 shows the interviewees in the NBIC fields and how the interviews were conducted, based on the symbolic references as delineated in Appendix 2.
- Record each interviewee and transcribe discussions, which were either initially approved by the interviewee or subsequently approved as to content and to ensure no proprietary breaches of confidentiality or nondisclosure occurred.
- Travel to the interviewee's research center or affiliated research center and observe the laboratories, meet with principals, and spend at least two to three

hours at each location. This was considered important to the thesis because the author wanted to obtain and authenticate a first-hand experience of both the experts and their laboratories in determining the depth of research and commitment of the expert.

Because the interview approach was experienced in three approaches (i) formal interviews, (2) informal interviews, and (3) mention of historical one-on-one discussions with experts that link to the thesis, the author was able to identify more effectively which persons to interview so as not to repeat information or to reach beyond the firmly defined aim of the study.

First Approach: Interviews with Experts in NBIC

The interviews were performed through: (i) email, (ii) telephone, (iii) Skype, (iii) Second Life, and (iv) face-to-face (ftf). The qualitative aspect of this process was (i) specific to interviewees and their research as relative to the thesis and their personal goals, and (ii) general in that each set of questions linked to the science and/or technology of human enhancement for prolonging life and that might lead to life expansion. To document the specific method of interviewing used, a symbol chart was constructed (Appendix 2).

This approach also included interviews with artists and designers works that employ one or more of the NBIC+ technologies (i.e., "+" refers to bioart, robotics and cryonics). Section 6.1 includes interviews with bioartists, curators and theorists of bioart as examples of approaches within the domain of biotechnology that do *not* link to biological life extension. Section 6.3 includes an interview of robotics and AI as an approach that *does* link to non-biological life expansion. Chapter 7 includes an artistic approach that engages cryonics.

The rationale for using the qualitative method is to understand and explain why the experts of emerging and speculative technologies within the domain of NBIC are concerned with life extension and, further, how they are going about accomplishing this aim. The research provides information on particular case studies, including more general assertions arrived at through such observations. An ethnographic method is applied in the collection of data in order to learn and understand the culture in which the researchers' works are located, especially in regards to narrative and interpretation (Agar 1996). Notably, the data-based interviews were viable in building an investigatory focus that reconciled issues of the researchers' current work being speculative (experimental in terms of a formative stage) and the viability of the expert's specific range of scholarship and knowledge. Some of the non-observable ambiguities of this method pertain to the fact that some of the researchers' work remains unresolved, as such outcomes may not be known for months or, likely, years. Nevertheless, while the cultural interpretations of the study reflect upon the issues raised in Chapter 5 (Contested Culture), the investigation is more focused on the researchers' specific ideas, what they are studying, and how they see their research as relating to the dissertation's thesis of life expansion. Regarding the notion that human enhancement and the prolongation of life (i.e., life extension) could feasibly lead to life expansion, a first step in this conjectural theory is to address biological aging and ways to slow and reverse it, and/or regenerate cells and their respective cellular systems of the body. Thus, the focus on the NBIC culture, as investigated in this thesis, pertains to the expert researchers' works and ideas, as they are vital parts of the culture, rather than the focus being more generally upon the culture itself.

Second Approach: Field Study of NBIC

The second part of this approach applied an empirical method as a "[p]rocess of developing systematized knowledge gained from observations that are formulated to support insights and generalizations about the phenomena under study" (Lauer & Asher 1988:7). The author traveled to research centers and met with the principals of each center, toured at the laboratories and was briefed about current research projects. After reviewing lab research projects and locations, the author selected the locations of Silicon Valley, California and Scottsdale, Arizona project sites. The California location included Halcyon Molecular, SENS, BioTime, Institute for Molecular Manufacturing (IMM), 24andme genetic testing laboratory, and the Singularity University (although IMM was not visited and 23andme laboratory was closed). In some instances the author had already visited the laboratories at different points in time, and, in others, the interviewee's research was taken to outside locations for a face-to-face meeting.

The rationale for the field study is based on the author's investigation of the expert's specific aims and goals in understanding what drives their work and the efficacy of such work, and is not based on a survey or collection of data for the purpose of scientific scrutiny concerning the work being performed. Thus, the objective is to shed light on the experts' pursuits in attempting to develop a resolve to reaching the biological gains in reversing aging, regenerating cells, and prolonging life and also pursuits to develop alternatives to the biological body as the sole means (or vehicle) for the existence of life (i.e., the state of being). The author's investigation in this chapter's field study is to validate the research style, character and behaviors observed in the laboratories. The investigations confronted have limitations, as the author was not able to participate in the scientific research and one could arrive at a false-positive by hoping for a noticeable observation rather than what the laboratory is actually producing. On this point, the author was careful to distill the scholarship protocol and culture (e.g., environment, attitudes and behaviors) of each laboratory visited, the patents already obtained, patents pending, and other corporate and managerial issues that could influence the viability of the choice of laboratory.

In this chapter, empirical data are mainly arrived at through observation. However, in the following Chapter 7 (an autopoietic approach), the empirical data are arrived at through experimentation. The observation is developed through distinct methodological traditional interviews, including field study, as an inquiry that explores specific relationships between the biological body and its intervention to prolong life and health (well-being). The author builds a holistic narrative that includes vital aspects of each interview. The interviews were conducted in a natural setting in person (face to face), or through Skype, email, Second Life, and/or telephone. By these methods, the author was able to study the phenomenon of language (terms and rhetoric) as a distinct opportunity or restriction between the interviewees and the author.

The method of field study investigation is qualitative in scope, including mild or semi-ethnography. Mild or semi-ethnography is mentioned because although the domain of NBIC experts is somewhat foreign to the author's academic and general background, the author is experienced and knowledgeable about the domain and its technologies so there was virtually no risk in lack of effective communication, either verbally or intellectually. The empirical aspect of the qualitative method pertains to the author's theory regarding life expansion and investigating whether or not the experts of NBIC in this Chapter do, in fact, support or discourage the notion of life expansion. One might conclude either possibility to be correct. However, an expert in stem cell cloning may not be agreeable to or supportive of artificial general intelligence (AGI) as an appendage to the human brain. Likewise, an expert in nanomedicine might not place value in regenerative medicine. To test the author's hypothesis that NBIC and NBIC+ could correlate ESM (emerging and speculative media) for artistic, design-based approaches, learning whether or not the experts interviewed were encouraging, discouraging, supportive or unhelpful was important because it is their level of expertise and knowledge that is essential in pursuing such an approach. In this regard, observing the behavior, attitudes, and levels of sincerity of the researchers and their respective laboratories that provided deeper insights into the specific work being done and the entire domain in which the thesis is immersed.

Third Approach: Autopoietic Work

This third approach is an intervention of the biological body and is influenced by the ways in which science and medical doctors use knowledge and skill to attempt to resolve disease and injury. However, is the artistic, design-based approach of the author's work that forms the scope of the investigation. The author selects methods for biological intervention that are most appropriate for each work and seeks an autopoietic process to ascertain the scope of identifiable problems of the skeletal system, muscular system, integumentary (skin) system, and vision system. This intervention forms what can be seen as an autopoietic process of participant-observer[181] and the biological body's network of systems. Through this process, the research forms an intersection of art, design, science and technology. As with the first and second approaches, this third approach responds to the thesis question concerning the required conditions for artistic, design-based approaches to life expansion.

In summary, the scope of the research method's investigation forms an integrative view of the human enhancement technology for prolonging life and leading ultimately to life expansion, which in this thesis is an articulated research of NBIC that which aims to (i) regenerate cells of the body and neurological functions, (ii) preserve the body and cognition, and (iii) transfer or copy the fabric of the brain's neurological functions (e.g., personal identity and memory) onto nonbiological platforms.

The outcome of the thesis study is a framework for further research of NBIC+ and the emerging and speculative media (ESM) for artistic, design-based approaches to life expansion, which are delineated as the tools of regenerative media, nanorobots, and artificial general intelligence (RNA).

[181] Note: The thesis refers to Part I of this dissertation and the supposition that life expansion is an outgrowth of the domain of cybernetics and includes the scope of second order cybernetics (i.e., n-order cybernetics).

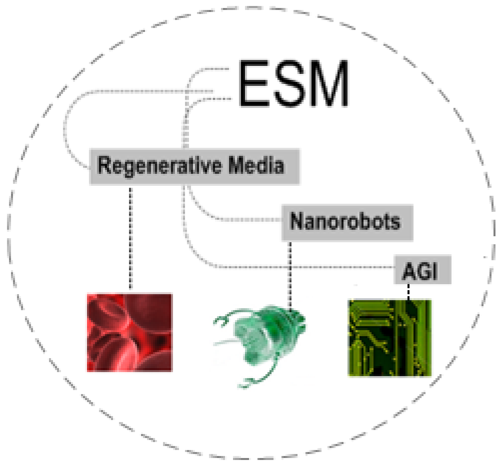

Figure 5: "ESM" 2011 © Natasha Vita-More.

6.1 Decomposition & Regeneration: Investigatory Study of Biotechnology for Life Extension

"Chaos (χάος) from Greek root cha (χά) has a twofold meaning of holding and releasing; hence chaos is both the holder and releaser of all that comes into being" (Landau 1967:31).

Figure 6: "Blast, 1" (Credit: Adolph Gottlieb, 1957).

A painting, like a single cell, according to abstract expressionist Adolph Gottlieb (1903-1974), should contain as much information as possible[182] and its symbolic structure should be a process for regenerating ideas. Gottlieb saw the circular form as a type of cellular

[182] See http://www.theartstory.org/artist-gottlieb-adolph.htm Downloaded January 14, 2012.

object that, for him, painting has a "regeneration, of perpetual decent and return"[183] in all its abstractions, of life and death, until the idea is in the end exhausted:

> *Blast 1*[184] is primal, an image felt not so much consciously as viscerally and intuitively. Its meaning and power emerge through the simplicity of its abstraction as an image devoid of historical and cultural content. It is at once existential and archetypal—an innate of primordial conflict, of heroic struggle and conquest, and of the ultimate victory of the night to which all life returns, only to renew itself again in conflict at each dawn (Eversole 2009:181-182).

From a distance, the abstractions of expressions of life might seem confusing, even chaotic. On closer observation, the complexity of information becomes evident, perhaps subjectively but, nonetheless, emerges in distinguishable functions of intent. The beauty of abstract expressionism is perceived by the viewer with visceral emotions and feelings that might even border on confusion and dislike. To experience a Robert Motherwell (1915-1991) painting[185] with its bold black brushstrokes generated through a process of automatism[186] and against a seemingly unfinished canvas, at least for the author, is to experience a sensation akin to the classic precepts of Zen. One might ask: What is it? But for others, it is all about how it makes them *feel*.

[183] Finley Eversole. "The Regenerative Art of Adolph Gottlieb". See http://theologytoday.ptsem.edu/jul1968/v25-2-article7.htm Downloaded January 14, 2012.
[184] "Blast 1" painting by Adolph Gottlieb (1957) (MoMA, NYC).
[185] For example, "Elegy to the Spanish Republic No. 110" (Motherwell 1971).
[186] Automatism is an approach where the painter (or writer) empties the mind and allows the unconscious to direct the work.

Figure 7: "Biotechnology Interviews"

> . . . I could exceedingly plainly perceive it to be all perforated and porous, much like a Honey-comb, but that the pores of it were not regular. . . . these pores, or cells, . . . were indeed the first microscopical pores I ever saw, and perhaps, that were ever seen, for I had not met with any Writer or Person, that had made any mention of them before this. . .[187] (Robert Hooke, 1635-1703).

The human cell[188] is the essential building block of life and each life form has different kinds of cells. The human form comprises approximately 100 trillion cells, all performing their varied expressions. The ancient prokaryotic cells (e.g., bacteria, for example) may be 3.5 billion years old, and possibly the first life forms on Earth. Masses of prokaryotic cells evolved into the more complex eukaryotic cells through symbiosis. Simply put, the cells worked together to form a more complex cell that contains a nucleus and mitochondria[189]. It is supposed that the mitochondrion is the descendent, the "great-great-great-great-great-great-great-great-great granddaughter of a free-living [prokaryotic-celled] bacterium that

[187] See http://www.ucmp.berkeley.edu/history/hooke.html Downloaded January 14, 2012.
[188] The word "cell" was coined by biologist Dr. Robert Hook as he was look at a small piece of cork under a microscope. See http://www.ucmp.berkeley.edu/history/hooke.html Downloaded January 14, 2012.
[189] Mitochondria are organelles that generate power to drive biochemical reactions and cellular processes. For example, when eat, the food's energy-rich molecules are burned up in the mitochondria and this process creates the power to drive other biochemical reactions and cellular processes in the body (i.e. energy release of respiration). See http://genome.wellcome.ac.uk/doc_WTD020740.html Downloaded January 13, 2012.

was engulfed by another cell."[190]

According to Aubrey de Grey, Chief Science Officer of Strategies for Engineered Negligible Senescence Foundation (SENS), it is the future of mitochondria that is important:

> We can easily identify the damage to cells associated with the disease of aging. If the damage is fixed, the cell is rejuvenated. Rejuvenation biotechnologies specifically target and directly repair the damage within the cell. This damage falls into a number of categories that include amyloid plaques, intracellular junk (lipofuscin), and death-resistant cells, including others. However, for rejuvenative medicine, we do not need to understand how cells are damaged we just need to know how to undo the damage (de Grey: 2011).

De Grey and his team at SENS have seven areas of focus, what de Grey calls "7 deadly things"[191] that we should be alert to for their role in cell aging. According to de Grey, aging is cellular abnormality such as DNA mutations, mitochondrial mutations, junk proteins within cells, junk proteins outside cells, cell senescence (an inability of a cell to divide or mitosis), and extracellular crosslinks or excessive cross-links between cells. Thus, according to de Grey, it is the integrity of the cell and its functions that are most relevant to degeneration. However, he also states that the aim is not to eliminate aging:

> The strategy is to periodically intervene with the damage caused by aging and having the accumulated damage repaired. You would not be viewed as having a biological age related to aging, but have a body that is rejuvenated that reflects your health. How often you go in for repair is based on how conscientious you are about rejuvenation (de Grey: See Appendix 2).

A different approach to regenerating human genomics is proposed by Gregory Stock, founder of The University of California-Los Angeles Program on Medicine, Technology and Society (1997) and author of *Redesigning Humans: Our Inevitable Genetic Future* (2002). Stock's research interests have concerned somatic gene therapies that introduce healthy genes into targeted adult cells in the body, but his particular focus also

[190] See http://evolution.berkeley.edu/evolibrary/article/_0/endosymbiosis_03 Downloaded January 14, 2012.
[191] De Grey is referring to SENS Foundation's research themes and their research conclusion that there are seven classes of cellular damage, usually on the molecular scale, that cause aging (also known as "Seven Deadly SENS"). See http://sens.org/sens-research/research-themes Downloaded January 5, 2012.

considers that “germline engineering is at the heart—the basis—of what it means to be human because it forces us to look at how our genetic makeup shapes us” (Stock: 2011). He explains:

> Somatic gene therapies have existed for a while now for fighting disease and treating illnesses. But whether or not biotechnology’s [germline] genetic engineering can actually redesign the human is basing the human on biology and this may not be the ultimate question (Stock: See Appendix 2).

According to Stock, the ultimate concern is not whether these technologies may or could alter genetics to eradicate disease, but acknowledging the effort to extend life is historical:

> It is an ancient dream and a plausible reality. Compare our ancestor’s way of life to our current way of life. There is no resemblance of our technologically enhanced world to our primitive beginnings. Human innovation doesn’t stop because one person has a problem with another person’s desire. Is changing the face of mortality too much to hope for? Not if we slow the process of aging and dramatically extending life is the result of this process. Some of the work done at Signum focuses on Alzheimer’s, and other diseases of aging. The anti-aging debate is full of ethical issues. It takes the emphasis from the political issue of mortality to one of a more humane interest in being healthy for a longer period of time (Stock: See Appendix 2).

One extraordinarily prominent ethical debate has centered on cloning cells. Undoubtedly, this is a chaotic and complex discussion on an international level and outside the scope of this thesis. However, what can be gleaned from the ethics, policies and laws enacted is that scientists are considering the ways to work with the problems and navigate around the issues in finding new ways to generate cells:

> One of the arguments against enhancement, especially germline enhancement, is a moral assertion that is wrong or too dangerous, will be misused and abused, and result in ways that affect human spirituality or the environment. Of course these are concerns. But they cannot stand in the way of advances especially in reproductive technology and its future. …Whether or not societies accept humanity’s transformation into something that lies beyond human may bring about the adventurous activists and the restrained conservatives who want to battle it out. I continue to argue that human transformation is an inevitability. The key question is whether or not biology is consequential to life. Here genomics, computer technology, and ethics will collide (Stock: See Appendix 2).

Sonia Arrison, Senior Fellow at California-based Pacific Research Institute for

Public Policy (PRI) suggests practical steps for engaging life extension:

> Let's start with near term evidentiary projects. Replacing body parts, from hearts to lungs, and also to grow new organs, is being done today. Evidence that we have seen successes with organ transplants and implants has been a first step. Using organs as scaffolds is a next step, as well as growing our own organs. In 2008, CNN covered the work of Dr. Doris Taylor at the University of Minnesota's Center for Cardiovascular disease. Her laboratory is creating replacement hearts. Taylor's research evidences that taking the livers and hearts of different species (certainly after the species has died, not from the experiments, but by natural causes) and removing the cellular components of the tissues and then using them to scaffold human tissues (Arrison: 2011).

Replacing organs is not new, yet it is a start in considering what this thesis refers to as whole body prosthetics, such as the author's work "Primo Posthuman" (1997, 2011). This work is based on conjecture about what *might* or *could* occur and more currently what is being developed in laboratories. Arrison's perspective is more pragmatic, based on policy-making. Yet, Arrison reaffirms the issues of replacing organs as necessary for life extension by processes, such as regrafting stem cells onto existing organs and or reseeding the scaffolds with human stem cells.[192] Arrison's research evaluates projects such as Taylor's as addressing health expectancy issues and proposes that the "aim is to protect ourselves, to last as long as possible with good health and to replace organs that are diseased with new organs" (Arrison: See Appendix 2).

> In the long term view, gene therapy and rewriting code. Here is an issue though: it is expensive and a few rich people are about to do it. Dan Stoicescu paid $350,000 to have his full genetic code sequenced. But the price will eventually come down. In fact, decode launched a web site for personal genomics service at a cost under $1,000.00. I cannot report how successful this is. A company that is well known is 23andMe and at their website you can order the DNA kit for $99.00, with certain limitations of course. But the point is that it this type of availability of learning about your own genes is becoming more and more available and lower costs (Arrison: See Appendix 2).

The author asked Arrison:

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[192] Dr. Taylor's research is explained cogently in an article in *Mail Online.* See http://www.dailymail.co.uk/health/article-1372938/Live-human-heart-grown-lab-using-stem-cells-potential-transplant-breakthrough.html Downloaded March 17, 2012.

The digital revolution proposed to change human life for the better, which it has to some degree. Yet, it has also made life more difficult, caused new political agendas, policy making, fraud, and privacy more rampant. In this life extension revolution, what might be the downsides that, in your opinion, ought to be addressed sooner rather than later?

The digital divide is actually about the divide of life extension and any technological advances that affect anyone using any form of digitality. We are in a world of digitality and so I see it as the divide of the available technology. Look at life expectancy throughout the world. In Monaco the life expectancy is about 90 years but in Angola it is about 38 years. This is enormous divide. The obvious assertion would be that it is the wealthy that have the medicine and technology and this is true to an extent; but we also have to admit that it is in large part because of politics, war and greed. The biggest problem in the divide is the cost of life extension, but the rich will also be the canaries in the mine and maybe being the first is not so good – perhaps it is better to wait and see the results. Nevertheless, when one is ill and aging that is not so important and we have to make things available to everyone. This reflects the "lag" in technology and society – or society's lag in catching up with technology. Historically this is due to economics and costs coming down. Let's hope that costs will come down and that governmental regulations do not interfere with people's hope of improving their well-being. We witnessed this in the United States under President Bush's administration and the halt of stem cell research. Fortunately that that been mediated[193] (Arrison: See Appendix 2).

6.1.1 Field Study: SENS

The SENS Mountain View, California laboratory is home to the MitoSENS project, headed by Dr. Matthew O'Connor. This is one SENS project, among many, that is specifically targeted on replacing the mitochondrial genome (its DNA). To briefly explain, the MitoSENS project is an intervention of the human mitochondrial genome to improve its functioning. When the functioning of mitochondrial genome is poor the result is evidenced by mitochondrial mutations, which result in diseases such as cancer. Specifically, the aim of O'Connor and his team is to prevent damage to the human mitochondrial DNA and to improve the environment in which the cells of the mitochondria function.

In the laboratory, O'Connor is trying to replace the mitochondrial genome and

[193] It is also discovered that stem cells are located in fat cells and the issue of embryos being used to propagate stem cells is no longer a major issues. See http://news.nationalgeographic.com/news/2009/09/090908-liposuction-leftovers-fat-stem-cells.html Downloaded March 17, 2012.

manipulate the proteins that are *supposed* to be made by the mitochondria to instead be made by the nuclear genome, which has a better environment that would prevent the typical mitochondrial mutations. In short, the mitochondrial genome and nuclear genome are different. Thus, replacing mitochondrial DNA with nuclear DNA that has been modified to "imitate" the mitochondrial DNA constitutes the research objective of the MitoSENS project. In sum, the mitochondrial DNA is fragile and accumulates mutations with age, largely because of free radicals produced by mitochondrial energy production (O'Connor: 2011). The engineered mitochondrial genome is healthier and less prone to mutation.

6.1.2 Field Study: BioTime

In the realm of biology, the BioTime laboratory is focused on core technologies that use what they refer to as novel stem cell, cells capable of becoming all types of cell types of the human body. These novel stem cells are used for the purpose of regenerative medicine. Chief Executive Officer and leading stem cell scientists, Dr. Michael West, lead research at Geron (1995-1998), the company which pioneered the field of embryonic stem cell research, which was dropped in November of 2011[194] largely because of social and political issues concerning the use of embryo for stem cells. Nevertheless, as the technology has advanced over the last year, scientists have discovered alternative ways to locate and isolate and even build stem cells apart from embryonic use. Currently West and his scientific team at BioTime are exploring induced pluripotent stem cells (iPS).

The author's field study at BioTime was to investigate what has been occurring within its laboratory and how this information could shine light on possible futures of regenerative medicine. In conversation with Dr. Hal Sternberg, Vice President of BioTime, and scientific researcher of Alzheimer's Disease, it became apparent that BioTime's central

[194] See NPR interview http://www.npr.org/2011/11/18/142512098/geron-to-end-embryonic-stem-cell-research Downloaded September 5, 2011.

objective is the potential use of embryonic stem cell (or induced pluripotent stem cell (iPS)) to generate clonal progenitor lines with potential to repair age-related damage of cells, tissue, and organs of the human body.

Sternberg notes that the advantage of iPS cells (i.e., reprogrammed from the patient's own cells such as dermal fibroblasts) is that they are immunocompatible and behave similar to embryonic stem cells with regard to their capacity to potentially be induced to become any cell type in the body (Sternberg: 2011).

IPS cells are *useful* in their character due to their capacity to form any cell type. It is hopeful that methodologies can be developed to repair age-related damage (such as cell and tissue loss) using clonal progenitor cell lines derived from embryonic stem cells or iPSC, which are driven to become the desired cell type needed. Once generated, these desired cell types may also be used as a component in the design of tissue constructs to replace tissues that are lost during aging (Sternberg: See Appendix 2).

The field study at BioTime informed the author's research on how stem cells could be used for disease. During the visit to BioTime the author observed scientists working on cancer related research (oncology) and, specifically, "homing" (Sternberg: See Appendix 2) endothelial cells (cells that line blood vessels and tumor blood vessels) to navigate and target the tumor's vascular cells to destroy the tumor formation. The homing process means that the endothelial cells (or ESC derived endothelial-like cells) are injected into the subject to take up residence within the tumor vasculature to specifically target the tumor by releasing cytoxins to kill the tumor (Sternberg: See Appendix 2).

6.1.3 Field Study: Halcyon Molecular

The aim of Halcyon Molecular is to extend human life and to create a world free from aging. Halcyon has been focused on sequencing DNA through its electronic microscopes. The larger aim of Halcyon is to transform biology into information technology. The atmosphere at Halcyon is different from other laboratories: basketball ring, game room, buffet lunches, and a keenly casually yet sophisticated environment. Regardless of the atmosphere of a scholarly, yet relaxed, university campus, Halcyon's many laboratories are actively pursuing the creation of synthetic DNA.

Michael Andregg, its co-founder, provided a tour of the large facility in greater detail than this study is informed enough to adequately report on. One observable incident occurred when discussing the graphic designs through its executive offices; it is evident that this lab wants to work with a transdisciplinary approach that could engage the artistic, design-based approaches to life expansion. Another fact is the location. Halcyon, like SENS, is located directly in Silicon Valley, an area known for ingenuity and breaking through institutionalized notions of borders between fields with a wide-eyed acceptance of nascent technologies.

Randal Koene was available for a face-to-face discussion. Regarding life expansion, Koene said, "[l]ife expansion is an interesting term" (2011) and a short discussion took place among Koene, Andregg and the author in Halcyon's conference room:

> I suppose you mean extending life but not in a linear way – in different ways?" Yes, good. It takes the singular idea of life extension beyond the biological imperative and it works nicely with the idea of whole brain emulation. Okay. This needs to be discussed further. Here at Halcyon we have frequent brain storming sessions. That sort of productive communication is a start. Artists can do modeling and build installations, environments through which to experience the brain, and so forth (See Appendix 2).

6.1.4 ESM: Regenerative Media

The emerging and speculative media (ESM) this thesis proposes for artistic, design-based approaches to life expansion begin with addressing the issue of extending biological life beyond the current limited lifespan of 122-123 years. The biotechnological scientific approaches include regenerative medicine that aims to defeat aging:

> This process is counter to the usual procedure contemplated by scientists in the field of aging or science for that matter because most scientists are interested in knowledge for its own sake but I am in this project of defeating death as a means to an end – to obtain enough knowledge that can be acted upon in reversing the aspects of aging (de Grey: See Appendix 2).

Stock claims, that "whether biotechnologies are possible to enhance the human mind and body, the larger issue has become an issue of being beyond our species—beyond *Homo sapiens*. Having mechanical organs takes us outside biology, although administering the organs is still biotechnology. Until then the choices we make today in redesigning our contour—prosthetics, aesthetic surgeries and the varied electronic extensions that we are dependent on in redesigning ourselves, it is still within the realm of biology" (Stock: See Appendix 2).

This thesis proposes the idea of regenerative media as a possible approach that would challenge the trends within the arts, such as bioart, and offer a new way of using biotechnology for engaging the idea of life extension.

6.1.4.1 Bioart Approach

This subsection includes the author's investigation of artistic, design-based approaches within the domain of biotechnology. In this vein, the obvious link is to bioart. The investigation was performed during the timeframe of the dissertation's preliminary research and contains interviews with bioartists, curators and theorists.

Bioart—like regenerative media of ESM—coincides with the current biotech era where genomics is a central focus and where bioart and its practitioners are experimenting with genetic engineering, transgenesis, cloning and hybridization. In lieu of a slippery slope in which artists and designers rely on total freedom of expression in substantiating works of art with tools of biotechnology that have possible unknown outcomes, one might ask if artistic practices can infuse visionary yet objective understandings that offer deeper insights about experimenting with new potentially dangerous media. In other words, are artists more concerned with novelty in biotechnological creations or is there a level of caution about species' dignity? For example, while an organism such as a C. elegans or an insect such as a butterfly may not be considered a higher-life form, the desire to manipulate its biology does cross a certain line making the artist effectively the creator-manipulator without the consent of the organism or insect. The "GFP Bunny"[195] named Alba, a collaboration between bioartist Eduardo Kac and geneticist Louis-Marie Houdebine (2000) is an example of a debate over genetically engineered creations. Alba was modified with the GFP gene, a green fluorescent protein that exhibits a bright green fluorescence when exposed to ultraviolet light blue light (Houdebine 2003). Described in detail:

> In his most recent piece, Kac has collaborated with geneticist Louis-Marie Houdebine to create a 'GFP rabbit'-- a transgenic albino bunny whose genetic makeup is altered with a gene obtained from a Pacific Northwest jellyfish that contains GFP, green fluorescent protein. Scientists have previously used this substance to track genetic changes in frogs and mice. Kac had originally wanted to create a GFP K-9' -- a dog that would turn fluorescent under a blue light or glow green in the dark, like the rabbit. But the technology was not yet advanced enough to permit bringing the fluorescence into the coat of a dog. Hence Alba, the albino bunny. But Kac insists that Alba alone is not the art project. Rather, according to Kac, 'It is one gesture--the creation, social integration, and response' that comprises the actual piece (Becker 2000:46).

An issue arose which caused consternation between advocates of the bioart practice of transgenesis when it was reported that Alba had died:

> Houdebine refrained from releasing Alba from the laboratory, fearing incitement of further protests among several reasons. Up until her inexplicable, nebulous death in 2002, Alba remained inside the laboratory [3]. Houdebine issued a statement claiming she died "without any reason" and then reassured the public that her death was commonplace by mentioning the fact that 'rabbits die often' and she was 'about four years old, which is a normal lifespan in [his] facilities' [4]. He denied any connection between the GFP gene and her death. However, Kac believed her death to be a hoax Houdebine used to reduce public attention and to avoid having Kac bring Alba home [4]. Kac also pointed out that Alba was two-and-a-half, not four, at the time of her supposed death, which would counter Houdebine's assertion that she had a 'normal lifespan,' raising questions about the details of the disappearance of this glowing rabbit [4] (Chu n.d.).

In 2003, Houdebine authored *Animal Transgenesis and Cloning* with no mention of Alba or Kac. At 2007, the European Molecular Biology Organization in Barcelona, Houdebine "presented in detail his version of the reality of 'The GFP rabbit story', placing

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[195] Alba was created at the laboratory of Louis-Marie Houdebine.

emphasis on sensationalism by journalists and the TV media."[196]

Notably, with bioart practitioners and practices developing at an ever-accelerating pace, there is potential that the issue of ethics could limit or restrict these artistic practices. Further, if a trend is toward artists working in laboratories, this thesis suggests that there may be a need for pedagogy that focuses on challenges of exploring new types of media, such as regenerative media. Thus, this section's brief investigation into bioart is important because, while the definition of bioart is not concretized and the formative medium is evolving in method, media and direction, it gives worthwhile insight into the uses of biotechnology as a tool (medium) for artistic approaches. In short, the inquiry into the currents of bioart as a fecund medium for spawning artistic practices offers potential for new understanding by unraveling some of the current protocol, issues, and concerns that bioartists face. By this, the author is referring to regenerative media as an approach that engages life expansion, as defined in this thesis, and the media proposed in this thesis referred to as ESM—emerging and speculative media of regenerative media, nanorobots and artificial general intelligence and related technologies of NBIC+.

This section is a brief investigation of the motivations of bioartists to determine if there is a link between bioart approaches and regenerative media of biological life extension, and to further inquire into any observable receptiveness or resistance to the concept of increasing the life span of organisms. Because life extension relates to biology and life expansion pertains to the posthuman concept of life beyond biology, the central focus here—in relation to bioart—is on life extension.

The strategy was to determine cohesiveness ideas concerning bioart and the motivations and practices of bioartists. The author interviewed fourteen artists, curators, and theorists of bioart in order to locate and identify any possible bias, which is essential in

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[196] See http://en.wikipedia.org/wiki/Alba_(rabbit) Downloaded April 8, 2012.

operationalizing the complexity of this medium/field (Multiple Interviews: Appendix 2). There were an observable wide range of incentives, a broad scope of influencers, and a strong reaction to what is often referred to as ideological conflicts of an assumed human-centric approach, often associated with the domain of human enhancement. Nonetheless, the strategy was not to stop at any one juncture, but to make a fluid exploration into bioart and to record as much information as possible in resolving some initial reason for this research project.

Bioart is relatively new nomenclature without a generally accepted operationalized definition and with vigorously contested meaning. While there is no concretized definition of bioart, its practitioners have varied views on the explorable parameters of this medium. 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: 2007). 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 "[b]ioart 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: See Appendix 2).

It is true that manipulating mechanisms of life involves a large assortment of tools and methods, and especially terminology in discourse of bioart. Because it is "constantly evolving" (Hauser: See Appendix 2), 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.

We might ask what makes biotechnology such an apt medium for expressing art and how biotechnology offers new trajectories for artists whose level of knowledge and experience with technology has outgrown many of their traditional practices.

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” (Stelarc: 2007).

According to Marta de Menezes, “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” (de Menezes: 2006). Why are future studies important to artists? “More often than not we make the judgments without full knowledge of the issues, technologies and research involved” (de Menezes: See Appendix 2).

Melentie Padilovski claims that “bioart cannot be image-based, text-based, dead biomaterial, or solely software actions” (Padilovski: 2006). It seems that bioart already has its purists. This may help to define the medium but if bioart is an umbrella term, it may need malleable and hydrated boarders rather than impermeable walls. What might be beyond the realms of bioart—one that seeks originality in approaching biotechnology from a different perspective? If an artistic, design-based approach offers a scholarship practice and theory, challenging Padilovski’s claim, a necessary transdisciplinarity and hybridity would offer a more timely engagement with NBIC, rather than being relegated merely to biotechnology.

According to Eduardo 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” (Kac: 2007). To wit: enter the genome and new opportunities in the bioworld. One important question to ask then is, “What is it that [bioart] brings that we did not have before?” (Kac:

See Appendix 2).

Many artists, including the author, have experimented with blood and other bodily substances in our works. But using biological elements does not necessary constitute bioart. According to a consensus of bioartists, it has to be a living medium wherein the art is produced, and not bodily substances such as blood that has expired. In contrast, the *living* blood used in Eduardo Kac's "A Positive," was funneled into a robot which then used the blood's oxygen to create a spark and ignite a flame. If living organisms must be used in bioart, then wouldn't our being alive right now and monitoring our bodily functions be bioart?

Anna Munster asks how artists engaged in bioart practices co-determine aesthetic and ethical value in their work. She suggests that such works "implicitly adopt the consequentialist ethics espoused by ecological and animal liberationist concerns."[197] Munster looks at the strategies for artists for preserving, domesticating and executing, or killing off their living works of art:

> 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 2008:18).

When a bioartist takes a life form and manipulates it, the nature of the organism and its cells are transformed. David Kremers asks if it is ethical "to take any living form and 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

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[197] See http://www.eaf.asn.au/biotech/symposium.html Downloaded March 20, 2012.

relationship between the artist and the practice? Must we ask, what does this artifact want? Where does it want to live?" (Kremers: 2007). Kremers' questions reflect on one issue that is problematic in bioart and which identifies a contradiction: that bioart places value on the nonhuman organism and its composite cells yet, at the same time, can be seen to devalue its life. Equally questionable is whether or not the bioartist has the right to determine what is best for a molecule, a cell, and an organism.

Bioartists Oron Catts and Ionat Zurr address what they refer to as an extended body as a new class of being. According to Catts and Zurr, this project, developed by Tissue Culture & Art (TC&A), defines a new category of life as a "unified body for disembodied living fragments" (Catts & Zurr 2006).[198] This project links to an earlier study by Catts and Zurr concerning semi-living concepts, whereby the cells are identified as having been parts of a larger system—an organism, for example—with a conventional biological taxonomy but also can exist outside this biological formation. One might interpret this understanding as seeking to identify cells as autonomous rather than as corporeally bound aspects of a larger whole.

The concept of "semi-living" and "partial lives"[199] (Catts & Zurr) concern tissue cells that exist without a specific biological body. These tissue cells, according to Catts and Zurr, are lab-grown life and morphed (i.e., reconfigured mixes and remixed) into various artistic forms. While Catts and Zurr refer to these disembodied cells as entities, they refer to individual cells kept alive in certain artistic formations as structures.

One could question this classification, given the tissue cells' stated lack of a body. At once, they are said to be without a body but they are, in fact, sculpted in a familiarly traditional sense (i.e., artistic manner) to represent an anthropomorphic image and form—

[198] See http://www.uoc.edu/artnodes/6/dt/eng/catts_zurr.pdf Downloaded March 18, 2012.
[199] See http://www.livingbooksaboutlife.org/books/Partial_Life Downloaded March 18, 2012.

an image and form keenly understood in the psyche of the human mind as a symbolic association with human-centered objects, unbeknownst to the life of the cell. Regardless, the work of Oran and Zurr in this regard focuses on manipulation of living matter (cells), which is approached differently than the manipulation of cells in science, which is to form a specific function within the body and not for its own sake, nor the sake of the scientist's research or artist's practice.

6.1.4.2 Regenerative Media or Bioart

Bioart is so timely because it unleashes the endeavor of exploration into a field which had been sequestered by scientists, generally untraveled by artists, and thereby uncluttered for intuitive exploration. Bioart helps the public to approach a bit more the exotic and abstract elements of biotechnology and it provides a means by which artists can reflect upon the viewing publics' biases, as well as their own. Here we can return to the issue of Alba the fluorescent bunny and its well-being, or the questions arrived at by Kremers concerning the very life of the organisms which bioartists manipulate, for better or for worse. Further, if the thesis' proposed artistic, design-based approach to life expansion subsumes aspects of bioart in manipulating the human body through biotechnology, for example, a deeper reflection upon the viewing publics' current biases might offer ways to discern what problems could arise through the use of NBIC to manipulate human life and its ultimate acceptance in the public eye.

In summary, the study's principal observation is that there are currently no known bioart practices focused on revivification or regenerating cells, organisms or animals for the express aim of life extension, or known artists who are working in the specific area of extending the life span of cells, organisms, or animals. The resistance of bioart to engage transhuman / posthuman is evident. It is also evident that bioartists are highly skilled, committed to their research and they engage science and art in a meticulous, conscientious balance, as noted in the various works by the bioartists who were interviewed in this study. Many of the works are highly consequential not only to the field of bioart, but also the general understanding and information of the practice, as presented in exhibitions by bioartists. Further, bioart has developed outside the realm of what Hauser and Padilovski proposed, and it has developed an association with plants and ecology, as well as DIYbio.

The observation that bioart is not currently involved in life extension—outside manipulating cells that are not affiliated with agency, sentience, or personal identity—and the lack of works in the domain of a prolonged life as it follows the concepts of transhuman and posthuman may be simply an alert—a red flag. There is both a gap and an opening for an unprecedented artistic, design-based approach in applying the technologies available in the biotech era and the further use of ESM, its regenerative media, nanorobotics and AGI (RNA), and other interpretations of NBIC+ for artistic expression.

One can compare the idea of regenerative media to the scholarship of bioart[200] in its use of biotechnology for engineering tissue culture and cell cloning, which signals the potential for regenerative media with artistic and design-based projects. However, because bioart is not currently involved in the area of human enhancement or its biological proposition of life extension, a new approach of regenerative media would fill this void. While regenerative media is similar to bioart's biotechnological media, including genetic engineering and stem cell cloning, for example, the artistic motivation and pursuit are clearly distinguishable. For example, regenerative media can, in some instances, run parallel to bioart, but it is not bioart because regenerative media is used for human enhancement, explicitly for approaches that pursue rejuvenation of cells and the slowing

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[200] "The phrase 'BioArt' was coined by Eduardo Kac in 1997 in relation to his artwork "Time Capsule". Although it originated at the end of the 20th century through the works of pioneers like Joe Davis and artists at SymbioticA, BioArt started to be more widely practiced in the beginning of the 21st century." Wikipedia. See http://en.wikipedia.org/wiki/BioArt Downloaded November 13, 2011.

and retarding of the effects of aging. Further, while bioart disavows artistic approaches that are not descriptively bioart but instead works with biology from a theoretical perspective, regenerative media would welcome theoretical and speculative research with insights that might be beneficial to its development and appeal. For example, performance artist Ciara Murphy's theoretical inquiry into the HeLa cell line (the immortal human cell line of Henrietta Lacks)[201] resulted in the performance "The Lives of Helen L":

> In a touching illustration of the contrast between mortality and immortality, on the very day the Henrietta died, while her body lay in the morgue and the pathologist inspected the host of solid tumors like glistening pearls attached to the organs of her abdomen, George Gey appeared on national television with a vial of Henrietta's cells, which he called HeLa cells to hide their true origin. He held them up to the camera, saying, 'It is possible that, from fundamental studies such as these, we will be able to learn a way by which cancer can be completely wised out' (West 2003:48).

[201] Henrietta Lacks' cells were taken without her knowledge, were bought and sold, and became a crucial medical tool in developing the polio vaccine and gene mapping. See http://oneread.dbrl.org/2011/06/16/the-immortal-life-of-henrietta-lacks-2/ Downloaded January 11, 2012.

6.2 Desirability & Feasibility: Investigatory Study of Nanotechnology for Life Extension / Expansion

> "… it is virtually impossible to predict in detail which alternatives will become technically feasible over any longer interval of time [than half a century]" (Drexler 1987:v).

> "Without accurate facts, we won't get the results we seek, but without values—without desires and preferences—we wouldn't seek anything in the first place" (213).

Figure 8: "The opening page of Dickens' *A Tale of Two Cities* written within a 6 mm square at 25nm line width using electron beam lithography *circa* 1985" (Credit: Courtesy of R. Fabian W. Pease, Stanford University).[202]

Writing the entire *Encyclopaedia Britannica* on the head of a pin might seem an absurd proposition: after all, how could one practically read it? Yet, what might be presumed absurd can be turned into a logical premise. Richard Feynman (1918-1988), physicist and Nobel Prize laureate thought so and offered a $1,000 prize for achieving such a task. In his talk "There's plenty of Room at the Bottom" (1959), Feynman wanted to move things on a scale of atom by atom: "… we can arrange the atoms the way we want; the very atoms, all the way down! What would happen if we could arrange the atoms one by one the way we want them (within reason, of course; …" (1959).

It would be another quarter of a century before an individual successfully completed the objective. In 1985, a graduate student at Stanford University named Thomas Newman

[202] See http://www1.union.edu/marrj/colloquium_Winter2011.html Downloaded March 6, 2012.

won the Feynman challenge and, while he did not inscribe the entire *Encyclopaedia Britannica* content, he “reproduced the first page of Charles Dickens’ novel, *A Tale of Two* Cities (1859), on a page measuring only 1/160 millimeter on a side” on what could be the head of a pin.[203]

Figure 9: “Nanocells”. © Freitas, E-spaces (n.d.);
“Pentacene of 5 carbon rings (atoms)” (Credit: Science/AAS).

> The comprehensive knowledge of human molecular structure so painstakingly acquired during the previous century will be extended and employed in this century to design medically-active microscopic machines. These machines, rather than being tasked primarily with voyages of pure discovery, will instead most often be sent on missions of cellular inspection, repair and reconstruction. The principal focus will shift from medical science to medical engineering (Freitas 2010: 686).

How might medical engineering, such as nanomedicine, be most aptly suited to the concept of extending biological life and potentially expanding persons onto nonbiological platforms? Recently, the prospects have been elucidated:

> Molecular nanotechnology will eventually enable us to selectively examine and repair cells, which will lead to considerable life extension. We will have the blueprint for cells, and we will be able to bring them back to a fully functioning youthful profile. In addition, we will be able to modify the original blueprint, substituting carbon fibers that are harder than bone, or respirocytes that are upgrades to red blood cells for carrying oxygen. Nanotechnology will eventually reduce the cost and increase the resolution of brain scanning devices. We will be able to back up and reproduce our biological memories on orders of magnitude faster and more robust hardware platforms (Jacobstein: 2012).

[203] See http://www.foresight.org/GrandPrize.1.html Downloaded March 3, 2012.

How might we go about assessing the possibilities of molecular nanotechnology as a regenerative process as well as one which builds cells anew or contrives whole body prosthetics engineered to run outside the biological-driven system, especially when the community of scholarship is often based on what is empirically observable rather than on projections which are as meticulously detailed. As such, what might be a possible strategy to bring about more speculation and investigation of nanomedicine and nanorobots, for example, in the arts and humanities? According to Freitas: “The simplest method is the classical ‘Gentle Seduction’ approach described by Stiegler in his SF [science fiction] story of the same name” (Freitas: See Appendix 2). For example, when considering how nanotechnology might link to life extension or expansion, Freitas suggests:

> In the human enhancement area, my sense of it is that the current ethical discussions mainly revolve around what biotech, not nanotech, can do -- such as reproductive gender selection, intelligence enhancement (either via pills or genetic modifications), and the like. These discussions invariably almost totally ignore the nanotech angle on this -- either because people either aren’t aware of the much larger impact that nanotech will have in this area, or because while understanding the potential huge impact people regard that impact as too far off in the future to worry about. This is not entirely bad, as biotech ethics might serve as excellent training wheels for nanotech ethics. But I do wish there was more discussion of the nanotech side so we could be better prepared (Freitas: See Appendix 2).

As earlier discussed in this thesis, the situation with the Kurtz family set a precedent for others working in the area of bioart. While nanorobotics may be in the near future, the practical idea of transhuman or posthuman bodies built with molecular nanotechnology remains a future prospect and worth strategizing about now. For example, while nanomedicine is currently available and one can find approximately 3,790,000 results through a Google search, the use of nanomedicine’s nanorobots (i.e., nanobots or nanoids) lies in the future, probably sometime during the 2020s at the earliest (Freitas 2009). While being prepared is crucial, what is more immediate is whether or not nanomedicine is feasible and, as such, what the rights associated with nanomedicine might be:

> There are risks associated with any powerful technology, and nanotechnology is no exception. Risks range from inhaling or absorbing nanoparticles …. However, the deliberate abuse of the technology to do harm will remain a risk going forward, and our best defense against that is to build a multilayered immune system like we see in the human body, or in anti-virus technology. The first line of defense is a well-educated population of nanotechnologists that benefit from thoughtful experimentation (Jacobstein: See Appendix 2).

Neil Jacobstein, president of the Singularity University, cautiously suggests a best-defense approach involving education, as a well-educated population of practitioners would influence the scope of work in the field of nanotechnology. As seen through the work of bioartists who approach biotechnology with a scholarship and heuristics based in an understanding of its possible risks, a similar best-defense approach has been established, especially in the works of bioartists and, notably, Munster in regards to adopting a "consequentialist ethics espoused by ecological and animal liberationist concerns".[204]

6.2.1 ESM: Nanorobots

> Looking at the world from science and art is necessary to grasp the fundamental physical similarities in principle and function. How ideas as assembled is a system much like the way matter is assembled – complex. Designers and engineers build because of a motivation to do so. [Pause.] Thinking about motivations – being cautious and conservative means that we ought to think about how to preserve life patterns like engineers and then reconstruct them like artists. It's a matter of putting atoms together in not only right ways but interesting ways – garnishing necessary patterns and omitting the unnecessary mass, energy-wise (Drexler: 1999).

What conditions might enable artistic, design-based approaches to nanorobotics and nanorobots when considering creative endeavors one might pursue? One might, for example, quickly turn to graphic design or illustrations about what nanorobots might look like in the future. For those within the locus of life extension / expansion, nanomedicine could help to repair cell damage and supplement body functions and nanorobots could be used in designing and building whole body prosthetics. For experts in the field of nanotechnology, the locus of possibilities takes such a vision into the arena of feasibility:

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[204] See http://www.eaf.asn.au/biotech/symposium.html Downloaded March 20, 2012.

> Artistic vision and expression are liberated by technology, not constrained by it. Many artists fear advanced technology as something threatening and heartless, but the technology is there for them to experiment with and inject with the properties that they most resonate with. Designers in particular would be well advised to track advances in two distinct areas of nanoscience and engineering: 1) new materials that exploit changes in the chemical, physical, and electronic properties of materials at the nanoscale, and 2) the long term development of molecular robotics, and systems of nanoscale devices that will eventually lead to inexpensive and thorough control of molecules with atomic precision. It is important for designers to realize that molecular nanotechnology and the molecular manufacturing that it will enable, is not just about building small machines, but will enable the hierarchical assembly of super strong macroscale devices of virtually any size (Jacobstein: See Appendix 2).

The beauty of thinking on the molecular scale—about moving atoms one by one, as Feynman proposed, or in clusters of all types of shapes and forms—appeals to the materiality of design. How might designers look at the world as patterns/particles or as molecules that can be arranged and rearranged? According to Hernando Ramírez Llinás, engineering faculty director at the Autonomous University of the Caribbean *and* co-founder of the Colombia-Purdue Institute for Advanced Scientific Research, the possibilities are potentially infinite:

> I think designers might look at the world as patterns or molecules that can be arranged and rearranged. This is the principle of teletransportation and this is the way the matter exists. Quarks, subatomic particles, atoms, molecules and so on. Arranged and rearranged to form everything we can see and detect (Llinás: See Appendix 2).

The essence of nanotechnology is "the control of the composition and structure of matter at the atomic level" (Freitas 2010:687). "Nano" relates to the size and scale of the composition being structured. For example, a nanometer is one-billionth of a meter (5 carbon atoms wide) (Freitas 1999). Nanomedicine is the use of nanotechnology in the medical field. Likewise, nanorobots mean that the robots are on the nano scale:

> Medical nanorobots would be even smaller [in comparison to a single bacterium] and would be constructed entirely of atomically precise mechanical components. The first and most famous scientist to voice the possibility of nanorobots traveling through the body, searching out and clearing up diseases, was the late Feynman, who proposed employing machine tools to make smaller machine tools, these to be used in turn to make still smaller machine tools, and so on all the way down to the

atomic level, noting that this is 'a development which I think cannot be avoided' (Freitas 2009:3).

Freitas developed the concept of nanomedicine and launched Nanotechnology Art Gallery in 2000 through Foresight Institute, inviting numerous artists to present their multi-media and theoretical works in the virtual exhibition space. Other examples of artistic design-based interests in nanotechnology and their potential can be seen, for example, in the project "Nano" (2003) through the direction of Professors Victoria Vesna (media artist) and James Gimzewski (nanotechnology scientist) in a collaboration between The University of California-Los Angeles and Los Angeles Contemporary Museum Lab. DIYbio hacker Marc Dusseiller, of Dusseiller Labs, conducts workshops on nanotechnology for life sciences and views his work as "developing simple tools for artists and hackers to enable them to work on topics of biotechnology by themselves,"[205] thereby expanding the potential for artistic approaches.

Life extension multimedia projects could apply nanorobots in a similar way as with regenerative medicine: selectively intervening on a molecular level and developing narratives that explore the body and its transformation. The media of nanorobots offer new approaches that build on the current field of robotics and human-computer interaction as creative pursuits that append and/or transform the human body in what this thesis proposes in becoming transhuman / posthuman.

6.3 Autonomy & Connectivity: Investigatory Study of Information Technology and Cognitive and Neuroscience for Life Expansion

Let's think about the software I walk around with today. Much of it is not needed. We don't have to hold onto every calorie, every neuron, every thought, or every gene. We will be able to turn genes off and add new genes through gene therapy.

[205] See http://www.body-pixel.com/2011/06/01/interview-with-marc-dusseiller-hackteria-org-part-1-on-diybio-and-nanotechnology/ Downloaded March 3, 2012.

The technologies that that involve gene expression will become more devoted to the intersection of biological engineering and information engineering (Kurzweil: 2011).

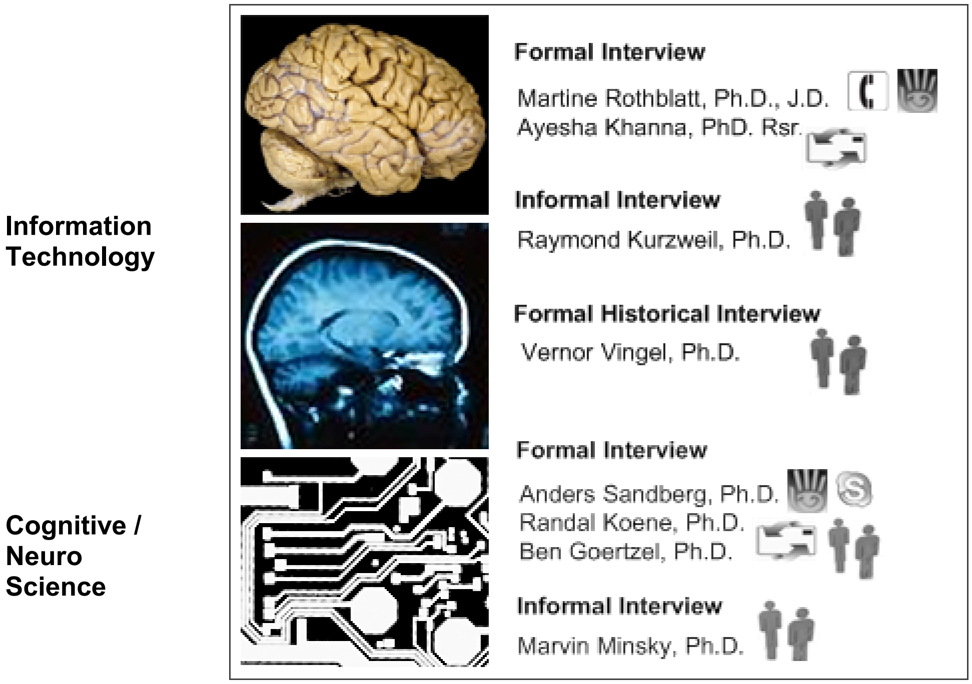

Figure 10: "Human Brain" (Fred Hossier/Getty Images);
"Brain Scan MRI and chip" © 2009 Natasha Vita-More.

Norbert Wiener wrote that "[t]he human species is strong only insofar as it takes advantage of the innate, adaptive, learning faculties that its physiological structure makes possible" (1954:58). Building theories and designing schemes to unfix biological systems as enhanced, extended, and expanded coincides with recent discoveries in science and the relentlessly exponential growth of technology. The engineering of tools has increased physiological abilities for sustenance, survival, innovation, enlightenment and for pleasure. From rock, wood, metal to electronics, robotics, cybernetics—innovative tools are directing many media toward a field of human enhancement where personal identity continues the notion that "life is a self-generated information system" (Kelly 2010:45). The many questions and concerns about modifying and enhancing human physiology draw from issues of human rights and the effects of converging NBIC sciences and technologies. The tools of life prolongation include protocols for exploring synthetic transbiological platforms for human inhabitancy rather than only for exclusively extending the biological life span.

However somewhat inconceivable, one could ask: What will brains look like in the future? Moreover, what might the mind look like in the future? These questions may be onto a grander contemplation—stemming from our observations and theoretical findings about art, science and the future and ideas from many highly specialized fields including, but not limited to, bioengineering, neuroscience, artificial general intelligence, nanotechnology, computational hardware architectures, visual art, immersivity and virtuality, industrial design, philosophy and psychology. According to Randal Koene and Suzanne Gildert, "ASIM [advancing substrate-independent minds] captures the fact that there are several ways in which hardware and software may be used to run algorithms that mimic the human brain" and that in doing so, there is not one but "many different approaches that can be used to realize this end goal" (2010). For example, the idea of uploading or transferring minds into computer-based systems is now referred to as whole brain emulation and/or advancing substrate-independent minds. These terms serve a strategic purpose for emphasizing more clearly the hard science of uploading as a possible outcome of computer science, cognitive science, and neuroscience rather than the science fiction concept of an upload:

> Regarding the link between AGI and life extension or life expansion, of course there are many possible future links. Recall that AGI is a subset of AI focused on making systems that have the same sort of learning capabilities that humans do, and ultimately greater ones. This includes self-awareness and a certain understanding and generalization capability. Right now I'm using simpler, "narrow AI" software to analyze genetics data related to longevity. In a couple years it may be possible to use early-stage proto-AGI software, such as my team's OpenCog platform, to help scientists understand data about longevity. In this case we would be integrating advanced AGI technology into bioinformatics projects that are linked to engineering life extension (Goertzel: 2011).

However, we currently have a body and that body, in whatever form or substrate it might be developed into, needs a mind:

> Our thinking is not separate from our bodies and the freedom of thought implies a certain freedom of brain activity. It is a difficult issue because there is no clear dividing line between the body and mentality and if we think about a freedom to alter the brain structure, it might best be included in morphological freedom (Sandberg: 2011).

Sandberg's interest in morphological freedom[206] fits with the thesis framework regarding new possibilities of the transhuman / posthuman in regards to life expansion. Notably, one issue to consider pertains to peoples' rights to enhance or not to enhance their bodies, as discussed in earlier chapters. The issue of autonomy in somatic rights must be addressed:

> As a negative right, morphological freedom implies that nobody may force us to change in a way we do not desire or prevent our change. This maximizes personal autonomy. There exist a number of special cases where volition becomes problematic, such as mentally ill people, pre-persons or deliberate changes in the motivational systems of the brain. That these cases are troublesome cannot be held as an argument against morphological freedom or any other freedom, since any ethical system will have its limits and messy borderlands. What is important is how well the general principle can be applied, and if it can be adapted with as little contrivance as possible to the special cases (Sandberg: See Appendix 2).

Sandberg further suggests that we need to think about the brain as an emergent system and that rather than focusing on theoretical constitutes about the brain, we need to emulate as much of the brain as possible, and that should include aspects of the body. "So, to some degree we would need a simulation of more than just a brain" and further, in Sandberg's opinion, the emulation would need to be sentient: "[I]t would have to be in relationship with the environment, but would not have to be precisely like the human body" (Sandberg: See Appendix 2). This view echoes the argument of disembodiment previously discussed in Chapter 4 (Transformative Body) and the dialectics regarding whether the

[206] Sandberg is referring to Max More's use and meaning of the term "morphological freedom" in More's seminal essay "Technological Self-Transformation" (1993).

posthuman would be disembodied or embodied. Sandberg suggests that an emulated brain would require aspects of the body because of the body's synergetic relationship with the environment. This view agrees with the thesis' supposition that a future being, such as a posthuman, would need a body to exist and, as Sandberg duly notes, that body need not be an exact and precise replica of the human body but could be something similar or quite different.

6.3.1 ESM: Artificial General Intelligence (AGI)

The autonomy of machines coupled with their molecular size and increasing computational power offers a medium of substantial potential for the field of human enhancement. Because artistic and design-based projects are already advanced in robotics (Harold Cohen, Stelarc, Leonel Moura) and HCI (Kevin Warwick, Steve Mann), one might ask what artistic, design-based approaches engage robotics and AI that reflect on the thesis' concern with life expansion and which offer potential for creative works seeking to enhance cognitive and perceptual experiences.

Martine Rothblatt[207] suggests that, regardless of life extension and further expanding a person onto non-biological platforms, the functions of memory and thought do not cease or are lost permanently because they *could* feasibly be stored in cybernetic form. Rothblatt has built the LifeNaut Mindfile project for just such a purpose:

> We are absolutely counting on the NBIC technologies to bring the LifeNaut vision to fruition. For example, our goal is to be able to download an individual's cyberconsciousness, based on reflections of their consciousness embedded in their LifeNaut Mindfile, into a nanobiological body. So, this clearly requires the Nano and Bio of NBIC. … We agree with medical experts that death occurs when there is an irreversible cessation of all functions of the higher brain. However, if some of those functions, such as memory and thought, are not irreversibly ceased because they are stored in a cybernetic form, in a LifeNaut Mindfile, then such an individual is not really dead. This will become obvious once we succeed in reviving these

[207] Rothblatt is an author and entrepreneur responsible for launching several communications satellite companies, including Geostar, PanAmSat, the global satellite radio network (WorldSpace), and the first non-geostationary satellite-to-car broadcasting system, Sirius Satellite Radio.

> mindfiles into a state of cyberconsciousness equivalent to the original consciousness of the person who created the mindfile. In this sense, LifeNaut aims to provide for an unlimited life extension of people who participate in the project (Rothblatt: 2012).

It seems nearly impossible to propose that by feeding one's personal data (e.g., experiences, documents, pictures, video clips, etc.) to an information processing system, such as Mindfile, that a true facsimile of a person would appear in digital form, fully conscious and cognizant. With little known to date on what actually is consciousness, Rothblatt's ambitious project seems an exceptionally enormous challenge and potentially unachievable. One might ask Rothblatt how the LifeNaut Mindfile project argues its enterprise as relying too heavily on the hope that this will be successful rather than on the feasibility of such technologies being reliable and even available:

> The main problem we foresee is if succeeding generations of project managers failed to heed the project's strict criteria. These criteria limit revival only to those individuals who have clearly given consent to be revived. Also, as with any biomedical project, our first objective is to avoid causing harm. Hence, we will be very careful not to engage any form of self-awareness until we are absolutely positive that the self-aware experience will be a positive one" (Rothblatt: See Appendix 2).

Rothblatt reminds us, as did Jacobstein with nanotechnology, about possible harms that could develop in using untested technologies for reviving Mindfiles into a state of cyberconsciousness. The Mindfile project bears some of the unknown attributes of projects such as cryonic suspension. For example, Mindfile obtains psychological attributes of a person for copying data and hopes to advance its technology in forming a simulated mind, while cryonics is attempting to preserve the brain—and its mind—for later reanimation through nanomedicine and artificial general intelligence. They are indeed different concepts with different protocols, but in the end are assuming a similar result—expanding life.

Alternatively, Ayesha Khanna, founder and director of Hybrid Reality Institute, proposes that "the process of hybridization is a very much part of evolution in the sense that evolution is not purely biological but a broader process of advancement." Going further, the "hybridization approach does lean towards a perspective that allows for evolution to be thought of as any combination of matters between organic and non-organic, such as is taking place today through man-machine synthesis" (Khanna: 2012).

> The Hybrid Age is indeed one of 'life expansion' since advances in nano- and bio-technology can radically increase the length of time we are biologically alive. Also, our global community will be expanded as it will be comprised of diverse sentient entities, including the artificial intelligence robots of our own creation, and artificial representations of our 'selves' in the form of avatars and surrogate artificial forms (Khanna: See Appendix 2).

The spectrum of possibilities suggested by Jacobstein, Sandberg, Rothblatt, and Khanna—while all on a similar track—offers alternative approaches and employs NBIC in different yet complementary ways. Khanna's approach reinforces the notion of life expansion as one in which a global community would not be just biological humans, but also synthetic agents, including avatars and sentient robots and other types of simulated persons. On the one hand, life expansion in this thesis is proposed as a feasible option for the human transformation to a transhuman and/or posthuman stage of existence, Khanna's hybrid theory calls upon artificial representations of our unique personhood. This idea does not conflict with the thesis because an artificial representation of a person would, according to this thesis, be an aspect of the central personhood, as a type of subpersona, and as delineated in Chapter 4:

> To clarify, the expanded person is one who exists outside the generally accepted and traditional essential parameters of being a biological human. This person could be a transhuman and/or a posthuman existing in real time and/or in virtual and artificial systems. The expanded person could also be a human with adjunct personae (selves) simultaneously in the virtual and artificial systems. Therefore, this is more a concept of multiplicity than as a singular concept of a human being a single person with a distinct identity. Of significance then is paramount importance of the quality of identity—the condition of memory in identifying the continuously connected embodiment of a person over time (see Chapter 4, p. 92).

As such, Khanna sees that "in the scientific realm, it is the demise of interdisciplinary boundaries in favor of collaboration that has propelled the Hybrid Age into being." Naturally, the logic here can be applied to the artistic, design-based approaches as well in that "the hybridity of the human form as a transdisciplinary project, the collaboration of arts and sciences can lead to the emergence of new aesthetics of self-representations" (Khanna: See Appendix 2).

The distinction between artificial intelligence and artificial *general* intelligence separates thinking-machines programmed to be problem solving, task orienting mechanisms (i.e., narrow AI) from general-purpose systems with developing intelligence comparable to the human mind (i.e., AGI):

"In recent years, however, more and more researchers have recognized the necessity—and feasibility—of returning to the original goals of the field. Increasingly, there is a call for a transition back to confronting the more difficult issues of 'human level intelligence' and, more broadly, artificial general intelligence (AGI)" (Goertzel 2012).

Artificial general intelligence is a speculative technology, and, therefore, a speculative medium. According to Ben Goertzel, chief AI scientist at Novamente, "[o]nce human science and technology have advanced adequately, 'radical futurist' technologies such as artificial general intelligence (AGI), molecular nanotechnology, pharmacological human life extension and genetic engineering of wildly novel organisms" (Goertzel 2004:1) will emerge. This type of transcension can be seen as a noosphere, omega point, or technological singularity. For the purpose of this thesis, however, AGI is viewed in offering potential to the transformative body more theoretically than in practice at this point in time. As such, it offers potential works that approach "theoretical and technical traditions, including (but not limited to) symbolic, connectionist, statistical, evolutionary, robotic, information-theoretic, as well as integrative and hybrid approaches."[208] Creators of art and entertainment certainly play a role here:

> Some uses of AGI relevant to your work could be building generally intelligent avatars, new types of video games or game characters, multidimensional gaming worlds, and then of course robotics. David Hanson's work with AI and robotics is worth mentioning here – it could be a start toward AGI-fueled social robotics (Goertzel: See Appendix 2).

The real-time person Bina Rothblatt and the robotic AI simulation of Rothblatt known as Bina48 constitute a novel arena for artistic, design-based approaches that attempt to expand personal identity through robotics and AI. David Hanson and his team built the head of Bina48 and its capacity for intelligence:

> The human face is key to our social intelligence. We 'read minds' through gestures, especially those of the face. Psychologists call this 'theory of mind' while the science and art of endowing machines with these capabilities are known as affective computing. These are no easy tasks. Neuroscientists estimate that as much as 70% of the human cortex is used in social thinking, and we are indeterminately far from replicating the functionality of the human brain with A.I. But we can make intelligent robots captivating (Hanson: 2012). … My robots serve as platforms for A.I. development, cognitive science and psychology research, and by gathering data from encounters with people. We need more science and development in the intelligence of the robots, and I believe we are pushing in the right direction. Making A.I. into characters can please people, the same way people like other forms of character arts, like cinema or novels. But intelligence is required for humanlike robots to really win our hearts; without it they are stiff and dumb.

When asked about the future possibilities of AGI and robotics, such as Bina 48, Hanson says that AGI would bring a type of persona character allowing robots to communicate with people in a natural way:

> I seek to realize genius machines—machines with greater than human, humanlike AGI. These machines would do anything the most brilliant humans can, but could do even more amazing things than people. If such genius machines are friendly, they could be amazing collaborations, and members of society. They could invent many things, [in the] arts, [as] new forms of AGI. This would include new forms of androids, and human enhancements, too (Hanson: See Appendix 2).

What if there was a person in real-time, a robotic facsimile of the same person, an

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[208] See http://journal.agi-network.org/tabid/91/Default.aspx Downloaded January 15, 2012.

avatar in Second Life, and/or an upload in cyberspace. With so many copies of a single person co-existing at the same time, how would one determine which person or entity was in control? The multidisciplinary interactions would require an unprecedented interaction of specialized skills:

> Redundancy is an issue – imagine having two copies at the same time which would have different experiences. How should you synchronize these? In terms of a team, for the brain, it would have to be multidisciplinary team of neuroscientists, computational neuroscientists who do functions, mechanism, modeling, for example; neuroinformatics, bioinformatics and so forth. For my own practice, I apply a cross-disciplinary set of skills, such as those mentioned, as well as psychology, electrical engineering and physics (Koene: 2011).

Koene explains that one-to-one mapping from a structural replica of the brain to a functional model of the brain would provide the ability to see and understand the processes that occur within the biological brain:

> What would really be a breakthrough for uploading would be specific types of new tools. What we need are tools that can obtain reliable data about the connections between all neurons and a functional characterization of each neuron. In effect, doing at large scale what neuroscientists can now do for a few neurons at a time. This is a major engineering project – how do we make this work on a scale of 86 billion neurons to produce graphs of all their connections with one another. We can slice and dice and visualize the brain in great detail now, but recording all the intricacies of the connection would be a break through (Koene: See Appendix 2).

According to Koene, there are five significant developments over the last decade that provide evidence of the feasibility of ASIM: (i) computer processing speeds and parallel computing, which is "a natural fit for neural computation … and even a neuromorphic computing platform" (Koene: See Appendix 2); (ii) neuroinformatics;[209] (iii) "recording from the brain – meaning recording electrodes (e.g., Ed Boyden's research on arrays with many thousands of recording channels)" (Koene: See Appendix 2); (iv) optogenetics (i.e., "the ability to introduce new channels into the cellular synapse to excite or inhibit wavelength of light stimulation" (Koene: See Appendix 2), and neurobiology

[209] For example, computational neuroscience with a focus on modeling detail and scale of structures and networks (Koene: See Appendix 2).

(including fMRI)).

The development AGI is sometimes referred to as strong AI. If strong AI were to develop, artificial intelligence effectively would surpass human intelligence by hugely significant magnitudes:

> A threshold will be capturing human intelligence in machines. And here we need to create templates of the brain and of human intelligence. The difference between machines reprogramming themselves and multiplying their information is different than the human brain which simple cannot do this -- we will be able to simulate the brain in machines, but our biology is not yet able to re-engineer the brain in biology. … When we are able to reverse engineer the brain the question of what is consciousness will take on new parameters (Kurzweil: 2010).

Vernor Vinge developed the concept of the technological singularity in his seminal essay "The Coming Technological Singularity" (1993).[210] In 1998, at his office at San Diego State University in California, the author asked what types of creative issues there might be for early posthumans and would, for example, the intellectual and creative pursuits of da Vinci be immeasurably and incomprehensibly surpassed by a posthuman *creativity augmentum*? The author coined this term in 1998 to coincide with Vinge's term *technological singularity*, one in which the idea of creativity as we know it today would become quite different, and expand exponentially in ways not yet imaginable. This expansion could be one possible result of the human brain being augmented with AGI and connected seamlessly with other minds, thus forming a type of joint of interconnected creativity mosaic among two or more minds:[211]

> 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 writing stories, I have tried to imagine emotions superhumans have that humans don't have. Creativity may be entirely different from before, and this would depend

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[210] Vinge's interest in the technological singularity can be traced to his science fiction novella *True Names* (1981).

[211] See file:///C:/DOCUME~1/NATASH~1/LOCALS~1/Temp/Temporary%20Directory %201%20for%20extropy_site_2001-11-27.zip/eo/articles/vinge.htm Downloaded March 24, 2012.

> in part on what types of emotions are available. A more concrete conclusion comes from our own past: before the invention of writing, almost every insight was happening for the first time (at least to the knowledge of the small groups of humans involved). When you are at the beginning, everything is new. 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 post-human 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 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-Singular years) (Vinge: Historical 1998).

No one knows what the future will bring, and it is impossible to be absolutely certain that any of these technologies will develop to the extent necessary to create life expansion. Nevertheless, this thesis urges that artistic, design-based approaches include the ideas, theories and practical approaches presented in this Chapter for the single reason that they are no longer just theories. Certainly, one could use any of these technologies for projects outside the realm of enhancement, the prolonging of physical life, and the expanding of persons onto nonbiological substrates, as we already can identify works that accomplish this. However, as this thesis has previously noted, there is an identifiable gap within the arts and humanities where artistic, design-based approaches to human enhancement of life expansion and the prospect for life expansion appears to have been neglected or weakly discussed, and if discussed it was then mostly to discourage than encourage (as we have seen in Chapter 5). Thus, the challenge remains, as Roy Ascott puts it, to "maintain artistic and ethical integrity at the progressive edge of our various fields" (2006). The author interprets a progressive edge in her field as being that of extending and expanding human life and notably the requisite for artistic and ethical integrity, as duly noted by Ascott.

Pushing the borders of what is considered to be normal, acceptable, and in concert with the status quo can place artistic creativity in arrears. Yet it is the creative impulse to follow one's course—and to then steer forward without fear of creative bankruptcy.

6.4 Conclusion

In this chapter, the scope of emerging and speculative technologies of NBIC+ was investigated because these technologies pertain explicitly to the domain of human enhancement of prolonging life and moving ultimately toward life expansion. Notably, this chapter focused on the sciences and technologies. Yet the transdisciplinary environment of art, design, and science necessitates that artists, designers, and scientists often use the same tools to develop their works. While artists and designers may not necessarily approach human enhancement in the same way a scientist does, it is crucial to provide a fundamental understanding of the focused aims of research in the sciences that pertains to life expansion. This thesis suggests that the most appropriate and well-suited media for artistic, design-based approaches to human enhancement seeking to extend life and expanding life onto semi- and non-biological substrates (also known as platforms) are located in the NBIC+ technologies.

Acknowledging Wiener's statement that "[t]he human species is strong only insofar as it takes advantage of the innate, adaptive, learning faculties that its physiological structure makes possible" (1954:58), the author attempted to establish the idea that innovative tools could lead to human enhancement and life prolongation. The questions and concerns about modifying/enhancing human physiology and the development of artificial general intelligence (AGI) demand our immediate attention and inquiry even if these developments remain many years away from feasible deployment. The author firmly believes that it is advantageous to do both because, one way or another, the reality of superintelligence will most likely develop and be present on a nanoscale level, and incorporated with nanotechnology.

Computer-generated works—including robotics, AI, and virtuality, as well as biological arts in altering cell structures—carry historical significance in the development of the field of human enhancement and life prolongation. More now than ever, we must consider a cross-disciplinary field for human futures, biologically unfixed bodies, and brain integration whereby personal identity of the biological person and supercomputers/AGI are strategized for the best possible outcome to sustain the human species.

The result of this chapter's study is the suggestion that from the scope of NBIC+, the technologies most appropriate for artistic, design-based approaches are regenerative media, nanorobots, and artificial general intelligence (RNA), what this thesis refers to as emerging and speculative media (ESM).

The following chapter is an investigation of ESM, primarily regenerative media, as related to eight artistic projects concerning autopoietic explorations of life extension. In this chapter, we will see the beginning stages of a wider vision for transformative, regenerative aspects of human biology and the body, as located at the intersection of art, design, science and technology.

CHAPTER 7: AUTOPOIESIS: AN ARTISTIC, DESIGN-BASED PRACTICE

> Chorus: You haven't, by any chance committed a further offence?
> Prometheus: Yes, I've made it so that humans cannot foresee their own death.
>
> Chorus: What sort of medicine did you use for this?
> Prometheus: I've filled their hearts with blind hopes.
>
> Chorus: That is a great gift you've given to the humans.
> Prometheus: And more than that, I've given them the gift of fire.
>
> Chorus: So the ephemeral creatures now possess the bright-faced fire?
> Prometheus: Yes and with it they will learn many crafts.[212]

The gift of fire gave incomparable benefits to humankind—warmth, light, sustenance, and protection. It was a formative stage in the human quest to manipulate matter that led to many millennia of tectonic shifts in paradigms, practices, and customs. In this chapter, the prospect for life expansion calls upon its own formative stage—that being biological life extension. Extending biological life might spark the ultimate intervention of the human in becoming transhuman and posthuman and realizing the Promethean ambition and the dialectics of the natural and artificial in full bloom.

In this chapter, the intervention of the biological body is influenced by how scientists and physicians methodically use their disciplinary knowledge and skills in the quest to resolve conclusively disease and injury. However, it is the artistic, design-based approach of the author's own work that forms the scope of current investigation. The approach is based on early stages of emerging speculative technologies and their respective media (ESM) of regenerative medicine, nanorobots, and artificial general intelligence (AGI), (forming RNA). Furthermore, the focus is on selecting tools of regenerative media

[212] AESCHYLUS' "PROMETHEUS BOUND" Translated 2006 by G. Theodoridis. See http://www.poetryintranslation.com/PITBR/Greek/Prometheus.htm Downloaded April 5, 2011.

as the most appropriate method for biological intervention. This intervention forms what can be seen as an autopoietic process engaging the participant-observer and the biological body's network of systems. Through this process, the research forms an unprecedented intersection of art, design, science and technology. The approach responds to the thesis question concerning the essential conditions for artistic, design-based approaches to life expansion.

In establishing these conditions, the author argues that we must start with the matter or molecular structure a person is currently composed of—that being biology—and then to speculate on what possible media or tools are available now and what *could* become available later, incorporating information based on the research interviews with experts in their respective fields of nanotechnology, biotechnology, information technology and cognitive and neuroscience (NBIC). Although the relevant conjecture is unresolved, the knowledge culled from the thesis' investigation of NBIC experts through interviews and field study provides evidence of the ongoing scholarship in the research and development aspects, as noted at Halcyon Molecular and Novamente, for example. The thesis also offers, at least, a prospect (Freitas; Jacobstein; Sandberg; Koene; Goertzel: See Appendix 2) and, at best, a real strategic potential of accelerating change and exponential growth (Kurzweil: See Appendix 2), that such technologies will probably become available.

Autopoietic Approach

The following serves as the most applicable definition of the autopoietic approach for the current investigation:

> Autopoiesis attempts to define the uniqueness of the emergence that produces life in its fundamental cellular form. … There's a circular or network process that engenders a paradox: a self-organizing network of biochemical reactions produces molecules, which do something specific and unique: they create a boundary, a membrane, which constrains the network that has produced the constituents of the

> membrane. This is a logical bootstrap, a loop: a network produces entities that create a boundary, which constrains the network that produced the boundary. This bootstrap is precisely what's unique about cells. A self-distinguishing entity exists when the bootstrap is completed. This entity has produced its own boundary. It doesn't require an external agent to notice it, or to say 'I'm here.' It is, by itself, a self-distinction. It bootstraps itself out of a soup of chemistry and physics (Varela 1995:212).[213]

Accordingly, this Chapter seeks an autopoietic process by which the author ascertains the scope of the living system of the somatic and cognitive spheres of the body in attempting to intervene with the aging process of four unique self-organizing systems (e.g., skeletal, muscular,[214] integumentary (skin), and vision)[215] that interact as a network with the larger recursive bodily system that maintains life. Autopoiesis takes the work into the realm of self-creation, which links to the notion of the transhuman / posthuman as possible self-creations in attempting to prolong life and, in the future, to expand personhood onto or within non-biological systems. Notably, the focus in this regard is not on the particular system of matter in which the continuous person is expanded into or onto but rather it is the *continuity of personhood* that is most important. Nevertheless, the matter in which the person exists is highly and inevitably relative (as Sandberg noted in the previous chapter) because the body is a part of the holistic person. Thus, considering the brain as an emergent system, rather than focusing on theoretical constitutes *about* the brain, we then need to emulate as much of the brain as possible, and that inquiry should include aspects of the body:

> So, to some degree we would need a simulation of more than just a brain … [the body] would have to be in relationship with the environment, but would not have to be precisely like the human body (Sandberg: See Appendix 2).

---

[213] Varela attributes his early work concerning self-reference and autopoiesis to the ideas developed in cybernetics and its theorists Warren McCulloch and Norbert Wiener (Varela 1995:212(

[214]The integumentary system, comprised of skin and its appendages (hair follicles, for example) is the organ system that protects the body. The skin is the body's first line of defense. See http://en.wikipedia.org/wiki/Integumentary_system Downloaded June 3, 2011.

[215] The "[v]ision System is a complex system consisting of two sets of lenses (the cornea and crystalline lens), two sensing devices (retina), and the brain." See http://www.shamirlens.com/vision-101.aspx Downloaded June 8, 2011.

Autopoiesis,[216] according to Humberto Maturana and Francisco Varela, refers to a self-contained system of parts that form an autonomous and self-actuating organization (1980). Quite appropriately: "Autopoietic systems—whether cells, organism, or communities—are run from the inside" (Margulis 1995: 221). One might question what are the inside and the outside components of the appended mortal whose transformative body is the self-creative goal of the expanded person who resides within a contested culture but who, nonetheless, aspires to become transhuman and/or posthuman. In this case, we might have to define what the inside and the outside of the system are in order to ascertain the criteria for the corresponding parameters of the system. The author recognizes the importance of the parameters that define borders between systems, and the fuzzy lines between them, and proposes that this particular topic needs far more investigation and articulation than what is possible in this chapter or in this thesis. Further, determining such parameters, borders, and lines might not be readily distinguishable at the present time because much of the work of life extension and life expansion is based on speculation about what is currently researched and developed, and the limitations which require more concrete information to resolve. In sum, it could be that the parameters, borders, and lines are unascertainable via today's knowledge and tools. We might have to become more transhuman and/or posthuman in order to recognize and determine such parameters. And rightfully so if the process is indeed autopoietic in part, or in whole, then one would have to be a transhuman and/or posthuman to experience such parameters and report on them. Thus, for the time being, this thesis can only recognize the issue and signal it as one to be considered in further research on the topic of life expansion.

[216] Autopoiesis and autopoietic was introduced by Maturana and Varela to underscore the aspect of self-producing nature of living systems. The definition is as follows: "an autopoietic machine continually generates and specifies its own organization through its operation as a system of production of its own components" (1980:78-79).

Another issue worth mentioning is the paradox, as noted by Varela, that the self-organizing network creates a boundary, or membrane, constraining the network. Varela calls this process a bootstrap (1995:212) that suggests a loop by which one or a system advances oneself or the system and can emerge as advances become successively more complex. Varela states that "[a] self-distinguishing entity exists when the bootstrap is completed" (212) that can be interpreted as the autopoietic process by which artistic, design based approach to life extension. For example, one might say that the intervention of an artistic, design-based practice of the author's body (by the author) is aimed at returning aspects (or systems) of the body to a state of normal functioning which would be what Varela refers to as a completed bootstrap. Here the loop becomes the process by which the artistic works form their own system and interrelated systems and maintain autonomy. Perhaps the larger paradox is that the work is never completed—that the idea of life expansion is an ever-emerging process and the system in which life emerges cannot have a definitive boundary because its future system is not yet known. Therefore, we must move beyond the concept of autopoiesis in order to understand the dynamics of life expansion. Perhaps a wider conceptual scheme of the relationships between human / transhuman / posthuman, and their respective matter, systems and emergence, is necessary to understand the conceptual framework of life expansion:

> The problem, of course, is establishing the 'observer' position that can use the notion of the interaction of organizationally closed informational systems to appreciate this larger whole encompassing the autonomous and mutually blind systems. Varela finds this position in Buddhist practice, with its necessity of stressing the 'connection between the world view, political action and personal transformation' (Protevi 2009:102).

Thus, for the purposes of this chapter and the relationship of the author's work, we will have to look at autopoiesis as the process by which the work has been developed, as an autopoietic organization of separate works that are maintained through the active compensation of deformations (Maturana & Varela 1980). Specifically, in the author's work it is the degeneration of bodily systems, which then fosters a self-maintaining unity. However, Varela's 1979 distinction that the autopoietic system must produce its component and conserve its organization and boundaries (Varela 1979) is problematic because in creating a boundary "which constrains the network that produced the boundary" (Varela 1995:212) the system becomes self-sustaining rather than an evolving or emergent entity.

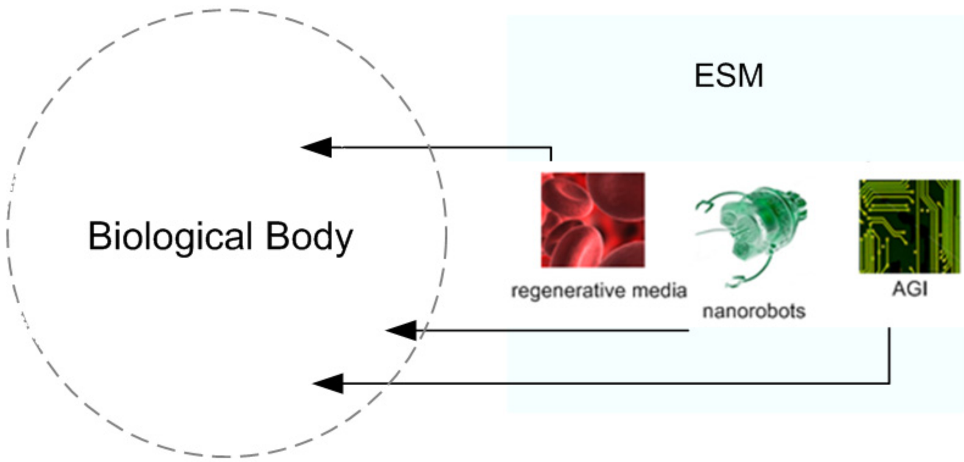

Figure 11: "ESM Intervention" 2011 © Natasha Vita-More.

For example, in Figure 11, the intervention of the biological body with emerging and speculative media (ESM) from what this thesis has carved out as (i) regenerative media, (ii) nanorobots and (iii) artificial general intelligence (AGI) (forming RNA) are outside the system and become part of the system for the purpose of prolonging life and continuous personhood. Thus, the bodily system, as it is today in the human stage, is not self-sustaining and cannot produce its own components to the degree necessary for an extended lifespan because its process of mitosis is limited and eventually the biological cells deteriorate and die and, as a result, the entire the system expires. Perhaps John Brockman explains it best in his translation of Varela's theory of autopoiesis as being "concerned with the active self-maintenance of living systems whose identities remain constant while their components continually change" (Brockman 1996).[217]

In *Towards a Practice of Autonomous Systems*, Varela addresses the inclusion of external stimuli as relative and that a system can transform itself through emergent behavior. For example, in relation to artificial life "[t]he autonomy of the living is understood here *both* in regards to its actions and to the way it shapes a world into significance" (Varela & Bourgine 1992:xi). In *How We Became Posthuman*, Hayles writes a clear summation of Varela's interest in artificial systems that result from the inclusion of emergent behavior occurring outside an operationally closed system, and thereby affecting the autopoietic system and its autonomy. A living system's autonomy, in asserting its presence in the world, is not processed in advance but occurs as the living system shapes its world. For example, Karl Sim's "Evolved Virtual Creatures" (1994) exemplifies the process in which the artificial shapes (creatures) perform a task and evolve based on their experiences in their environments. Returning to Varela, Hayles points out that the difficulties Varela had with evolution was because he emphasized the holistic aspect of circularity of a closed system. His insight by including emergent behavior, then, approached concepts of systematic evolution:

> When Varela and his co-author speak of 'shap[ing] a world into significance,' the important point for them is that the system's organization, far from remaining unchanged, can transform itself through emergent behavior. The change is not so much an absolute break, however, as a shift in emphasis and a corresponding transformation in the kind of questions the research programs pose, as well as new strategies for answering them. Thus the relation of the third wave to the second is again one of seriation, an overlapping pattern of replication and innovation (Hayles 1999:222-223).

Thus, as Hayles duly notes, the observer has not disappeared from the system or become disembodied, but remains present, narrating the tale of distinctions between natural and artificial and, in the case of this thesis, carrying the story forward in observing,

[217] See http://www.edge.org/3rd_culture/varela/varela_print.html Downloaded April 22, 2011.

participating in, and constructing possibilities for personal continuity of being in the world.

In this thesis, the emergent behavior's early function would be, for example, reversing the damage of cell mutation causing aging and disease and attempting to sustain well-being as long as possible.

The strategies used in the research for the intervention of the biological body are adapted to each work, of which there are seven mentioned below. The biological work is based on the author's visual and physical observations of her body and the confirmation and authentication of such observations by experts in the fields of endocrinology, ontology, plastic surgery, ophthalmology, and neuroscience. The methods used by the author in this biological work include visual observations for identifying irregularities in the body and physical observations based on a range of normal[218] for the author's age, height, weight, and through physical aerobic and anaerobic exercise, for example. The methods employed by medical scientists in ascertaining the data include body scans, brain scans, x-rays, tissue samplings, and blood work. Other tests include balance testing, inner ear testing, cognitive testing and reflex testing. While the data are solidly based in science and medicine, the author's salient approach is based on first-hand experiences, as the participant-observer within or of the system, and solution findings helped to form an artistic, design-based approach applicable to the domain of human enhancement that pursues life extension. Lastly, the strategy includes DNA testing for detecting hereditary genetic issues that could signal molecular degeneration. This method employs the process of sampling DNA to genotype hundreds of thousands of single-nucleotide polymorphism (SNP) or "snips" that are generated because scientists believe SNP maps will help to identify the multiple genes most likely associated with diseases such as cancer, diabetes, vascular disease, and some

[218] The author discusses issues of normal and normalcy in Chapter 3 in reference to human enhancement. In this section the use of normal reflects the scientific and medical measure by which a person's physiology can be tested in order to ascertain a level of well-being and healthfulness.

forms of neurological disorders.

The artistic, design-based approach of observing, identifying, and intervening with cell degeneration is based in large part on scientific and medical testing, and provides a methodology for artistic, design-based approaches to regenerative media.

The strategies used in working with early stage possibilities for approaches to life *expansion* are based on projects that attempt to preserve aspects of personal identity. Lifenaut Mindfile is a web-based research project for backing up a person's recordable memories and personal characteristics. The last project mentioned in this stage of possibilities includes cryonic suspension, or cryonics. This project takes place in the present time, but its outcome will not be available until a future time. The approaches of ESM most applicable to life expansion are suggested to be AGI and nanorobots. Notably, these technologies are not currently available; thus, in this regard, speculation and conjecture are used in this dissertation to explain what *could* be developed in the future if and when AGI and nanorobots are developed.

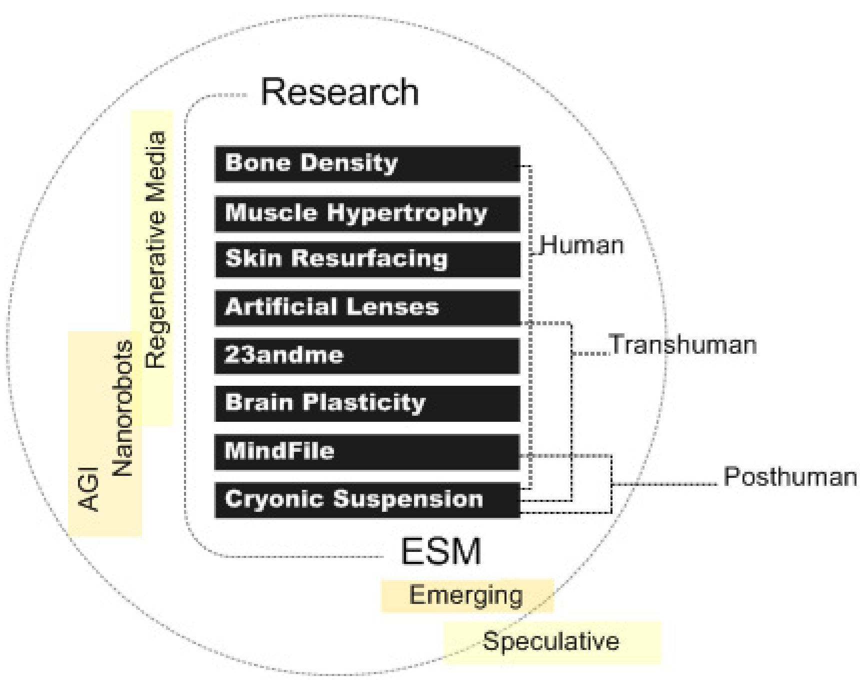

Figure 12: "ESM: Transhuman / Posthuman" 2011 © Natasha Vita-More.

7.1 Human+ Somatic / Cognitive Design Project

At eleven years old, I had a benign maxillofacial cystic mass removed from my jaw bone. This was my first experience with cellular abnormality.

In 1980, I was found semi-conscious, hemorrhaging internally from an unexpected ectopic pregnancy that took the life of my unborn fetus and nearly my own. This was my first experience with death.

In 2001 I had bladder cancer and in 2010 I was diagnosed with basal cell carcinoma, both signs that malignant mutations were occurring in my body.

In 2011 and 2012 respectively, I had the natural crystalline lenses of my right and left eyes replaced with artificial lenses, a procedure to restore sight and reverse the effects of environmental damage of UV light—electromagnetic radiation emitted by the sun.

This section is an investigatory summation of eight projects developed between 2007 and 2012 that form an intervention of the biological body and its physiological observation and probable cellular degeneration. Several of these projects are artworks, while a few are clinical investigations and intervention of aging and disease, and the last project represents the author's engagement in a speculative measure for sustaining life. This summation attempts to engage each of the four previously named autonomous systems (e.g., skeletal, muscular, integumentary (skin), and vision) in opening up the exploratory arena to bring about an emergent behavior of transformation, discover what future possibilities there could be for bodily functioning and, lastly, to sustain the brain. Thus the author is an observer and participator of aspects of her own self-creation.

General Concept

The Human+ Somatic / Cognitive is an ongoing research project of science and medical technology where the biological body is the medium for creative inquiry. Medical technology offers resolve to improving the psychological quality of human life as a matter of medicine. Alternatively, Human+ Somatic / Cognitive Design (H+sc) is an artistic project that is located in the domain of human enhancement for the purposes of rejuvenating the somatic and cognitive systems. In some works the project engages scientists, technologists, and medical doctors who performed the surgeries and other processes of medical and/or biological intervention. The autopoietic principle is applied to these projects for the purpose of artistic inquiry and expression. For example, the project has observable increased bone mass ("Bone Density") and developed muscle mass ("Muscle Hypertrophy"). In each of the five artistic works, the project observed issues prior to medical intervention and the parties to the project, in some instances, arranged for the medical work. For example, the "Bone Density" work identified the effects of bone loss prior to an endocrinologist's requested full body scans of the patients. Alternatively, in the work "Muscle Regeneration," the author observed a weakening of muscle mass and strategized building muscle fiber grown through anaerobic exercise. Ultimately, the aim of this project has been to observe, recognize and intervene with aspects of the body's biological degeneration and thus attempt to reverse, restore and sustain it, including the brain.

A unique set of concerns and problems developed because the specific aspects of the body, such as bone density and muscle mass, do not function on their own but work in concert with the body's whole physiology. In this regard, focusing only on these areas proved to be unsuccessful, as other issues such as diet, nutrition and well-being affect the entire physiological system—both somatic and cognitive. Further, the medical field is concerned with resolving disease based on narrowly specified disciplines and areas of expertise. For example, the endocrinologist is concerned primarily with the chemistry of the body, such as hormones, while the ophthalmologist is concerned with eye disease and surgical procedures to resolve the disease. Other problems concerned the heuristics of the artistic project because the objective of human enhancement for artistic purposes is largely overlooked. The balance between being too involved with the medium—the body, or one's own body—and the analyzing issues against medical findings were at times synchronous, but not always. For example, the project "Vertigo" is based on the author's experience with symptoms of dizziness and nausea associated with the medical condition of vertigo but the medical doctors could not conclusively resolve why vertigo was manifest. Brain scans showed no inner ear problems or neurological problems and, thus, the recommendation was to resort to valium and anti-nausea medication during a vertigo episode. Alternatively, the project approached vertigo as a bodily sensation—a warning or alert to slow down and consider the body's relationship with the environment.

Meanwhile, the aim of the H+sc project has been to intervene with the observable degeneration of the biological body and to seek resolve through DIYbio approaches, exercise, nutrition, pharmacology and, as a last resort, medical surgery. Biological and artificial appendages, in some cases, are added to the body, and, in other cases, neuropharmacology alters the brain's neurofunctioning. Each project is seen as a unique work of artist intervention in that its focus on the body for the purposes of observing and intervening with cellular regeneration. These works are aspects of the larger, holistic project blurring the boundaries between what is expected to occur in the body as a natural process or through technologically mediated means: cell mutation/modification, normal/engineered, and aging/regeneration. Likewise, we can see how the works challenge artistic boundaries that append the body and/or morph the body as well as their capacity to improve body function or extend human life. Further, the works challenge how the organism and its body is perceived as a work of art at the juncture of bioart and human enhancement and as an autopoietic process not for the sake of art, per se, but for the sake of staying alive in good health.

The five H+sc project works include: body enhancement of the (1) skeletal system for bone density, (2) muscular system for muscular hypertrophy, (3) integumentary system for skin resurfacing, and (4) vision system for artificial lenses, and (5) brain plasticity for balance (cognitive enhancement and neuropharmacology (e.g. dopamine regulation and serotonin reuptake inhibitor)).

7.1.1 Bone Density

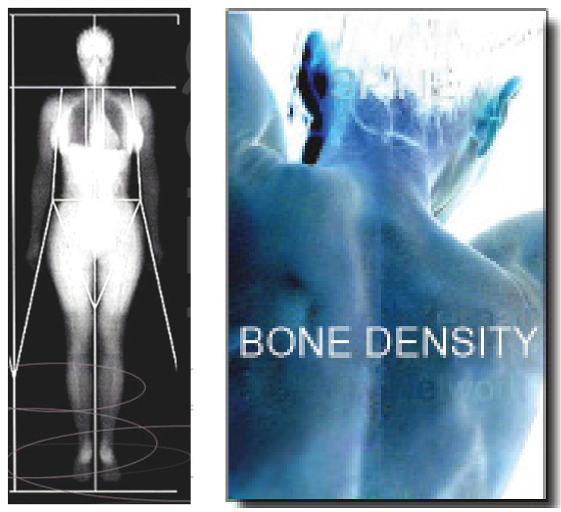

Figure 13: “Bone Density” 2010 © Natasha Vita-More.

“Bone Density” (2008-2010) is an artistic intervention of bone degeneration in an attempt to reduce bone loss and rebuild mass. The work was documented in a 12-minute video of a series of intervention practices showing the scientific data developed through bone scans and blood work produced, which evidenced bone loss, along with the artistic, design-based intervention which explores hormone replacement therapy (HRT), anaerobic exercise, and vitamin supplements. The video documentary was exhibited at the Moscow Film Festival (2010) and the “Evolution Haute Couture, art and science in the post-biological age” at the National Centre for Contemporary Arts, Kaliningrad Russia (2010).

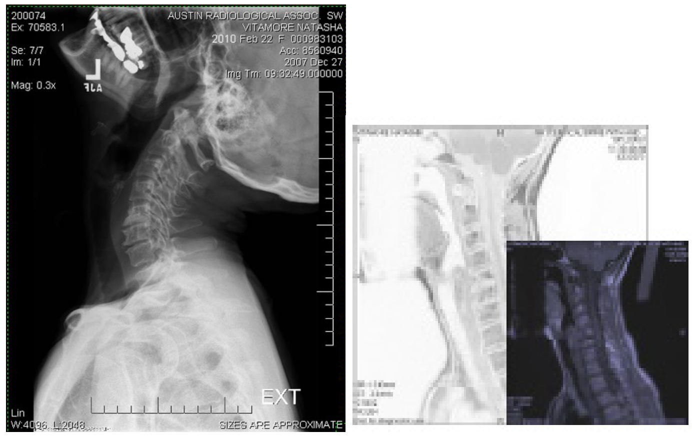

Figure 14: “Cervical Spine X-ray” 2010 © Natasha Vita-More.

Description

Osteopenia is a bone condition characterized by a decrease in bone density, which can lead to weak and fractured bones. Osteopenia can be caused by genetics or genetic disorders, hormone imbalance (e.g., a decrease of estrogen or testosterone), vitamin D deficiency, and/or large amounts of alcohol consumption. It affects 34 million people yearly in US, 80 percent being women.[219] Osteopenia can be present for many years before detection and an increase in life span could result in an increase in osteopenia, and osteoporosis.[220]

<u>Symptoms</u>: Observable tightness and inflexibility in left hip and persistent dull pain at hip joint.

<u>Diagnosis</u>: The medical process included measuring bone mineral density (BMD) (See fig. 15). The test is the DXA scan (dual energy X-ray absorptiometry)[221] of the hip and spine. The DXA scan gives two results: a T score and Z score. The Z score compares the patient to the average/norm of a person same size/age. The T score compares BMD to a

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[219] http://www.medicinenet.com/osteopenia/page2.htm Downloaded January 12, 2012.

[220] The total cost to the U.S. health system for bone fractures due to osteopenia and osteoporosis was estimated at $17 billion in 2005. Due to the aging population, the number of hip fractures, and the related costs, could double or triple by 2040 http://www.medicinenet.com/osteopenia/page2.htm Downloaded January 12, 2012.

[221] Radiation of the DXA machine is less than an airplane flight from California to New York. See http://en.wikipedia.org/wiki/Dual-energy_X-ray_absorptiometry Downloaded January 12, 2012.

person of the same sex. The test is measured by deviations. The lower the T or Z scores, the higher the risk for bone fracture. A normal bone measure would be T-score greater than -1 and an Osteopenia T-score is -1 and -2.5.

Author's Intervention: aerobic exercise, calcium supplements. Even though sun exposure is recommended, the author did not take this route because of concerns about skin cancer.

Medical Science Intervention: hormone replacement theory (HRT) using Estradiol Transdermal Patch of bioidentical estrogen at 1.94 mg estradiol, which provides 0.05 mg daily and prometrium at 100 mg daily. The rate of bone loss once hormone replacement therapy (HRT) is discontinued is not unusually rapid.[222]

Observations: The study showed that the left femur was at T-1.3 in January of 2009 and T-1.6 in December of 2011. With HRT, the total hip loss decreased, evidenced by the red square in Figure 15 showing the findings of 04.2%. A longer period of time would be needed to test whether bone loss would resume if intervention stopped.

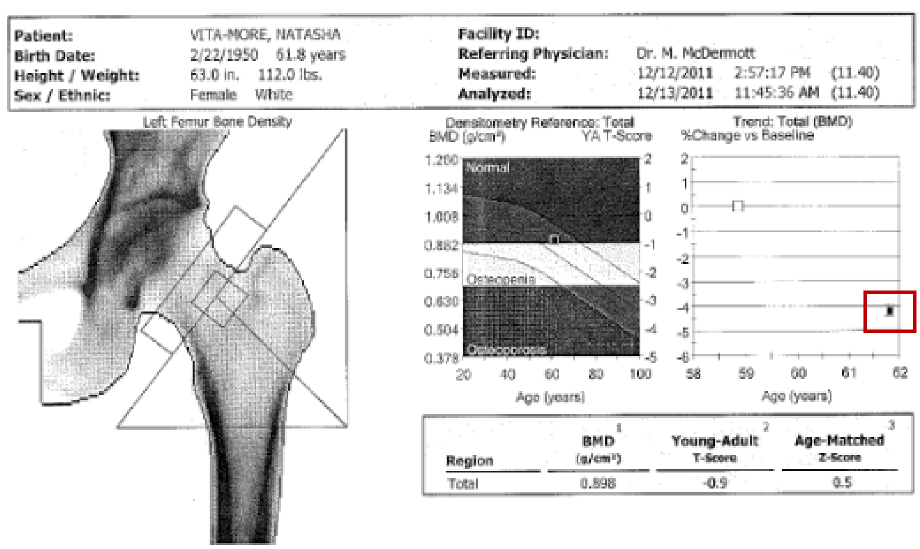


Figure 15: "Bone analysis" 2011 © Natasha Vita-More.

[222] According to results from the Postmenopausal Estrogen/Progestin Interventions (PEPI) trial published in the March 25 issue of the *Archives of Internal Medicine* (Greendale, Espeland & Slone 2002). http://www.medscape.com/viewarticle/431187 Downloaded March 15, 2012.

The skeletal system of the body forms the scaffold for all other systems in the body. If the skeleton is the framework for the body, then the muscles are the driving force, putting the body into motion.

7.1.2 Muscular Hypertrophy

Figure 16: "Muscle Regeneration" 2010 © Natasha Vita-More.

Description

Minor muscle atrophy occurs when there is a lack of exercise, injury, poor nutrition or other reasons which might be associated with genetics. Aging is the largest known cause of muscle loss, which, in turn, could result in eventual immobility if the muscle is inactive, meaning not stretched and exercised. When muscles are not working, they weaken and eventually atrophy. Because of the relationship between the muscles and mobility, a strong yet flexible muscular system is crucial for life extension. Muscle hypertrophy means an increase in the size of muscle cells. Accordingly, "Muscle Regeneration", a visual narrative of anaerobic muscular development, was exhibited at SXSWi (2010).

Symptoms: observable decrease in bulk, length, size, definition of muscle and lack of physical strength. There was no prevailing condition or doping issue that would alert scientific or medical supervision.

Author's Intervention: anaerobic exercise, strength training (body building) and high increase in protein consumption, including whey powder (see Fig. 17). Weight training strategies were explored, including a progressive overload, meaning increasing the weight, repetitions (reps), and sets, and alternating regimens of light weights vs. heavy weights, and burning muscle, meaning lifting to exhaustion. The most successful method for this work was to alternate between heavy weights and low reps with burning once a week. Taking the supplement creatine,[223] a substance found in muscle, was tested but it caused nausea and while it did show some increase in muscle mass, based on ways in which creatine can build muscle, it was eliminated from the strategy after a few weeks.

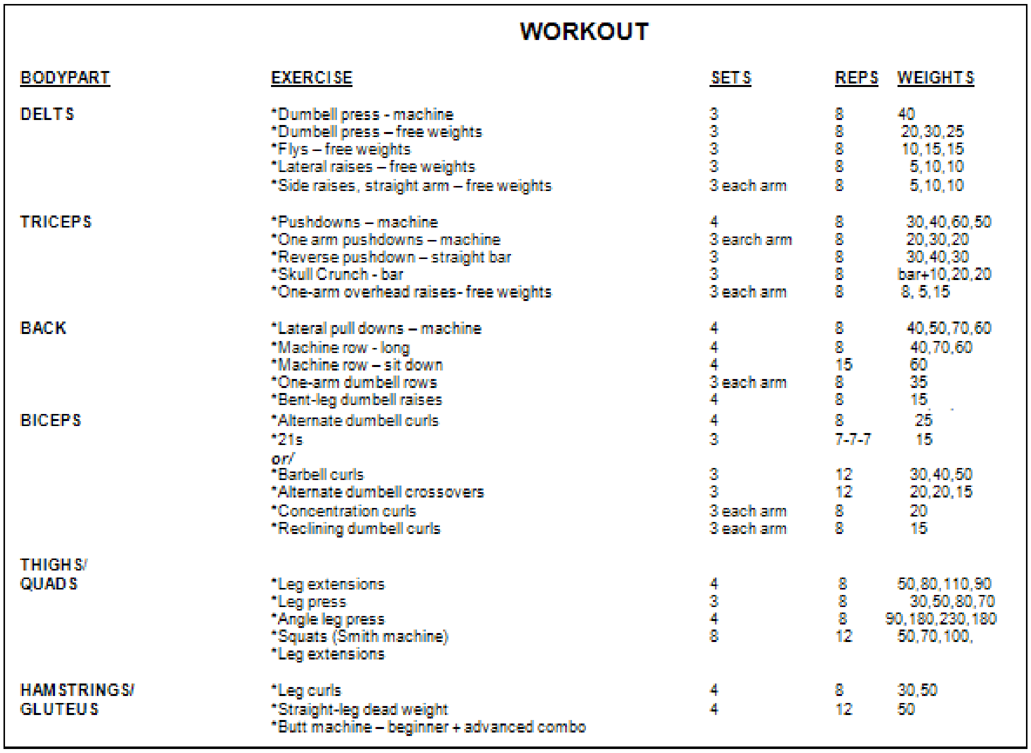
Observations: After six months of anaerobic training, weight lifting (See Fig. 18) and high protein intake, muscle mass increased and the author was able to start sculpting, defining the length and size (definition) of muscle mass.

DAY	BREAKFAST	SNACK	LUNCH	SNACK	DINNER
Monday	6 egg whites scrambled w/ cheese, toast, fruit	Protein drink = non-fat milk, protein power (25 grams or more), strawberries or other fruit, banana	Chicken breast, 1/2 baked potato, green salad	Protein drink = non-fat milk, protein power (25 grams or more), strawberries or other fruit, banana	Broiled salmon, yam, broccoli, fruit
Tuesday	6 egg whites scrambled w/ cheese, toast, fruit		Baked fish, dark green salad, rice		Turkey meat, corn, green beans, fruit
Wednesday	Yogurt, fruit, protein drink		Chicken breast, cottage cheese, fruit		Chicken caesar salad, fruit
Thursday	Fiber cereal, raisins, walnuts non-fat milk		Pasta, green salad, fruit		Salmon grilled, dark green salad, sorbet
Friday	Yogurt, fruit protein drink		Egg whites omelet cheese, veggies, fruit		Turkey grilled, side of pasta, green beans
Saturday	Fiber cereal, raisins, walnuts non-fat milk		Tuna salad, veggies, yogurt, fruit		Broiled salmon, yam, broccoli, fruit
Sunday	Fiber cereal, raisins, walnuts non-fat milk		Veggie burger, bun, lettuce, tomato		Egg whites omelet cheese, veggies, fruit

* Reminder: Drink 6-8 glasses of water daily and take a multiple vitamin daily.

Figure 17: "Nutrition Guide" 2008 © Natasha Vita-More.

[223] Creatine is a nitrogenous organic acid that helps to supply energy to muscle cells by increasing the formation of denosine triphosphate (ATP). See http://en.wikipedia.org/wiki/Creatine Downloaded May 26, 2011. See also http://www.muscleandfitness.com/nutrition/new-creatine Downloaded August 13, 2011.



WORKOUT

BODYPART	EXERCISE	SETS	REPS	WEIGHTS
DELTS	*Dumbell press - machine	3	8	40
	*Dumbell press – free weights	3	8	20,30,25
	*Flys – free weights	3	8	10,15,15
	*Lateral raises – free weights	3	8	5,10,10
	*Side raises, straight arm – free weights	3 each arm	8	5,10,10
TRICEPS	*Pushdowns – machine	4	8	30,40,60,50
	*One arm pushdowns – machine	3 earch arm	8	20,30,20
	*Reverse pushdown – straight bar	3	8	30,40,30
	*Skull Crunch - bar	3	8	bar+10,20,20
	*One-arm overhead raises- free weights	3 each arm	8	8, 5,15
BACK	*Lateral pull downs – machine	4	8	40,50,70,60
	*Machine row - long	4	8	40,70,60
	*Machine row – sit down	4	15	60
	*One-arm dumbell rows	3 each arm	8	35
	*Bent-leg dumbell raises	4	8	15
BICEPS	*Alternate dumbell curls	4	8	25
	*21s	3	7-7-7	15
	or/			
	*Barbell curls	3	12	30,40,50
	*Alternate dumbell crossovers	3	12	20,20,15
	*Concentration curls	3 each arm	8	20
	*Reclining dumbell curls	3 each arm	8	15
THIGHS/ QUADS	*Leg extensions	4	8	50,80,110,90
	*Leg press	3	8	30,50,80,70
	*Angle leg press	4	8	90,180,230,180
	*Squats (Smith machine)	8	12	50,70,100,
	*Leg extensions			
HAMSTRINGS/ GLUTEUS	*Leg curls	4	8	30,50
	*Straight-leg dead weight	4	12	50
	*Butt machine – beginner + advanced combo			

Figure 18: "Routine 1" 2008 © Natasha Vita-More.

The muscles work with the skeletal system through connective tissues of tendons, which act like glue in attaching the muscle to bone. We cannot see the muscle, other than how the skin adjusts to its increasing or decreasing size. Skin, on the other hand, tells the outside world what could be occurring inside the body.

7.1.3 Skin Resurfacing

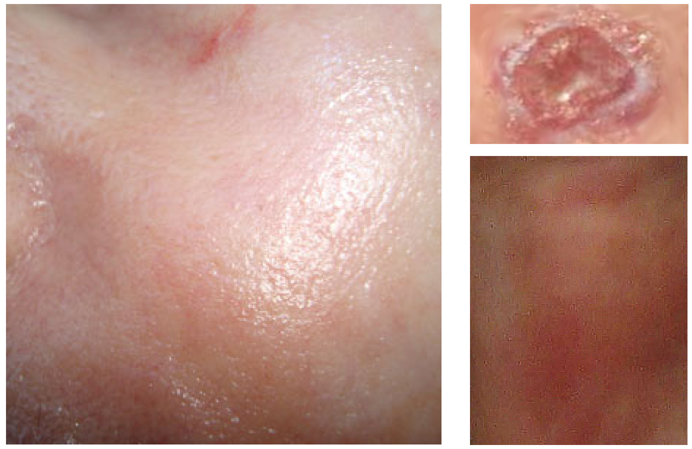


Figure 19: "Skin Resurfacing" 2011 © Natasha Vita-More.

Description

"Walkabout" is a performative bioart work in which the author participated in a walkabout[224] ritual between February and April in 2009. Walkabouts are journeys of self-reflection and Zen-like focus in separating oneself from *self* and becoming one with the environment or task at hand (i.e., *Zen in the Art of Archery* (1999)). The main point of a walkabout is to challenge one's circumstances. The key challenge is to reach a balance between detached and connection. For example, in this project the detachment to the physical body balanced the mindful connection to the environment.

The bioart walkabout was performed within a bioart garden laboratory (Fig. 20) in Austin, Texas during a period of three months and at temperatures between 100 and 110 degrees Fahrenheit. Because of the climate and high heat level, multiple insect swarms and microscopic infestations of spider mite, aphids and mold developed on the cultivated specimens. The strength and duration of the sun's ultraviolet radiation caused author to develop basal cell carcinoma, a skin cancer. Dealing with the absolute urgency of these conditions provided an unexpected yet meaningful new perspective of the research topic

[224] The walkabout refers most commonly to a rite of passage of Australian Aborigines. The author uses this term in respect of this ritual and adds a Zen aspect to it.

that might not have been realized otherwise. Sun Tsu strategizes how to deal with conflict in *The Art of War* (1994 (Trans.)) in what can be summed up by choosing battles wisely. During the months of insect breeding the project, the project was put on hold. During the months when the roses were not consumed by the swarms, the projected flourished.

Figure 20: “Walkabout: 6 species” 2009 © Natasha Vita-More.

The walkabout was a participant-observer experience. Paradoxically a unique balance manifested, where the bioart and the artist to acquiesce to the unintended consequences.

Symptoms: observable bump on nose, followed by tingling. Dermatologist burned it off twice, but it grew back.

Diagnosis: Basal cell carcinoma is a non-melanoma skin cancer. The basal cell carcinoma starts developing on the top most layer of the skin called the epidermis.

Author’s Intervention: various sunscreen creams at SPF (sunscreen protection factor) 15, 30 and, eventually, 50. Sunburn caused by ultraviolet-B (UVB) radiation with SPF values that only indicate a sunscreen’s UVB protection and information on the sunscreen’s effectiveness blocking the ultraviolet-A (UVA) rays are not indicated. It is the UVA ray that contributes to the development of skin cancers.[225]

Medical Science Intervention: The biopsy was performed on a damaged section of the skin tissue and results were positive for basal cell carcinoma. Dr. Gregory Nikolaidis performed Mohs[226] surgery, a microscopic procedure also known as chemosurgery. Mohs surgery is microscopically designed to keep selecting and removing tissue cells until there is no sign of cancer. For example, Nikolaidis selects tissue from the affected area, cuts into

[225] See http://dermatology.about.com/cs/skincareproducts/a/spf.htm Downloaded July 6, 2011.
[226] Mohs surgery was developed by Dr. Frederic E. Mohs.

the skin to remove the tissues and immediately inspects the sample under a microscope to check for cancer cells.[227] This process was repeated several times until there was no sign of cancerous cells. Thus, Mohs surgery obtains marginal control of the cancerous growth potential, as the rate of basal cell skin cancer returning is one percent with the Mohs surgery, which compares to 10 percent with other forms of treatment.[228] Dr. Cameron Craven, MD, FACS, performed the reconstructive plastic surgery by reconstructing the scarred area from where the cancerous skin was removed.

Observations: No matter how careful one is or might be in protecting skin against sun radiation, there is a possibility that the radiation will penetrate through the sunscreen and/or other modes of protection. The best practice is to stay out of the sun during its peak hours. Interestingly enough, the author was more concerned about the insects damaging the foliage of the roses and was in constant battle with the insect swarms (e.g., white fly, spider mite, mildew and aphides) during the walkabout and had no idea it was skin that was also be revenged by the sun.

Skin contains the body and protects its inner systems from the outside world. The eyes receive light and transmit it to the brain to produce images of this perceived world.

[227] See http://www.nlm.nih.gov/medlineplus/ency/article/000824.htm Downloaded December 4, 2012.
[228] See http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001827/ Downloaded May 16, 2011.

7.1.4 Artificial Lens

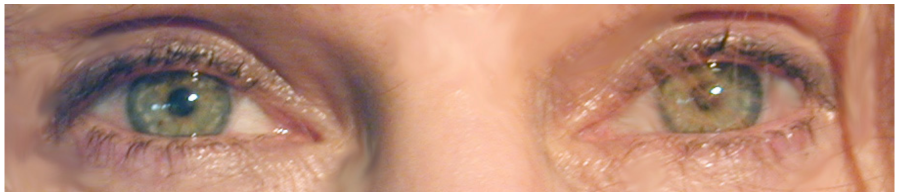


Figure 21: “Artificial Lens” 2011 © Natasha Vita-More.

Description

“Artificial Lens” is a poetic narrative in which the author’s gaze weakens as she struggles to see printed words on pages, street signs, bottles, and labels. Letters become bothersome and email becomes rushed with little attention to typographical correctness. She knows what she wants to say, but the letters become a nagging reminder that she cannot see them clearly. The brain’s memory attempts to recreate from its resources what could have or might have been written in the past to suffice what she tries to see, but as the eyes grasp helplessly at discerning the printed text accurately, the mind also weakens to the point that she begins to avoid reading altogether.

Symptoms: blurred vision, sensitivity to light, glare.

Diagnosis: cataracts in the right and left crystalline lenses of the eyes.

Author’s Intervention: consulted with several eye specialists.

Medical Science Intervention: eye surgery to augment the right and left eyes with artificial intraocular lens implants (IOL).These are clear, flexible lenses that replace the natural lenses of the eye. The right eye receives the ReSTOR® implant and the left eye received a standard implant.

Observations: the ReSTOR® artificial lens implanted in the right eye was not successful in that sight was not returned to normal, but a subnormal state. The subnormal states is one in which halos, glare and concentric circles appear around bright lights and can cause a distortion in the visual field. According to Dr. Tom Walters at Texan Eye, this type of fracturing of light occurs in 10 percent of individuals with lens implants. At the present time there is no feasible resolution to this problem. According to Dr. Lisa McIntire of Mann Eye Institute, removing an implanted artificial lens could result in retinal dysplasia, a serious eye condition, with a five percent chance of this occurring.[229]

The aforementioned works pertain to the degeneration of biological cells and artistic interventions that employ available technologies to repair and return the cells to a normal state of functioning. This next subsection addresses possible approaches to assessing the biological script or predetermined map for biological processes that can, and often do, cause disease, aging and death.

7.1.5 DNA breakout

Figure 22: "DNA Breakout" 2009 © Natasha Vita-More.

Description

"DNA Breakout" is a visual metaphor that bares the physical body to the fundamental component that forms it and keeps it alive—DNA. This piece speaks to the narrative of

[229] The author met with Dr. Tom Walters to discuss issues of glare and concentric circles on June 18, 2010 and with Dr. McIntire about removing the faulty artificial lens on July 14, 2011.

DNA's biological coding that preordains, for the most part, who we become in our physicality. There are times when the codes go awry, mutate and cause aspects of the body to deteriorate. From Biblical times, pouring salt over the left was believed to dispel evil. In this artwork story, it is the act of pouring river water over the right shoulder that should cause the angel—the guardian of life—to transmutate. Like a river, the rhythmic flow of life runs deeply into the future anew. "DNA Breakout" is the prelude to the author's 23andme sampling.

The DNA testing is the sampling genotype hundreds of thousands of single-nucleotide polymorphism (SNP) or snips. The maps of snips will aid the 23andme scientists to identify the multiple genes most likely associated with diseases such as cancer, diabetes, vascular disease, and some forms of mental illness. The process for testing begins with filling a tube with human spit, which is then returned to a certified Clinical Laboratory Improvement Amendments (CLIA) location and processed, which takes between six and eight weeks (see fig. 25).

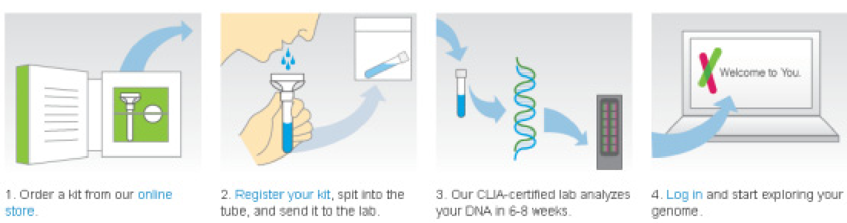


Figure 23: "Guide for collecting specimen" 2012 (Credit: Personal Genome Services®).

Author's Intervention: Register for kit and complete sampling, take sample, and send off sample.

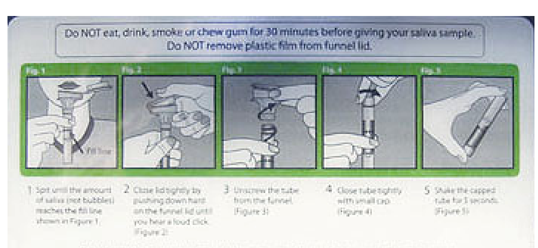
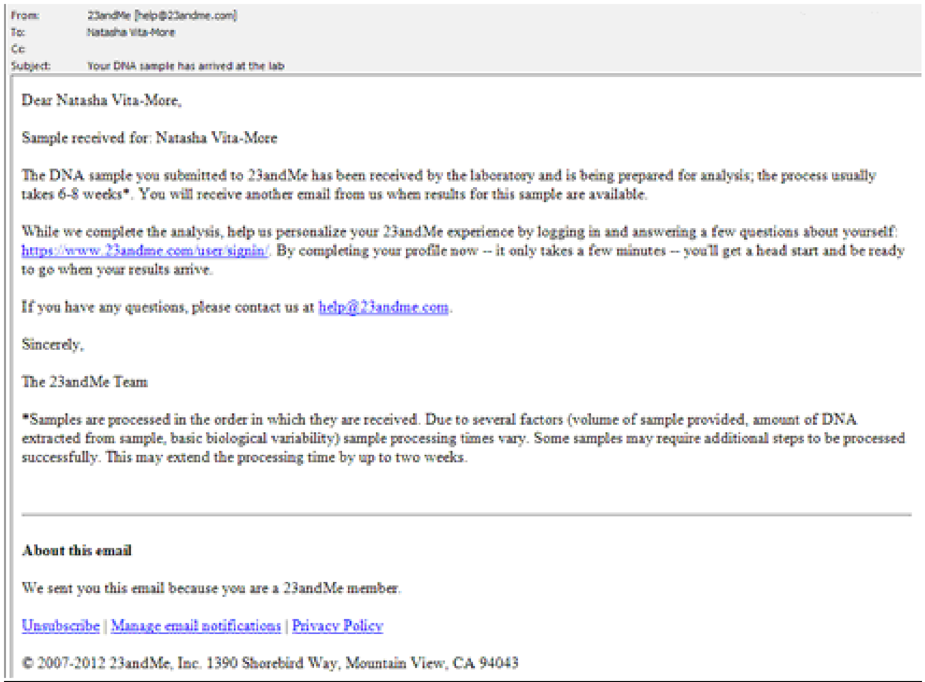


Figure 24: "Inside of actual specimen kit" 2012.

Science Intervention: Examine sample and create snip map.



From: 23andMe [help@23andme.com]
To: Natasha Vita-More
Cc:
Subject: Your DNA sample has arrived at the lab

Dear Natasha Vita-More,

Sample received for: Natasha Vita-More

The DNA sample you submitted to 23andMe has been received by the laboratory and is being prepared for analysis; the process usually takes 6-8 weeks*. You will receive another email from us when results for this sample are available.

While we complete the analysis, help us personalize your 23andMe experience by logging in and answering a few questions about yourself: https://www.23andme.com/user/signin/. By completing your profile now -- it only takes a few minutes -- you'll get a head start and be ready to go when your results arrive.

If you have any questions, please contact us at help@23andme.com.

Sincerely,

The 23andMe Team

*Samples are processed in the order in which they are received. Due to several factors (volume of sample provided, amount of DNA extracted from sample, basic biological variability) sample processing times vary. Some samples may require additional steps to be processed successfully. This may extend the processing time by up to two weeks.

About this email

We sent you this email because you are a 23andMe member.

Unsubscribe | Manage email notifications | Privacy Policy

© 2007-2012 23andMe, Inc. 1390 Shorebird Way, Mountain View, CA 94043

Figure 25: "Email exchange" 2012 © Natasha Vita-More.

Observations: Selected results:

Figure 26: "Genetic Data" 2012 © Natasha Vita-More.

7.1.6 Brain Plasticity

Figure 27: “MRI Scan” 2012 © Natasha Vita-More.

> Brain plasticity refers to the brain’s lifelong capacity for physical and functional change; it is this capacity that enables experience to induce learning throughout life. Research in this field has demonstrated that the adult brain continuously adapts to disproportionately represent relevant sensory stimuli and behavioral outputs with well coordinated populations of neurons. This adaptation is achieved by engaging competitive processes in brain networks that refine the selective representations of sensory inputs or motor actions, typically resulting in increased strengths of cortical resources devoted to, and enhanced representational fidelity of, the learned stimulus or behavior (Mahncke, Connor & Appelman 2006).[230]

Description

“Brain Plasticity” is an artistic work where the author attempts to resolve issues with balance that resulted from vertigo. For a dancer, balance is crucial and the core of the body, meaning the abdominal section, must be strong because it holds the center of the body upright and movements from the arms and legs stem from this core. When an infection occurs within the inner ear or within the brain, balance can be affected. The relationship

[230] See http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1526649/#b7 Downloaded May 18, 2011.

between brain plasticity and balance can be found in the ways in which one adapts to physical and cognitive capabilities.

Figure 28: "Texting at Neurosensory Clinic" 2011 © Natasha Vita-More.

Symptoms: Sudden extreme dizziness and nausea; lack of concentration, aproxia and slight dyslexia.

Diagnosis: Vertigo caused by either an inner ear infection of inflammation in the brain.

Author's Intervention: dancing, yoga, Pilates, and downhill skiing for physical flexibility and concentration; acquiring new intellectual skills and meditation for cognitive plasticity.

Medical Science Intervention: brain scans and balance, allergy, hearing, and concentration testing. According to Dr. Kendal Stewart, founder of the NeuroSensory Centers of America:

> In the past, neurological symptoms (such as dizziness, vertigo, pain, tingling, numbness, etc.) were impossible for physicians to see, leaving the doctor using his best educated guess in treating these disorders. … The NeuroSensory Center's™ evaluation is different. The NeuroSensory Center is a state-of-the-art facility specifically designed to provide the most complete diagnostic evaluation of the nervous system available. This center is equipped with Sensory View™, a breakthrough diagnostic system that provides a complete array of non-invasive tests.[231]

According to Stewart, vertigo can be caused by neurological inflammation and to

[231] Based on the writings and work of Dr. Stewart. See http://www.neurosensorycenters.com/patient/dizziness_vertigo.html Downloaded September 23, 2011.

counter this, he prescribed amantadine, which is used to treat and prevent infections caused by the influenza A virus, and acyclovir, which is used to heal viruses that have remained in the body after bouts with chickenpox or shingles. Non-prescription compounded therapy includes neurotransmitter support with optimal methylation and dopamine processing support formula, mitochondrial support to help restore the decline of mitochondrial function associated with methylation deficiencies, and neuro-immune topical cream which contains active significant levels of B12 for normal methylation support. DNA methylation is important for epigenetic mechanism that cells use to control gene expression.[232]

Observations: Stewart's aim is to resolve symptom-based issues, such as vertigo, that could be the result of immune system disorders or neurological issues. These issues do not have to be life threatening to be significant because they cause inflammation in the body, which is considered to be associated with many diseases, including cancer and coronary disorders.

This next subsection turns to artistic, design-based approaches if and when advances in nanorobots and AGI become available.

7.1.7 Lifenaut: Mindfile

Description

The Mindfile[233] is a digital memory vault where persons uploads aspects of their lives into files that are preserved in cyberspace. These files can interact with one another. For example, uploading a video clip of one's childhood as well as a series of family photographs can be formed into a network representing an historical timeline of the individual's visual life. Documents can also be uploaded, such as birth certificates, love

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[232] Dr. Stewart talks about methylation in a video clip on the web at http://thestradtnerfamily.com/findingournewnormal/?p=436 Downloaded March 3, 2011.
[233] See //www.lifenaut.com Downloaded January 6, 2012.

letters, parking tickets, resumes, etc. that constitute essentially a digital portrait of the person's life. The files are organized by linking emotions and feelings to the images and texts. For example, an image of one's dog could reflect feelings of companionship and happiness, or an image of one's mother might reflect stability and thoughts of being pleased (see Fig. 29). The user interfaces with Mindfile through an avatar, a type of "twin or copy of the user" (Rothblatt: See Appendix 2).

The avatar copy of the user is built by uploading an image resembling a portrait and following the directions of the instructions avatar. For example, moving the 'x' symbol to the corners of the eyes, and the mouth and to the bottom of the chin allows this new copy of the user to blink, smile and talk (see Fig. 28). Voice is currently based on two options: male and female. The discussion between the individual and the copy avatar develops over time, based on the amount of digital memory files the user uploads and the connections between them. More advanced stages of Mindfile will be based on artificial intelligence (Rothblatt: See Appendix 2).

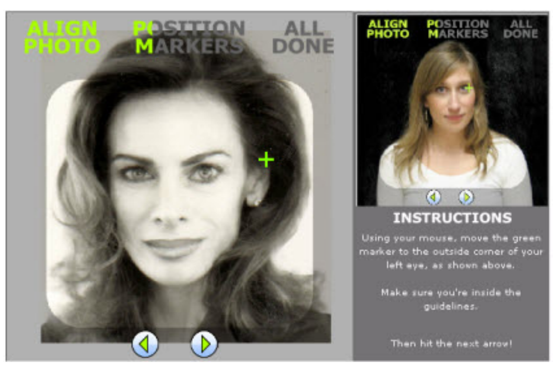


Figure 29: "Screen shot of Mindfile Avatar" 2012 © Natasha Vita-More.

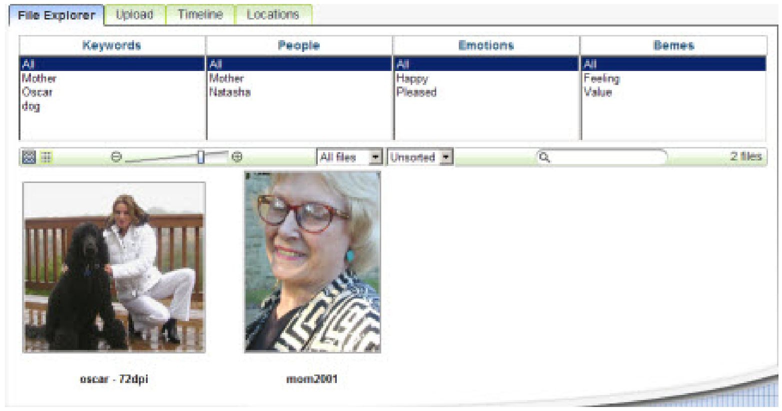


Figure 30: “Screen shot of adding digital data” 2012 © Natasha Vita-More.

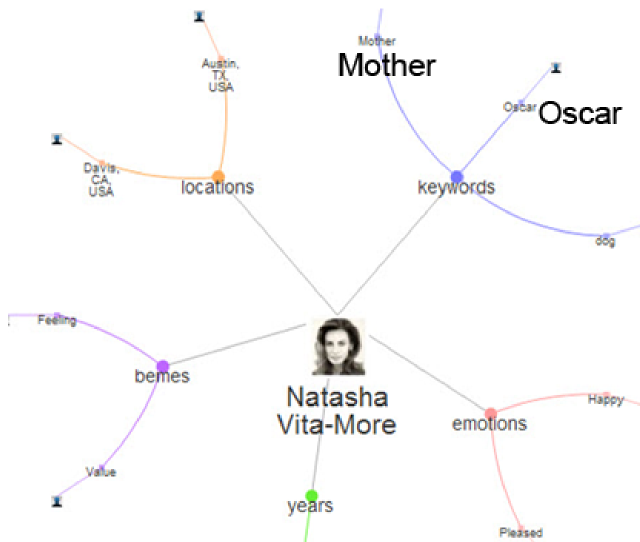


Figure 31: “Mapping personal data” 2012 © Natasha Vita-More.

The idea of Mindfile is to begin preserving aspects of oneself as a type of virtual storage. The aim of Mindfile is to work cohesively with NBIC+ to develop ways in which a person can be *backed up*. This project is a relevant example of a venture that seeks ways in which a person could be uploaded (i.e., whole brain emulation and/or substrate-independent mind) into a cybernetic system. The project begins to address questions about what types of artistic, design-based approaches might engage life expansion. Mindfile is one such approach that offers possibilities for furthering its scope into the realm of arts and design. For example, the designs of avatars in Second Life are unique, with numerous styles, colors, shapes and virtual appendages, and, with artistic vision, could also be applied to the Mindfile user's avatar.

Further, the idea of Mindfile directly links to the technology of cryonics. One of the central issues with cryonics is protecting the brain's neurological system from damage of vitrification and radically lowering the brain's temperature. Whether or not cryonics is successful in the future, having a backup of the brain and its memory could be crucial for life expansion.

7.1.8 Cryonics

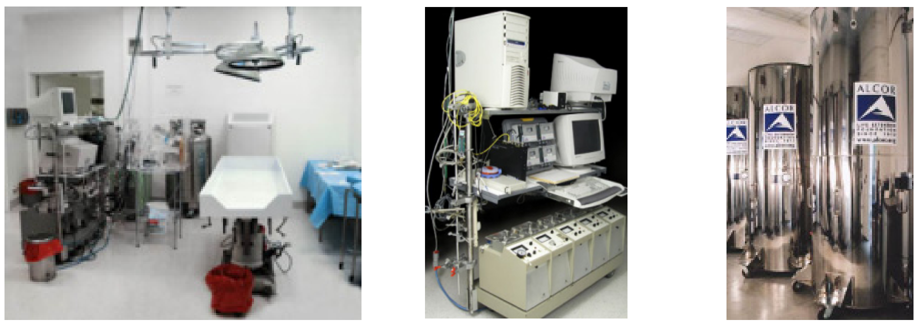
Figure 32: "Field Study Alcor Life Extension Foundation" © Natasha Vita-More, 2011.

Description

"Neuro Suspension" is a future work that documents the cryonic suspension of the author's brain. Cryonics means vitrification of the whole body preservation or neuropreservation of a person in liquid nitrogen for the purposes of preserving that person at a constant state of suspension until technology is available to reverse the disease which caused death and ultimately to restore the person to health. For neurospensendees, it is just the brain that is suspended in liquid nitrogen. Additionally, a prosthetic body would be used instead of a biological one if and when the person is reanimated.

Author's Intervention: The author signed up for cryonics in 1991 and visited the Alcor Life Extension facilities in 2011 as part of the dissertation's thesis field study (see

Appendix 2). The artistic, design-based approach is conceptual because it refers to the speculative technologies of ESM and proposes a future scenario for the combined approaches of nanorobots and artificial general intelligence. It is plausible that new areas could open up that more directly engage life extension, such as the regenerative media of cryonics, a process by which the human patient, whole-body or neuro, is vitrified in liquid nitrogen, below -120°C, and other possible future directions that would emerge within the domain of life expansion.



Operating room to perform profusion — Perfusion system — Dewers

Figure 33: "Alcor Facilities" (Credit: Alcor Life Extension Foundation).

<u>Observations</u>: The author's field study includes traveling to Alcor Life Extension Foundation to observe the preparation, surgical and storage facility of cryonics patients. The author spoke to Dr. Mike Perry, care services manager, about issues concerning freezing a patient and the process of vitrification. Rather than using the term *freezing*, which is not the process by which a cell or organism is cryogenically preserved, "[v]itrification is preservation at extremely low temperatures without freezing. According to Fahy, "[f]reezing involves ice crystal formation, which damages delicate structures such as blood vessels. Alternatively, the process of vitrification involves the formation of a glassy or amorphous solid state which, unlike freezing, is not intrinsically damaging even to the most complicated of living systems (See Fahy: Appendix 2). Perry explained that

when “the patent is taken to -196 centigrade (i.e., freezing is 0 centigrade) the patient is not frozen, he is vitrified” (Perry: 2011):

> The reason is that the patient is vitrified and not frozen is because freezing implies that a liquid turns to a solid and ice crystals. Vitrification is the result of a cryoprotectant that protect the integrity of the cell structure because the cryoprotectant allows the scientists to cool the patient down at a slower rate at the glass transition point, which is the point where large scale cracks in the body or brain tissues could occur in the preservation. Thus, the crucial area for the cryonics process in regards to protecting the cells is the cryoprotectant. Cryoprotectants are measured by effectiveness in preventing ice accumulation and toxicity. Very effective cryoprotectants protect against ice damage, but have a level of toxicity. Toxicity can disrupt cells. We want to minimize damage done. One the one hand Alcor wants to eliminate the damage of cell crystallization and on the other it wants to use a cryoprotectant that has a low level of toxicity caused by the cryoprotectant. The current state-of-the-art cryoprotectant is designed by 21st Century Medicine, called M22 (Perry: See Appendix 2).

Although this study’s observations did not include a cryonics procedure (as that can only occur when a person is pronounced dead and transported to Alcor for suspension). Another issue which became clear while observing in the operating room is the urgency of getting a patient cooled to the proper temperature. After death, the immediate first hours are vital. Within an hour ischemia sets in, and in 24 hours of ice, the amount of damage done by carrying a patient from the facility occurs in rapid initial cooling. Thus, technology is not the only measure for a successful suspension. What is vital is the amount of time from when a person is pronounced dead to the point when cooling down 10 (or 20) degrees from normal body temperature. The timeframe will improve or deter the patient’s conditions. (Perry: See Appendix 2).

Figure 34: “Cryonics Bracelet” 1991 © Natasha Vita-More.

The author signed up for cryonics in 1991 as a neurosuspension[234] candidate, meaning that if and when death occurs, the brain then would be suspended in liquid nitrogen until the technology becomes available for reanimation, a term used for return at patient to animated life. There is controversy about whether neurosupension or a whole body suspension is more advantageous for reanimating a patient. If the whole body is suspended, then there is additional biological information available to the reanimated person. Because the body is a network of biological systems, it is possible that information contained in all areas of the body are consequential to the future person (i.e., continuous personhood). This is an issue that has yet to be resolved because, to date, no human cryonics patient has been reanimated. However, if cryonics does succeed—and this, indeed, would be an extraordinarily unexpected but desired achievement—neurosuspendees will need a body prosthetic. The author designed "Primo Posthuman" with this in mind. The field of prosthetics has grown immeasurably over the past few decades by including artificial intelligence technology and robotics. It is possible that in the future building prosthetic bodies might become a new domain of interest for artistic, design-based approaches to life expansion.

[234] Neurosuspension means that the cryopreservation of a person would be only of the brain.

7.2 Speculation on ESM: Affordance Theory

Figure 35: “Whole Body Prosthetic” 2011 © Natasha Vita-More.

> The word ‘affordance’ was originally invented by the perceptual psychologist J. J. Gibson (1977, 1979) to refer to the actionable properties between the world and an actor (a person or animal). To Gibson, affordances are a relationship. They are a part of nature: they do not have to be visible, known, or desirable. Some affordances are yet to be discovered. Some are dangerous. I suspect that none of us know all the affordances of even everyday objects (Norman 2002).[235]

According to James J. Gibson, first the environment in which one exists must be described, because “what there is to be perceived has to be stipulated before one can even talk about perceiving it” (1986:2). The environment of life expansion is a speculative environment and cannot be fully described or stipulated because such description and stipulation could not be evidence because extending human life and expanding persons over time is a concept which time has not arrived.

This section liberally applies affordance theory to the environment of life expansion (life extension + whole brain emulation) in providing a locus of experience for perceiving what *could* feasibly be presented before us if we apply artistic, design-based approaches to the domain of life expansion in fulfilling a certain mission or calling to preserve or sustain

[235] Don Norman’s essay “Affordances and Design” is located at http://www.jnd.org/dn.mss/affordances_and.html Downloaded June 23, 2011.

life, as long as possible, and morph personal identity onto virtual, synthetic and artificial systems. Here the interest in human enhancement and bodily augmentation offer a variety of artistic, design-based possibilities (see Fig. 34). Whether the potential and outcome of these types of transformative appendages and/or augmentation is known or unknown, the transformative human (i.e., human becoming transhuman / posthuman) is furthered by the acquiescence of emerging and speculative technology (e.g., stemming from HCI and leaning toward regenerative media, nanorobots and AGI) and thereby becomes a prospect which might at some point be realized. This links to the earlier stated objective of a melioristic aim and which takes us into the domain of experience and design, and offers potential for artistic, design-based approaches to fill an opening that may already be perceived or that has yet to be perceived, known, or born.

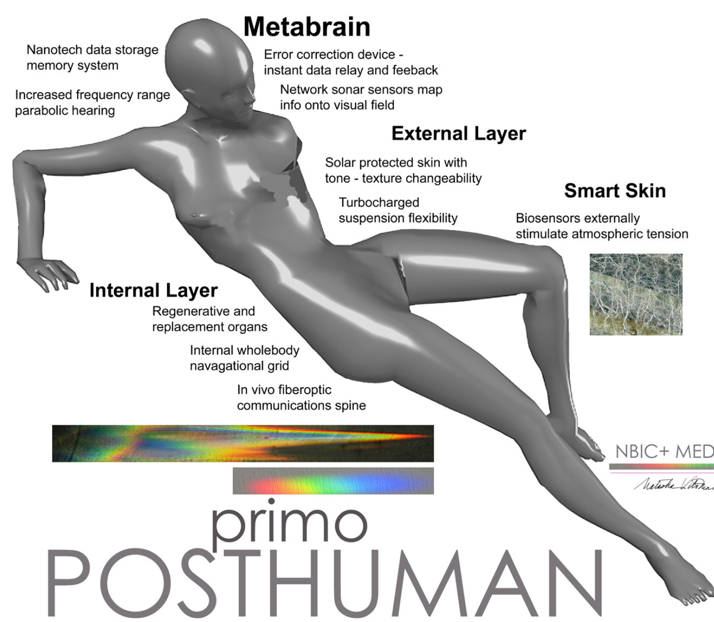


Figure 36: “Primo Posthuman” 1997, 2011 © Natasha Vita-More

From within the system, the author speculates, but not without advantage. This dissertation has attempted to cover an historical account of life expansion and take it into the future where its vision *could* be realized. In order to do this, the author has draw from the investigatory research which performed qualitative investigations of experts of NBIC and related technologies, such as robotics, that link to software that records a person's personal memories, and to cryonics, which aims to develop the technology to potentially return a vitrified person to a state of consciousness. Further the thesis' investigation has asked experts such as Kurzweil, Koene, and Sandberg, to name just a few, about the cognitive sphere of brain computer integration and what aspects of a person must be understood in order to feasibly develop the means to transform and/or copy the brain's functions (including memory) onto nonbiological systems (Goertzel; Koene; Sandberg: see Appendix 2). While the questions were answered with scholarship, it is evident that there is an equal mixture of passion (desire) and skill (feasibility), bringing the topic at hand into a realm worthy of further inquiry. Thus, through this exercise, we have before us an array of conjecture and evidence within domains of biology and technology—and one might wonder if these elements are being used or referred to too loosely and if the hope for life expansion somehow precedes the feasibility of it and if, therefore, there is a logical correlation that one is grabbing at straws, inebriated by their own verve.

The element most obvious to hold onto in this sea of uncertainty is that the science fiction of yesterday has mimetically engineered a narrative for today and we have the opportunity to use it wisely. And in doing so, to sculpt our future in ways that evokes the artistic, design-based wherewithal that has been the driving force of this dissertation and the practicability of its future.

A door opened quietly and she walked into the room
her body smooth, supple
Her shoulders held back, proud—a glimmer in her eye
and without notice she brushes her hair away

'How old are you?' they asked, 'How old are you?'

A hesitation filled her as she quickly assessed,
'My augmentation is three years now—my right hip five
ocular implants just two weeks, age reversal nearly nine.'

She took a sip of water licking the droplets off her lips
her eyes glimmering—hair a shimmering sterling
her outer sheath like mulatto warm bronze

'How old are you?' they asked, 'How old are you?'

And when she turned to leave the room all eyes followed her form
just to realize before she left she was not yet born.[236]

[236] From "The Automorpher" (Vita-More 1999) performed at Electronic Café International, Santa Monica, California.

PART IV

CHAPTER 8: CONCLUSION

8.1 Summary of Findings

During the thesis study, the domain of emerging and speculative technology of human enhancement was reviewed in accordance with the concept of human enhancement as explicitly evoking life extension beyond the current maximum lifespan and, further, seeking to expand life beyond biology. The focus of this research was to contemplate how the concept of life expansion could be situated in the arts and humanities as a viable theoretical inquiry and a practice for artistic, design-based approaches.

In order to embark upon this journey, the author looked back over history to what could be the first attempts to prolong life through the manipulation of chemical matter which directly links to the current speculative attempt to prolong life through the manipulation of molecular matter. This human intervention of moving of matter became the red thread throughout the thesis—the decomposition and regeneration of matter through which transformation results.

Thus, the aim of the research was to investigate an historical inquiry that linked to the notion of life extension (immortality and/or life prolongation) and to follow where the ideas developed in forming what this thesis recognizes as a melioristic aim to use technology to elevate the human condition in which death is expected. The research investigated the appended mortal as having an historical link to the protoscience of alchemy and sought to delineate criteria for death and death's possible futures as having developed out of human's earliest manipulations of matter. With the advent of biotechnology, the human body has been manipulated in ways that have helped to sustain well-being and to delay death. Yet, the human life span has not changed and remains lodged in the chronological time frame of a reported maximum of approximately 122-123 years. Thus, for all the technological advances, the human continues to be programmed by it hereditary genomics. Nevertheless, the era of biotechnology is attempting to change the human's preordained genetic script. Considering the development of nanotechnology, of which the aim is to manipulate and regenerate matter on a nanoscale, and biotechnology, which manipulates matter on a microscopic genomics scale, the prospect is not without potential.

In locating human enhancement as a concept linked to human-computer interaction, the investigation identified cybernetics as a domain in which the appended mortal emerged, including its near-cousin the cyborg and further appendages such as prosthetics and aspects of the human self that have been transformed due, in large part, to digital and telematic expansion of the self and perception. Thus, by focusing on the theories of transmutation of matter and reflecting upon the biochemical process of death and death's possible technological futures, the thesis investigation established the seed of thought from which the analysis emerged, starting with the appended mortal and the transformative body.

As the focal point, the research delineated the emerging and speculative technologies of nanotechnology, biotechnology, information technology and cognitive / neuro science (NBIC) and included robotics, prosthetics and cryonics, forming NBIC+, as additional possibilities to engage human enhancement in a wider conjecture of the transhuman / posthuman as conceptual paradigms for life extension and a framework for artistic, design-based approaches concerned with prolonging human life and sustaining personal identity of the transhuman / posthuman.

The topic of human enhancement in the thesis links to HCI and wearable technology as enhancement that, in ways, extends human capabilities, such as motor activity and communications, but do not attempt to extend human life. The technologies associated with human enhancement begin in the areas of electronic arts and communication arts and gravitate toward interfaces with robotics and virtuality. Biological research and bioarts bring new insights to the arts in terms of manipulating biological matter but stop short of actually engaging the human biology, especially in regards to enhancement that explicitly attempts to extend life. Virtuality offers a different perspective and approach, one that attempts to move one's self or persona outside its biology and onto digital platforms, such as the Metaverse (i.e., Second Life). This domain of design-related avatars and environments dedicated for interplay offer stylish encounters with the user and the avatar. Nevertheless, these encounters do not attempt to extend human life and, further, the avatar is not claiming to be or conditioned to be an alternative, a copy or a twin of its human counterpart (user). Thus, while HCI, wearable technology, digitality, virtuality, robotics, bioart, and avatars have extended human senses, mobility and communication, as well as explored alternative selves of the user, they have not attempted to extend human life.

This is the obvious gap identified in the thesis that the author sought to resolve by first identifying what is missing and then attempting to discover what could provide a means to bridge the gap. In investigating connections between and among inquiry and advances in the sciences, new developments in technology, and artistic works that are building artificial life, digital personae (e.g., avatars), and wearable appendages for communications (i.e., that actually expand perception, including sensorial abilities), it became clear there is currently no work being done in the "arts" that is explicitly engaged in life extension. Although human persons have been expanded in digitality through the technology of the Internet, Second Life, and other interfaces, these persons do not contain the user's cognitive functioning. Establishing links to HCI, wearable technology, body art, performative art and bioart exist outside the sphere of life extension but do in ways that engage the concept of person expansion through virtuality, for example, but not so far as to actually consider the continuous person as a human evolving into the transhuman and posthuman states of existence.

The author determined that the emerging and speculative technologies of nanotechnology, biotechnology, information technology and cognitive and neuroscience (NBIC), along with robotics, prosthetics and cryonics (NBIC+) form the new tools, or media, for artistic, design-based approaches for the field of human enhancement in the specific area of life extension, as it leads to expanding life outside biology. Thus, the central aim of this thesis has been to establish a framework for life expansion as being located in the domain of human enhancement that explicitly pursues extending the maximum human lifespan and expanding personhood beyond biology, and possibly onto computational systems.

The study invites the transhuman as one outcome of the melioristic aim of human enhancement and the posthuman as a proposed outcome of the continuation of personal identity in computational system, or what this thesis refers to as the continuous person.

Research Question: The thesis asked: What are the required conditions that enable artistic, design-based approaches to human enhancement that explicitly pursue extending human life?

In working toward the objectives of the research investigation, the author identified and interviewed experts of the research's proposed emerging and speculative technologies (NBIC). The author also traveled to four laboratories to ascertain how life could be extended through the application of biotechnology, how cellular damage could be reversed based on nanomedicine, and how the human brain's functions could be copied and/or transferred onto computational systems. The author then applied this knowledge to possible approaches within the realms of arts and design and determined, that the emerging and speculative media (ESM) of regenerative media, nanorobots, and artificial general intelligence (RNA) are the most likely and appropriate media for such artistic, design-based approaches addressing the challenges of life extension and the ultimate expansion of personhood onto systems of unprecedented development.

8.2 Methodological Aspects

The methodological approach engendered a qualitative investigation that formed a triad strategy that included interviews, field, and an autopoietic artistic, design-based approach. First, the author interviewed 21 experts of emerging and speculative technologies, and nine artists and designers of robotics, wearable technology, body art and bioart. Second, the author conducted field studies at the biotechnology laboratories of BioTime, SENS, Halcyon Molecular and Alcor Life Extension Foundation. Third, the study engaged an autopoietic, artistic, design-based approach of the author's own biological body for the purposes of intervening with bodily degeneration.

8.2.1 Implications of Findings

The study has situated the thesis within the understanding that the human desire to live longer and to ameliorate disease is a deeply rooted historical one. Thus, the acceleration and convergence of emerging and speculative technologies (NBIC) stands to further this desire and achieve feasibility. The tools used by scientists and the technologies to realize this aim are many of the same tools used by artists, including human-computer interaction, robotics, and biotechnology, for example, and the research and development within the sphere of NBIC is focused on leading toward extending human life well beyond its biological limits. Additionally, one could suggest that because artists and designers use some of the same tools that designers also would form interest in life extension and expanded personhood in relationship to product design for whole body prosthetics, for example.

The artistic, design-based approaches must include the ideas, theories and practical approaches presented in this thesis study for the single reason that they are no longer just theories and this study has identified works that accomplish this. However, as previously noted, there is an identifiable gap within the arts and humanities where artistic, design-based approaches to human enhancement of life extension and the prospect for life expansion appear to have been neglected, and weakly discussed, and then mostly to discourage than encourage. Thus, the challenge remains, as Roy Ascott puts it, to "maintain artistic and ethical integrity at the progressive edge of our various fields" (2006). The author perceives a "progressive edge" in her field as being that of extending and expanding human life and notably the requisite for artistic and ethical integrity, as duly noted by Ascott. From the theory-building perspective, this becomes a matter of determining if we have been asking the right questions to give an understanding of the transhuman and posthuman their due credence and legitimacy. This propels the Ascott's question into the core of this thesis, which in turn brings this concept of life expansion out into the open and for others to acknowledge that we have entered the terrain of possibility and probability and, thus, we are now into formative stages of a long-term paradigm shift as suggested in this thesis.

If the field of human enhancement engages the proposition of life extension, and also life expansion, then the arts and humanities will need to be more informed than they currently are about the human capacity to unfix itself from its biology. Thus, there will be the need to redefine death to meet new criteria as technology continues to intervene with the determinants of death. In order to fully comprehend the concept of life extension and the expansion of persons onto nonbiological systems, deeper inquiry into what elements of life are worth regenerating must be addressed. One must consider the dialectics of embodiment vs. disembodiment in determining the viability of the argument that if a person is to exist—the person must have some kind of a body, whether it is biological, semi- or nonbiological.

The transdisciplinary environment of art and science requires that artists and scientists often use the same tools. Thus, one can objectify the possibilities of regenerative media, nanorobots and artificial general intelligence (RNA) for artistic, design-based approaches in seeking the transhuman / posthuman.

The incremental findings of the study challenge the current postmodernist discourse across the arts and humanities and the sciences and, although it is highly improbable that we will achieve the posthuman status in our lifetimes, the discourse must include both a clinical and artistic contemporary merit. We must now contemplate the implications of life extension and expansion in relation to postmodernist discourse on the corporeal language of the body and the language of the social engineering of culture and its many subcultures. What must be reconciled, and how do we go about reconciling the obvious and hidden problems within this current and pending discourse? For example, do we accept the dystopic postmodern view of progress or do we move forward in our evolution in becoming transhuman / posthuman with a sense of responsibility and efficacy?

The artist has an opportunity to participant in steering the course forward, which is neither entirely melancholy nor high-spirited, and challenge categorizations of hegemonic nature that sequester us to one or the other under the dictum of a dystopic gloom.

8.2.2 Limitations of Findings

Some of the limitation of the author's perception can be seen through her enthusiasm about regenerative media, life extension and designing whole body prosthetics to the point of subjectivity. This has its benefits, in that it propelled the enthusiasm and commitment to this thesis and its research. However, it also became a noticeable interference in trying to work against a subjective tone, and taking a concerted effort to resolve.

The most obvious limitation is that the environment of life expansion is unknown—no one has yet to live beyond 122-123 years, no one has been uploaded into computational systems, and no one has been reanimated from cryonic suspension. These facts could cast doubts on the integrity of the thesis and its study. However, the field study's empirical approach help to authenticate research, minus patent pending projects that yet would add more viability to this study, but obviously could be included presently because of proprietary concerns. As such, an objective limitation that limited possible findings of the thesis study was the matter of privacy concerning projects that were locked in highly sensitive legal status primarily because of intellectual property and patent rights concerns.

Lastly and perhaps most significantly, the contested culture in which the topic of human enhancement resides is one which seeks a socio-political reconciliation of the precautionary gaze onto humans modifying themselves to improve their nature. The author argues for morphological freedom, but deeply understands and empathizes with ethical issues that must be engaged in order to protect the rights of anyone who selects not to enhance while allowing a freedom of choice to anyone who moves forward with the decision. This is a highly significant opening for future research.

8.2.3 Original Contribution to Knowledge

In summary, human enhancement can be seen as leading toward life extension and the expansion of the continuous person onto computational systems. The original knowledge then arises from a different and, perhaps, new interpretation of the postmodernist orientation within the arts and humanities. The transhuman / posthuman, as approached in this thesis, proposes that we can legitimately liberate ourselves from some of the inevitable limitations people and society commonly expect. The thesis has laid out the case for propelling this inquiry forward and in the open. This now becomes the theoretical proposition that drives future lines of research and inquiry.

The knowledge proposes that the most appropriate tools for artistic, design-based approach to this domain are the emerging and speculative media (ESM) in which regenerative media, nanorobots, and artificial general intelligence (RNA) are located. This knowledge is arrived at through the assessment and analysis of the qualitative, empirical research arrived at though interviewing experts in these fields and travelling to their laboratories.

8.3 Future Directions and Further Research

Human enhancement, life extension and life expansion have been the focus of this research, which has interconnected numerous issues that surround this theme. The thesis presented a study that provides a theoretical model for theory and practice that evokes further development, steering toward a new field of research engaging the domain of life expansion and new approaches to the transhuman and posthuman. In doing so, this thesis has paved the way for continued research that seeks to prolong life and to expand persons outside biology and explore many of the technologies that the thesis investigated that are in the research and development stages.

For example, the issue of memory is highly consequential to life expansion and further research to adequately navigate the interrelationship of the body, brain, and mind would require inquiry into neuroscience, cognitive science, psychology and many other physiological disciplines that are outside the scope of this thesis but do need to be addressed in subsequent research. Further, the issue of whole body prosthetics is valuable to the scope of life expansion and although the author's "Primo Posthuman" has yet to be actualized, it is one artistic-design based project that is transdisciplinary in scope and can be seen as a viable concept to develop further.

As time goes forward, the technologies revealed in this thesis will inevitably be available for artistic pursuits. If, on the other hand, socio-political conflicts arise and there is a forestalling of advances of regenerative medicine, nanomedicine and artificial general intelligence, then this thesis has at least set in motion the issues as they present themselves today in hopes that further research will elaborate upon in more detail at a later date.

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“Human Enhancement & Nanotechnology Conference” at Western Michigan Univ., 2009.
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“Human Enhancement Technologies: The Role of Art and Design”, 2008.
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APPENDIX 1

AUTHOR'S INFORMATION

Selected Publications

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"Extended Minds" in Sistemi Intelligenti. Bologna, Italy: Il Mulino Publishing House. 2012.

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2011

"Human Enhancement: Co-Evolving with the Brain -transformative (conceptual/actual/critical) media" in BEYOND DARWIN: the co-evolutionary path of art, technology and consciousness. Ed. María Gómez-Lechón. Valencia, Spain: SALA PARPALLÓ Diputación de Valencia. 2011.

"Zone of Life Expansion" in AI Society, Issue on "Biotopia". Heidelberg: Springer. 2011.

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"Zone of Life Prolongation" in Technoetic Arts - A Journal of Speculative Research. Bristol, UK: Intellect Ltd.

"Bringing Arts/Sciences and Design into the Discussion of Transhumanism" in Transhumanism and Its Critics. Philadelphia: Metanexus Institute. Chapter 4, pp. 79-96.

"Aesthetics of the radically enhanced human" in Technoetic Arts: a Journal of Speculative Research. Bristol, UK: Intellect. Vol. 8, Issue 2. Nov. 2010. pp. 207-214.

"Life Prolongation: Tools and Consequences" in Nanotechnology Now. Online 7thWave, Inc.

"We are Strong: Only Insofar As We Take Advantage of Our Innate Abilities and Build Smarter Tools" in Nanotechnology Now. Online 7thWave, Inc.

"Zone of Life Prolongation" in *BIOTOPIA* (Eds. Morten Søndergaard and Victoria Vesna), New York: Springer Verlag.

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"Transhuman Statement" in ARTISTS' MANIFESTOS, New York: Penguin Modern Classics.

"The Aesthetics of Transhumanism in TIF English Journal. Institute of Media Arts, Yonsei University.

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"Designing Human 2.0 — Regenerative Existence". Volume 3, Pub. Routledge.

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"Nanomechatronics Nanosystem and Mitochondria Symbiosis" in Nanotechnology Now. Sept, 23. http://www.nanotech-now.com/columns/?article=236

"Putting Criticism Forward" in Nanotechnology Now. April 10. http://www.nanotech-now.com/columns/?article=187

"Nanofactory or AGI — Which technology could cure humanity's many problems"? in Nanotechnology Now. Jan 24. http://www.nanotech-now.com/columns/?article=164

2007

"Posthuman - Putting Transhumanist Perspective into Contrasting Theories" in Nanotechnology Now. Aug 2. http://www.nanotech-now.com/columns/?article=090

"Brave BioArt 2: Shedding the Bio, Amassing the Nano, and Cultivating Posthuman Life." in Technoetic Arts: A Journal of Speculative Research. Volume 5.3, pp. 71-86, London: Intellect, Inc.

2006

"Strategic Sustainable Brain". Nanotechnology Perceptions: A Review of Ultraprecision Engineering and Nanotechnology, Volume 2, No. 1, March 27. Collegium Basilea, Pub. Institute of Advanced Study, Basel, Switzerland.

"The Perfecting of Man" in AnOtherMan, Issue 3, Autumn/Winter.

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2011

"Human Enhancement: Co-Evolving with the Brain -transformative (conceptual/actual/critical) media" in BEYOND DARWIN: the co-evolutionary path of art, technology and consciousness. Ed. María Gómez-Lechón. Valencia, Spain: SALA PARPALLÓ Diputación de Valencia.

"Zone of Life Expansion" in AI Society, Issue on "Biotopia". Heidelberg: Springer.

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2010

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2009

Atkinson, Michael. Beyond the Masculinities Crisis. Washington, DC: American Philosophical Association.

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Moura, Leonal. (Ed.) “Human Enhancement to the Extreme: A New Role for Art and Its Media” in INSIDE [arte e siencia], Editoria LxK> Pub. Impressao Europress, pp 312-217.

Bulatov, Dmitry. (Ed.) Evolution Haute Couture, art and science in the post-biological age, “Bone Density”, Kaliningrade: KB NCCA pp 64-65.

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Coulombe, Maxime. Imaginer le Posthumain, Sociologie de l’art et archelogie d’un vertige. Quebec. Canada: Les Presses de L’Universiete Laval.

Conference Papers / Presentations

2012

“Design Options” at Human Design or Evolution? Aalto University, Helsinki. Jan 28- Feb 2.

“Hi Tel Aviv! Radical” at Radical Life Extension Festival. (filmed talk) Tel Aviv. Jan 16.

2011

“The Arts and Human Forms” at Extreme Futurist Festival, Los Angeles. Dec 18.

“Life Expansion Project” at Humanity+ Conference, Polytechnic University, Hong Kong. Dec 3-4.

“Life Expansion” at Maison de la Recherche, Sorbonne University, Paris. June 16.

“Rewire Conference – Leonardo magazine. FACT, Liverpool, UK. Sept 30- Oct 2.

“Human+” at Human+ Science Gallery, Dublin. June 6.

“Designing Substrate-Independent Minds” at the Humanity+ Conference at Parsons The New School for Design” in New York, New York. May 15-16.

“Emerging Transmortal Designs for Wearable Selves” at Exploring Human Enhancement: A Symposium, The Center for Values in Medicine, Science, and Technology. University of Texas, Dallas. April 8-9.

“The Singularity: Humanity’s Huge Techno Challenge”, SXSWi Music + Film, Austin, Texas. March 13.

2010

“Emerging Designs of Wearable Selves” at the Humanity+ Conference at California Institute of Technology in Pasadena, California.

“The Expectant Automorpher” at the TransVision Conference in Milan, Italy.

“Zone of Life Prolongation” at the BIOTOPIA SYMPOSIUM - PORT 20:10 International Conference in Aalborg, Denmark.

“Human Enhancement Technologies: Mejoramiento de Calidad de Vida en Latinoamérica a través de Nanotecnología” at the Nanotechnology & Mechatronics International Forum in Cartagena, Colombia.

“Human Enhancement: Technological Singularity and Transhumanism” keynote at GOGBOT Festival in Enschede, Netherlands.

2009

“Interconnected Significance: Human Enhancement and Radical Life Extension” RE:live Media Art History Conference, Melbourne, Australia Nov 26-29.

“The Sciences and Technologies of Human Enhancement” Super Human Conference, Melbourne, Australia Nov 21-23.

"Design Aesthetics of the Radically Enhanced Human" 10th Annual Planetary Collegium International Research Conference, University of Applied Sciences, Munich, Germany Nov 19-21.

"Human Enhancement to the Extreme: A New Role for Art and Its Media" [INSIDE] art and science, Lisbon, Portugal Oct 10

"An Optimal Neo-Normal", AND Conference, Liverpool, UK Sept 26-27.

"Transhumanist Aesthetics" Metanexus Institute Annual Conference, Tempe, Arizona July 18-19.

"Design Issues Concerning Extreme Life Extension" American Philosophical Association, Annual Meeting, Vancouver, British Columbia April 10-12.

"Human Futures on the BRINC" Associate of Professional Futurists Meeting, Pasadena College of Art and Design, Pasadena, CA March 20-21.

"Human Enhancement of Extreme Life: Co-Evolving on the BRINC, Beyond Darwin Conference, Sala Parpallo, April 19-29.

"Morphological Freedom" Stand-Up for Human Rights Conference, Pozan, Poland. Feb 26.

2008

"Hybrids" Trondheim Matchmaking 2008 - Annual Festival for Arts and Technology. Trondheim, Norway 16-18 October.

"The Law of Intended Consequences: Designing Possible Futures" The First Conference on Artificial General Intelligence Workshop on the Sociocultural, Ethical and Futurological Implications of AGI, FedEx Institute of Technology, University of Memphis, in cooperation with AAAI, March 1-3.

2007

"Human 2.0 DESIGN how biotechnology, generative media, and other currents are changing creative inquiry in the arts & sciences" Pecci Museum, Contemporary Art Center, Prado, Italy.

"Brave biological design – how biotechnology, generative media, and other currents are changing creative inquiry in the arts & sciences" The Third SENS Conference: "Strategies for Engineered Negligible Senescence" Queens' College, Cambridge University, England, 6-10 September.

"Brave BioArt 2: shedding the bio, amassing the nano, and cultivating emortal life" Reviewing the Future Conference, Montreal Canada.

"POSTHUMAN – naked and hypermodern" TransVision 2007, Field Museum, Chicago, 24-26 July.

2006

"Skin EXObody" FAQ?, Sao Paulo, Brazil.

"Wisdom through AGI / Neural Macrosensing" TransVision, Helsinki, Finland.

"Wisdom through AGI / Neural Macrosensing" Consciousness Reframed, 8th International Research Conference, Plymouth, UK.

Artistic, Design-Based Work / Exhibitions

2007-2012

"Transhuman", Niet Normal, Beurs van Berlage, Amsterdam.

"Bone Density", Evolution Haute Couture: Art and Science in the Post-Biological Age", Moscow Film Fest

— National Centre for Contemporary Arts, Kaliningrad Russia

"Homo Sapiens Noves evolvere", Second Life

"Primo Posthuman" ZurzweilAI.net

Film, TV, Documentary, Theater

2010

"Bone Density", Evolution Haute Couture: Art and Science in the Post-Biological Age", Moscow

"Bone Density", National Centre for Contemporary Arts, Kaliningrad Russia.

"Human Enhancement". Dissidents, France2. France, Producer: Cecile Denjean.

2007

A Life Eternal (Film Documentary), Les Armateurs S.A.S., Paris France.

Interviews: Related to Research

2012

Smithsonian Magazine "How to Become the Engineers of Our Own Evolution. Available http://www.smithsonianmag.com/science-nature/How-to-Become-the-Engineers-of-Our-Own-Evolution.html

2011

Flaunt Magazine. "Posthumans are People too – Natasha Vita-More" (Dec 2011-Jan 2012). Available: http://flaunt.com/features/118/post-humans-are-people-too-natasha-vita-more

Popular Mechanics. "5 Near-Term Technology Forecasts From Industry Leaders at SXSW". (March 18)

2010

US News "Stem cell wars" (Aug 8)

Techcrunch.tv, "Media, Culture and Technology"

Singularity Weblog, "Profile of Natasha Vita-More"

Dutch Film & Television Academy, "The Singularity"

Le Monde, "Transhuman and Human Enhancement"

Ilabs, Italy, "Ethics and Law of Singularity"

Polytopia ezine, "The Audacious beauty of our future – Natasha Vita-More, and Interview" (Feb 8)

2009

Tomorrow Museum, "Natasha Vita-More and Bruce Sterling at SXSW" 3/9/09.

2008

Memebox "Natasha Vita-More: Transhumanism on the Rise" by (Mar 7) by Venessa Posavec http://memebox.com/futureblogger/show/98-natasha-vita-more-transhumanism-on-the-rise.

The New York Times, "Droid Rage", by Cintra Wilson. (Oct 21).

2007

Nutraceuticals World, "The Anti-Aging Movement" (Sept).

2006

Tin Foil Music, "20 Questions with Natasha Vita-More".

Meme Therapy. "Interview with Natasha".

Neofiles #38, "Interview with Natasha Vita-More" RU Sirius.

MondoGlobo #38, RU Sirus http://www.mondoglobo.net/neofiles/.

Radio

2012

Tel Aviv YouTube Blast: “Radical Life Extension” (Jan 18).

2011

NPR / WNPR “Human Future” Studio 360, NYC. (June)

Silicon Radio, “Natasha Vita-More: future is fun!”, Paris, France (June 17-19).

2010

Today on Beyond Beijing, “Future Society” (Jan 12).

2009

Today on Beyond Beijing, “Future of the Human” (Dec 22)

Hplus Café, “LIVE Chat with Natasha Vita-More” (June 29, 7pm – 8pm).

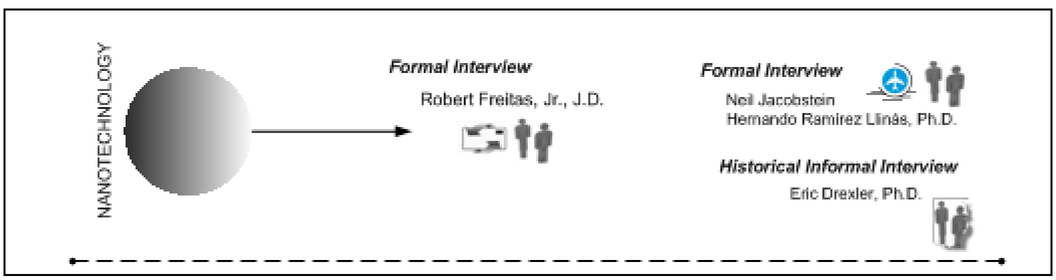
Biota, Visions of the EvoGrid podcast, (June 14, 4:00 pm).

APPENDIX 2

INTERVIEWS WITH EXPERTS OF NBIC
FIELD STUDY
INTERVIEWS WITH BIOARTISTS AND CURATORS

INTERVIEWS WITH EXPERTS OF NBIC

Nanotechnology: Nanomedicine and Nanorobotics



Formal Interview: Robert Freitas

Interviewee	Date	Method
Robert Freitas, Jr.	Tuesday, May 5, 2011	

Robert A. Freitas, Jr., J.D., conceptualized the concept of nanomedicine. Currently, he is Senior Research Fellow at the Institute for Molecular Manufacturing. In the years 2000-2004, he was a Research Scientist at Zyvex Corp. Freitas authored *Nanomedicine* (1999, 2003), the earliest technical book on medical nanorobotics.

> *Have you witnessed a growth in institutions or laboratories that are expressly working with nanotechnology for the purpose of transformative human enhancement, including life extension? If so, are there any recent advances that bring us closer to seeing this realized? If it is just theory, how can it be suggested as a viable technology and best evidence this?*

I'll address your questions in reverse order. First, regarding how to 'best evidence' nanomedicine: The first thing you should note is that nanomedicine is already a thriving field that is well recognized in the mainstream. There are half a dozen academic journals on 'nanomedicine'. In 2005, the National Institute of Health created and well-funded a rather large nanomedicine program with eight nanomedicine centers-of-excellence at universities around the country[237] see the latest manifestation of this program at http://commonfund.nih.gov/nanomedicine/. Thus it is an established fact that 'nanomedicine' is a well-funded and thoroughly mainstream activity.

In fact, I've been collecting data on this phenomenon since 1999 for a recent article that I wrote. It shows the number of hits for 'nanomedicine' on Google (the whole web) and on PubMed (the mainstream medical-specific database), and also the number of PubMed hits on 'nanorobot' over the last 11 years -- all three growing at a Moore's Law rate with a doubling time of 1.1 years for 'nanomedicine' and 1.6 years for 'nanorobot'. As of May 2011 there are 2232 nanomedicine articles on PubMed. So there's no question that the field exists and is being developed.[238]

Most of this 'nanomedicine' effort is concentrated in short-horizon areas that are experimentally accessible today -- e.g., using bionano approaches, self-assembling DNA, functionalized nanoparticles, etc. But there is also growing amounts of work in the nanorobotics area, though again with fairly short time horizons by my standards. Particularly noteworthy are the groups headed by Dinos Mavroidis, Antoine Ferreira, the Martel group in Canada, Nelson's group and a few others. Here's a list of some recent mainstream papers in medical nanorobotics [Attachment Freitas 1]:

For the best and most recent summary of the application of MNT to medicine and aging, you should read my chapter 'Comprehensive Nanorobotic Control of Human Morbidity and Aging', in *The Future of Aging: Pathways to Human Life Extension*.[239] This article concentrates on medical and anti-aging applications of MNT, but the application to human augmentation seems rather obvious.

I would say there has not yet been a significant growth 'in institutions or

[237] http://www.nih.gov/news/pr/oct2006/nei-27.htm
[238] "[BTW, if you'd like to use the chart, please note the copyright and cite it as coming from the following source: Robert A. Freitas Jr., "Diamondoid Nanorobotics," in Dinos Mavroides, Antoine Ferreira, eds., *NanoRobotics: Current Approaches and Techniques*, Springer, New York, 2011. In press.] Of course, I also published the first book in this field in 1999 (http://www.nanomedicine.com) -- it would be cool if you also mentioned that!"
[239] Gregory M. Fahy, Michael D. West, L. Stephen Coles, and Steven B. Harris, eds, Springer, New York, 2010, pp. 685-805; http://www.nanomedicine.com/Papers/Aging.pdf

laboratories that are expressly working with nanotechnology for the purpose of transformative human enhancement,' but this growth has indeed occurred both in nanotechnology and in nanomedicine, in pursuit of more near-term purposes and specific (i.e., disease- or surgery-oriented) applications, but applications to human enhancement will unquestionably follow as the technologies mature."

> *Is it academically difficult to suggest nanotechnology as a method for regenerating the cell structures? Often scholarship is based on what is observable rather than on projections. What do you see as a possible hook to help bring the proposition of nanomedicine deeper into scholastics?*

The simplest method is the classical 'Gentle Seduction' approach described by Steigler in his SF story of the same name. (Aka. 'boiling a frog' or 'camel's nose under the tent'.) You start with something innocuous that anyone would obviously accept, then slowly ratchet upward the level of control afforded to the human physician. In this case, the obvious hook would be to target something that everyone agrees is a harmful flaw in the cell -- e.g., amyloid tangles in neurons that lead to Alzheimer's, genetic diseases ranging from sickle cell to Fragile X syndrome, even cancer -- and offer MNT as a convenient means to reverse these flaws and eliminate human pain, suffering and disease. They will have to buy off on these or be seen as cruel heartless curmudgeons who think 'suffering is good for the soul'. Then you walk them up the ladder of increasing capabilities ever so slowly, making it clear that what remains after each up-step is still 'human', is still 'self', and is demonstrably 'better' than the previous step on any number of various dimensions. If the upslope is gentle enough, you could probably walk people a considerable distance up the mountain before they remembered to look over the edge and finally saw with a shock how high they'd risen! (Sorry for the mixed metaphors...)."

> *Do you find that people use the term "nanotechnology" loosely? If so, how? For example "molecular nanotechnology" vs. molecular manufacturing".*

'Nanotechnology' has now become as generic as 'fridge' and 'burger' in popular parlance. In the technical area, basically all of chemistry and fabricating anything under 100 nm in size has been re-labeled as 'nanotechnology'."

With Foresight Institute becoming less active in recent years (and having been largely re-purposed away from the future by Scott Mize in the mid-2000s and re-positioned most strongly toward near-term nanotech), and with the technical dormancy of Drexler (who left Foresight in a huff a few years ago and now apparently confines himself to writing his generalist blog, promoting self-assembly which is the longest possible path to MNT, and giving a few lectures at obscure venues around the world), it is basically Ralph and I and a few others that are carrying forward on true MNT.

Interestingly, the acronym MNT is now in the process of being co-opted as 'MicroNanoTechnology' by some MEMS/NEMS people, and this is a rather clever move on their part because the earlier references to MNT (our usage, meaning truly atomically precise molecular machinery) are not entirely dissimilar from the new MNT, unlike the rebranding of 'nanotech' into 'chemistry' which was a much bigger leap.

We still use MNT a lot, but we've begun retreating to 'molecular manufacturing' as a process term that has not yet begun to be co-opted, and also to 'atomically precise' (to describe the key characteristic of what we plan to build) which may be harder to co-opt by others).

What are the current ethical concerns about developing nanorobots / nanocytes of nanomedicine?

Again, with the retreat of Foresight Institute (that used to discuss ethical implications of MNT and produced the Foresight Guidelines, a process in which I participated) and the dormancy of CRN (Chris Phoenix appears to have left the nanotech field and is now doing executive coaching for a living), the ethical discussions of the long-horizon applications of MNT have pretty much died down. They will perhaps rekindle in 5-10 years if/when some more striking and demonstrable progress is made on the experimental front in MNT. In the meantime, the ethical discussion on the nano side has largely degenerated into reviews of the biological safety of nanoparticles in the nanotech sector, while the intensity of ethical discussions in the AI area has probably increased. Mainstream people who have heard the various 'killer nanobot' theses probably don't think it's credible or think it's too far off, so aren't willing to think or talk about it a lot. In the human enhancement area, my sense of it is that the current ethical discussions mainly revolve around what biotech, not nanotech, can do -- such as reproductive gender selection, intelligence enhancement (either via pills or genetic modifications), and the like. These discussions invariably almost totally ignore the nanotech angle on this -- either because people either aren't aware of the much larger impact that nanotech will have in this area, or because while understanding the potential huge impact people regard that impact as too far off in the future to worry about. This is not entirely bad, as biotech ethics might serve as excellent training wheels for nanotech ethics. But I do wish there was more discussion of the nanotech side so we could be better prepared.

Even the SF writers are falling down on the job. Every summer I gather the latest crop of nanotech-related SF for my 2-week vacation reading, and over the last several years I've found that there is precious little out there that illustrates likely futures involving MNT in what I'd regard as a reasonable way. The classic is *Diamond Age* (1995), but it is getting a bit old and misses a lot in the medical area since it predates all of my work. (The first half of DA is pretty good but the second half degenerates into implausibility.)

I'd say there are two great technological currents running into the future: AI and nanotech. Everything else is pretty much noise. Most conceivable problems that society has today can be dealt with by one or both of these. Also, of course, both embody great risks.

So, one big question is the relative pacing of the development of these two technologies. Will mature AI or mature nanotech arrive first (and if so, with how big of a lead), or will they arrive together? Nobody knows at this point. The AI people think that by 2030 we can have a human-equivalent intelligence, if the effort is adequately funded. We MNT people -- myself and Ralph, e.g., our Nanofactory Collaboration[240] timeline -- believe we could have the first nanofactories able to manufacture medical nanorobots also by about 2030, again if adequately funded. Obviously, the ethical scenarios are dramatically different in the cases where you have full AI but not full MNT, full MNT but not full AI, or both AI and MNT. In SF, I think Stross' *Accelerando* does a pretty good job of communicating the feel of a world in which AI runs significantly ahead of MNT in its development. The best book I've read in the last 10 years which convincingly describes a plausible world in which MNT develops ahead of AI is *Counting Heads* (2005) by Marusek. If you haven't read it yet, check it out! It's perhaps the most plausible description of a future in which MNT leads and AI lags that I've read (though of course many other futures are also possible). He talks about cloning, multi-hundred-year lifespans, cryonics, etc., so it might give you some ideas.

> *Are you and your colleagues any closer today than you were in 1997 to a reanimation of a cryonics patient?*

With adequate funding, we think the first cryonics revivals could start in the 2050s."

[240] http://www.molecularassembler.com/Nanofactory

Formal Interviews: (a) Neil Jacobstein and (b) Hernando Ramírez Llinás

Interviewee	Date	Method
Neil Jacobstein, President Singularity University	March ___, 2012	
Hernando Ramírez Llinás, PhD Resr.	March 21, 2012	

(a) Neil Jacobstein is the president of the Singularity University, a non-profit educational organization located at NASA Ames Research Park, and co-chair of the Artificial Intelligence and Robotics Track. Jacobstein is a Distinguished Visiting Scholar at Stanford's Media X Program and a Senior Research Fellow at Reuters Digital Vision Program at Stanford University.

> *How might nanotechnology be most aptly suited to the concept of life extension and expanding life onto nonbiological platforms?*

Currently, we have no means of repairing damaged cells. When the majority of cells in a portion of human organ tissue are damaged, we cut the cells out with surgery. Molecular nanotechnology will eventually enable us to selectively examine and repair cells, which will lead to considerable life extension. We will have the blueprint for cells, and we will be able to bring them back to a fully functioning youthful profile. In addition, we will be able to modify the original blueprint, substituting carbon fibers that are harder than bone, or respirocytes that are upgrades to red blood cells for carrying oxygen. Nanotechnology will eventually reduce the cost and increase the resolution of brain scanning devices. We will be able to back up and reproduce our biological memories on orders of magnitude faster and more robust hardware platforms.

> *In your view, what might artists and designers be aware of when considering nanotechnology for creative endeavors?*

That artistic vision and expression are liberated by technology, not constrained by it. Many artists fear advanced technology as something threatening and heartless, but the technology is there for them to experiment with and inject with the properties that they most resonate with. Designers in particular would be well advised to track advances in two distinct areas of nanoscience and engineering: 1) new materials that exploit changes in the chemical, physical, and electronic properties of materials at the nanoscale, and 2) the long term development of molecular robotics, and systems of nanoscale devices that will eventually lead to inexpensive and thorough control of molecules with atomic precision. It is important for designers to realize that molecular nanotechnology and the molecular manufacturing that it will enable, is not just about building small machines, but will enable the hierarchical assembly of super strong macroscale devices of virtually any size.

> *What possible problems could arise from individual pursuits and/or garage- type labs in working with DIY nanotechnology (e.g., DIYBio has formed a large following where people are using biotech tools to create all sorts of things)?*

There are risks associated with any powerful technology, and nanotechnology is no exception. Risks range from inhaling or absorbing nanoparticles, which are current risks, to future risks, such as solar powered exponentially replicating nanotechnological devices, or specifically engineered next generation nanoweapons. Note that we can get the benefits of nanotechnology and control most of the risks through professional standards and guidelines, good engineering practices and oversight, and redundant systems of safety devices. However, the deliberate abuse of the technology to do harm will remain a risk going forward, and our best defense against that is to build a multilayered immune system like we see in the human body, or in anti-virus technology. The first line of defense is a well educated population of nanotechnologists that benefit from thoughtful experimentation.

> *In your view, what is the central catastrophic risk or extinction risk related to molecular manufacturing? Have you changed your mind over this during the past 10 years? In other words, is there something you foresee today that you did not consider 10 years ago?*

I continue to think that the single biggest catastrophic risk associated with molecular manufacturing is the risk of not developing it soon enough to ward off a host of baseline risks that are accelerating our way. These include the risk of climate change, thermonuclear war sparked by nation state competition, and economic collapse in parts of the world. These problems could be viewed as a consequence of not fully developing and utilizing technologies such as molecular nanotechnology that could address these problems squarely. While I have concerns over the safe deployment of molecular nanotechnology, I think that these risks can be addressed effectively. The risk of deliberate abuse by terrorists is a real concern, but they are likely to utilize biotechnology first. In addition, we can greatly reduce (although not eliminate) the number of terrorists by systematically addressing with advanced technologies the material, nutritional, educational, health, and psychological needs of marginalized and impoverished populations.

(b) Hernando Ramírez Llinás is Director, Faculty of Engineering at the Autonomous University of the Caribbean, Director of Artificial Intelligence Academic Unit, Neuroscience Institute and Co-founder of the Colombia-Purdue Institute for Advanced Scientific Research.
Interview

> *In your view, how does nanotechnology link to the growing field of human enhancement, which most often is equated with such emerging and speculative technologies as NBIC (nano/bio/info/cogno)?*

From my point of view the nanotechnology is one of the pillars for human improvement; if we do not work at molecular scale, it is impossible to make real changes at the cellular level through which remedy the deficiencies that we have as human race. Obviously sometimes the subject is taken as speculative, but it has been one of the great aspirations throughout history. Therefore the people use vitamins and food supplements, to be better. Now it is more of the same, much deeper, but more of the same.

> *How might nanotechnology be consequential and/or significant to the concept of radical life extension?*

Nanotechnology would be consistent and significant for the concept of radical life extension at the time through it could be accomplished cell regeneration and better performance of the telomerase during cell life. This, for In VIVO works and research. If we talk about the cryonics suspension, it is of vital importance for re-animation, repairing damaged cells, and possible solution to the problems of disease for which a person decides to opt for cryonics.

> *What possible problems could arise from nanotechnology (nanomedicine) and especially for repairing brain functioning?*

Problems regarding to the pollution of nanorobots in the human body and its possible consequences could arise in the field of nanomedicine. While inside a human cell the limit in volumetric injection is ~50-100 micron3 per cell (0.5 - 1% of the cell volume) which means ~3-100 nanorobots depending on the size of the target, it is enough to not have a representative impact, but we don't really know what would happen to have a large number of cells inoculated with Nanodevices. One of the main fields of action is the brain. A cousin of mine, Dr. Rodolfo Llinas Riascos is working with nanowires to initially scan the brain and subsequently through the inhibition of certain neurotransmitters and action potentials correct neurons that produce the tremor of Parkinson's disease. Side effects in terms of changes in the personality of the patient and potential loss of their true identity have been detected. But it is a field still to investigate.

> *In your view, what might designers and other creatives be aware of when considering nanotechnology for engineering new types of body designs?*

In my view, designers and other creatives be aware of ethics. That corresponding to allow only people who have enough money, access to the technology and its supposed benefits. It could be a tremendously negative impact regarding the emergence of an improved race and those "normal".

> *Do you think designers might look at the world as patterns/particles or as molecules that can be arranged and rearranged?*

Yes, I think designers might look at the world as patterns or molecules that can be arranged and rearranged. This is the principle of teletransportation and this is the way the matter exists. Quarks, subatomic particles, atoms, molecules and so on. Arranged and rearranged to form everything we can see and detect.

Historical Informal Interview: Eric Drexler

Interviewee	Date	Method
Eric Drexler, Ph.D.	August 8, 1999	

K. Eric Drexler, Ph.D., is author of *Engines of Creation: The Coming Era of Nanotechnology*. Drexler's 1981 paper in the *Proceedings of the National Academy of Sciences* established the basic of molecular design, protein engineering and productive nanosystems. Drexler's research focuses on advancements of nanotechnology and current and future directions.

This informal exchange took place at the Extro3 Conference "Biotech Futures: Challenges of Life Extension and Genetic Engineering" (August 7-8, 1999) at the University of California, Berkeley. Drexler and the author exchange ideas about ways in *which artistic, design-based approaches might intersect the growing domain of life extension and genomics.*

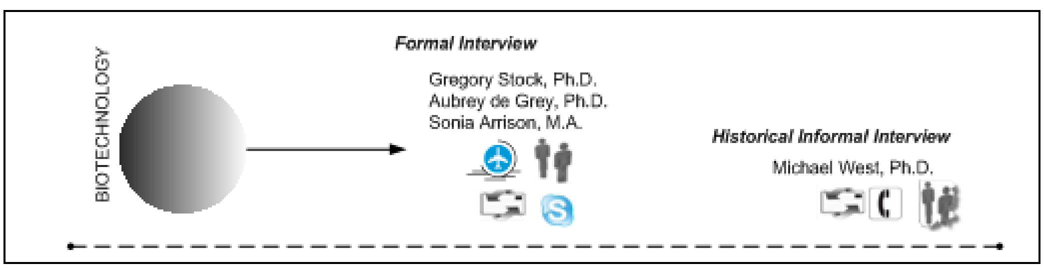
> *Do you see a possible opening for creative pursuits by artists and designers in the field of nanotechnology?*

(Paraphrase) Yes, I can understand your concern. There needs to be more discussion on how artists can be a part of this growing field. In my own talks, I should mention art more often. One thing we can do is to learn by immersing yourself into a topic and learn about its related fields.

> *Why do we discuss the state of the art of technology, but not the state of the art as important to technology?*

(Paraphrase) Looking at the world from science and art is necessary to grasp the fundamental physical similarities in principle and function. How ideas as assembled is a system much like the way matter is assembled – complex. Designers and engineers build because of a motivation to do so. (Pause.) Thinking about motivations – being cautious and conservative means that we ought to think about how to preserve life patterns like engineers and then reconstruct them like artists. It's a matter of putting atoms together in not only right ways but interesting ways – garnishing necessary patterns and omitting the unnecessary mass, energy-wise.

Biotechnology: Regenerative Medicine and Stem Cell Research



Formal Interview: Gregory Stock

Interviewee	Date	Method
Gregory Stock, Ph.D.	June 15, 2011	

Gregory Stock founded the University of California Los Angeles Program on Medicine, Technology and Society in 1997 and served as its director for ten years. In 2004, he co-founded and served as the Chief Executive Officer of Signum Biosciences, a spinoff of

Princeton University's anti-inflammatories and therapeutics for neurodegeneration. Stock is the author of *Redesigning Humans: Our Inevitable Genetic Future* (2002).

How much does biotechnology affect the scope of redesigning humans?

Germline engineering is at the heart – the basis -- of what it means to be human because it forces us to look at how our genetic makeup shapes us. Over the years the central question has been whether or not technology will become feasible, which we know it has, but more importantly when it will become feasible[241]. Somatic gene therapies[242] have existed for a while now for fighting disease and treating illnesses. But whether or not biotechnology's genetic engineering can actually redesign the human is basing the human on biology and this may not be the ultimate question. In *Metaman* (1993) I wrote that whether biotechnologies are possible to enhance the human mind and body, the larger issue has become an issue of being beyond our species – beyond Homo sapiens. Having mechanical organs takes us outside biology, although administering the organs is still biotechnology. Until then the choices we make today in redesigning our contour – prosthetics, aesthetic surgeries and the varied electronic extensions that we are dependent on in redesigning ourselves, is still within the realm of biology.

In your view, is it possible to change the face of mortality or is this a pipedream of life extension activists?

It is an ancient dream and a plausible reality. Compare our ancestor's way of life to our current way of life. There is no resemblance of our technologically enhanced world to our primitive beginnings. Human innovation doesn't stop because one person has a problem with another person's desire. Is changing the face of mortality too much to hope for? Not if we slow the process of aging and dramatically extending life is the result of this process. Some of the work done at Signum focuses on Alzheimer's, and other diseases of aging.[243] The anti-aging debate is full of ethical issues. It take the emphasis from the political issue of mortality to one of a more humane interest in being healthy for a longer period of time.

How do government regulations, laws and rules factor in?

[241] In 1989, Stock with Dr. John Campbell organized the "Engineering the Human Germline" symposium at the University of Los Angeles, which touched on this area. Dr. James Watson was one of the speakers. See http://www.gregorystock.net/are-we-the-next-frontier.asp Downloaded Jun 13, 2010.

[242] Somatic means adult cells in the body. Therapies introduce healthy genes into a targeted cell.

[243] Stock mentions new therapies, which can be found at http://www.gregorystock.net/where-are-the-new-therapeutics.asp

It is an unavoidable topic and not one that is encouraging. When self-named ethicists like […] draw a line in the sand and stand vehemently on one side of that line, unwilling to recognize that many children and adults suffer from heinous illnesses and desperately need genetic reengineering, it is a crime against humanity to ignore this. Stepping back from the obvious, we need to explore the arguments for and against all technologies and consider the child or adult who has a degenerative illness and needs help. One of the arguments against enhancement, especially germline enhancement, is a moral assertion that it is wrong or too dangerous, will be misused and abused, and result in ways that affect human spirituality or the environment. Of course these are concerns. But they cannot stand in the way of advances especially in reproductive technology and its future. The usual "playing God" metaphor stands out dominantly, but it is far too hyperbolic to argue or defend how regulations need to be set and met […].

Whether or not societies accept humanity's transformation into something that lies beyond human may bring about the adventurous activists and the restrained conservatives who want to battle it out. I continue to argue that human transformation is an inevitability. The key question is whether or not biology is consequential to life. Here genomics, computer technology, and ethics will collide.[244]

Formal Interview: Aubrey de Grey

Interviewee	Date	Method
Aubrey de Grey, Ph.D.	June 10, 2011	

Aubrey de Grey is the Chief Science Officer of Strategies for Engineered Negligible Senescence (SENS) Foundation. He is the editor-in chief of *Rejuvenation Research* academic journal, and co-author of *Ending Aging* (2007).

> *What is your research trying to accomplish and how far is the research from this goal?*

Let's define the problem or describe the problem. The problem is aging. At SENS, our objective is to defeat aging. In doing so, the focus is on rejuvenation and methods that are conducive to how we can solve this problem of aging. We are a long way from

[244] Stock is referring to the Moravec scenario, for example: "The ultimate question of our era is whether the cutting edge of life is destined to shift from its present biological substrate – the carbon and other organic materials of our flesh – to that of silicon and its ilk, as proposed by leading artificial-intelligence theorists such as Hans Moravec …" (Stock 2001:18).

understanding the causes of aging but there are some things we do know. The pathologies of aging are caused by damage that gradually accumulates in the body as a byproduct of metabolism. Most prospective treatments for diseases of aging try to either alter metabolism to slow the buildup of damage or counter the damage's downstream – further down to the DNA molecules and the effects at this level.

We can easily identify the damage to cells associated with the disease of aging. If the damage is fixed, the cell is rejuvenated. Rejuvenation biotechnologies specifically target and directly repair the damage within the cell. This damage falls into a number of categories that include amyloid plaques, intracellular junk (lipofuscin), and death-resistant cells, including others. However, for rejuvenative medicine, we do not need to understand how cells are damaged we just need to know how to undo the damage.

But we do understand certain changes in cells that cause diseases of aging and death. We call them seven deadly things[245] to watch out for [later de Grey referred to them as "7 deadly SENS"]. I'll give you the breakdown from a 2005 article[246]:

- "Nuclear Mutations/Epimutations (first sign of cellular abnormality, e.g., tumor): These are changes to the DNA, the molecule that contains our genetic information, or to proteins which bind to the DNA. Certain mutations can lead to cancer.
- Mitochondrial Mutations: Mitochondria are components in our cells that are important for energy production. They contain their own genetic material, and mutations to their DNA can affect a cell's ability to function properly.
- Intracellular Junk: Our cells are constantly breaking down proteins that are no longer useful or which can be harmful. Those proteins which can't be digested and simply accumulate as junk inside our cells.
- Extracellular Junk: Harmful junk protein can also accumulate outside of our cells. The amyloid plaque seen in the brains of Alzheimer's patients is one example.
- Cell Loss: Some of the cells in our bodies cannot be replaced, or can only be replaced very slowly.
- Cell Senescence: This is a phenomenon where the cells are no longer able to divide.

[245] De Grey is referring to SENS Foundation's research themes and their research conclusion that there are seven classes of cellular damage, usually on the molecular scale, that cause aging. See http://sens.org/sens-research/research-themes Downloaded January 5, 2012.
[246] De Grey is referring to the 2005 interview at Live Science. See http://www.livescience.com/6967-hang-25-year-wait-immortality.html Downloaded February 23, 2012.

They may also do other things that they're not supposed to, like secreting proteins that could be harmful.

- Extracellular Crosslinks: Cells are held together by special linking proteins. When too many cross-links form between cells in a tissue, the tissue can lose its elasticity and cause problems."

What is your strategy for dealing with the problem of aging?

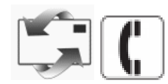
I have identified a set of things to fix – aspects of aging that can be repaired. My thinking on this is that, again, we don't need to know all the details of how aging happens – how disease happens. So long as we know what these things are that do happen we can figure out ways to fix them. This process is counter to the usual procedure contemplated by scientists in the field of aging or science for that matter because most scientists are interested in knowledge for its own sake but I am in this project of defeating death as a means to an end – to obtain enough knowledge that can be acted upon in reversing the aspects of aging.

So the idea here is that we wouldn't be eliminating aging. The strategy is to periodically intervene with the damage caused by aging and having the accumulated damage repaired. You would not be viewed as having a biological age related to aging, but have a body that is rejuvenated that reflects your health. How often you go in for repair is based on how conscientious you are about rejuvenation.

Can you delineate what you mean by "Longevity Escape Velocity"?

I call this the process of overcoming aging through regenerative medicine. We want to extend healthy lifespan indefinitely – without limit. Reaching to solve all the problems associated with aging at once is not the objective. We want to repair cell damage as best we can to keep the overall health of a person and to keep the overall level of damage below pathogenic levels. By pathology I mean all the usual suspects: cancer, heart disease, diabetes, osteoporosis, macular degeneration, stroke, etc. There are many. If life expectancy increases faster than each year of anti-aging research, a person is ahead of the curve and the odds are in her favor. Staying healthy while advances are being developed is important.

Formal Interview: Sonia Arrison

Interviewee	Date	Method
Sonia Arrison	March 5, 2012	

Sonia Arrison is a founder, academic advisor, and trustee at Singularity University, and a Senior Fellow at the California-based Pacific Research Institute for Public Policy (PRI) and a columnist for *Tech News World*. Arrison is the author of *100+: How the Coming Age of Longevity Will Change Everything, From Careers and Relationships to Family and Faith* (2011).

Interview

> *In your view, what evidence can be found in the fields of science, technology and medicine that proposes extending the maximum life span is doable?*

Let's start with near term evidentiary projects. Replacing body parts, from hearts to lungs, and also to grow new organs is being done today. Evidence that we have seen successes with organ transplants and implants has been a first step. Using organs as scaffolds is a next step, as well as growing our own organs. In 2008, CNN[247] covered the work of Dr. Doris Taylor at the University of Minnesota's Center for Cardiovascular disease. Her laboratory is creating replacement hearts. Taylor's research evidences that taking the livers and hearts of different species, certainly after the species has died and not from the experiments but by natural causes, and removing the cellular components of the tissues are being used to scaffold human tissues. In other words the human cells regrafted onto the structure or of the organ. This is called reseeding the scaffolds with human stem cells[248]. In my own research, I evaluate projects such as Taylor's and look at "health expectancy" issues. The aim is to protect ourselves, to last as long as possible with good health and to replace organs that are diseased with new organs.

In the long term view, gene therapy and rewriting code. Here is an issue though: it is expensive and a few rich people are about to do it. Dan Stoicescu paid $350,000 to have his full genetic code sequenced.[249] But the price will eventually come down. In fact, decode

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[247] See http://articles.cnn.com/2008-01-14/health/rebuilt.heart_1_heart-cells-rat-heart-heart-transplants?_s=PM:HEALTH Downloaded March 17, 2012.

[248] Dr. Taylor's research is explained cogently in an article in *Mail Online.* See http://www.dailymail.co.uk/health/article-1372938/Live-human-heart-grown-lab-using-stem-cells-potential-transplant-breakthrough.html Downloaded March 17, 2012.

[249] Arrison's mention can be referenced through an article in *The New York Times* (2008). See http://www.nytimes.com/2008/03/04/health/research/04geno.html Downloaded March 17, 2012.

launched a web site for personal genomics service at a cost under $1,000.00. I cannot report how successful this is. A company that is well known is 23andMe and at their website you can order the DNA kit for $99.00[250], with certain limitations of course. But the point is that it this type of availability of learning about your own genes is becoming more and more available and at lower costs.

> *What credence can you give to Bill McKibben's opposition to "techno-longevity" and why, in your view, is this term appropriate or inappropriate when considering extreme life extension?*

It does not make sense, not to mention that it is a confusing term. Humans have always used technology to increase our longevity through earliest tools. It is just that now our tools are far more different and on a molecular scale. So McKibben's claim is a non-issue.

> *Do you consider what you call the "death trance" to be genetic, innate characteristic or a result of an enculturated phenotype?*

Death has been something we have always expected with no legitimate way to fix it or ultimately avoid it. The psychological coping mechanism sufficed for a very long time. Now – now we are standing at a point in history where we can grow new body parts and we are also looking at ways to back ourselves up. The death trance means that humans are good at making ourselves feel better about dying – it's God's will – that we should be thankful for having a life and the reward is death and to beware the Promethean complex.

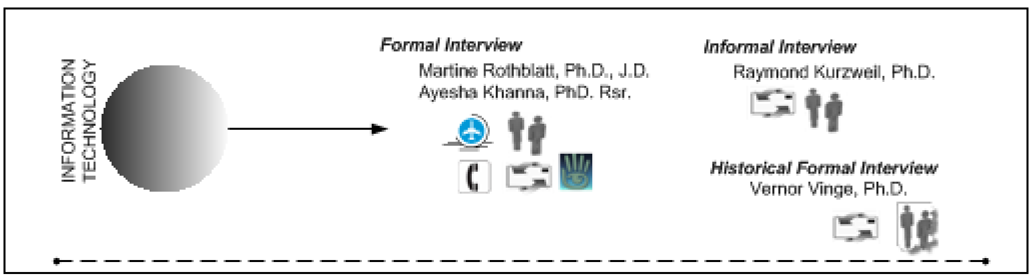
> *The digital revolution proposed to change human life for the better, which it has to some degree. Yet, it has also made life more difficult, caused new political agendas, policy making, fraud, and privacy more rampant. In this life extension revolution, what might be the downsides that, in your opinion, ought to be addressed sooner rather than later?*

The digital divide is actually about the divide of life extension and any technological advances that affect anyone using any form of digitality. We are in a world of digitality and so I see it as the divide of the available technology. Look at life expectancy throughout the world. In Monaco the life expectancy is about 90 years but in Angola it is about 38 years. This is enormous divide. The obvious assertion would be that it is the wealthy that have the medicine and technology and this is true to an extent; but we also have to admit that it is in large part because of politics, war and greed. The biggest problem in the divide is the cost

[250] See https://www.23andme.com/ Downloaded March 17, 2012.

of life extension, but the rich will also be the canaries in the mine and maybe being the first is not so good – perhaps it is better to wait and see the results. Nevertheless, when one is ill and aging that is not so important and we have to make things available to everyone. This reflects the "lag" in technology and society – or society's lag in catching up with technology. Historically this is due to economics and costs coming down. Let's hope that costs will come down and that governmental regulations do not interfere with people's hope of improving their well-being. We witnessed this in the United States under President Bush's administration and the halt of stem cell research. Fortunately that that been mediated.[251]

Information Technology: Codes / Computational Matter



Formal Interview: Martine Rothblatt

Interviewee	Date	Method
Martine Rothblatt, Ph.D., J.D.	March 13, 2012	

Martine Rothblatt is vice-chair of the Bioethics Subcommittee of the International Bar Association and founder of United Therapeutics. Rothblatt is responsible for launching several communications satellite companies, including the first nationwide vehicle location system (Geostar, 1983), the first private international spacecom project (PanAmSat, 1984), the first global satellite radio network (WorldSpace, 1990), and the first non-geostationary satellite-to-car broadcasting system (Sirius Satellite Radio, 1990).Rothblatt is the author of

[251] It is also discovered that stem cells are located in fat cells and the issue of embryos being used to propagate stem cells is no longer a major issues. See http://news.nationalgeographic.com/news/2009/09/090908-liposuction-leftovers-fat-stem-cells.html Downloaded March 17, 2012.

The Apartheid of Sex, co-creator of the Lifenaut Mindfile project[252], the History Lives module[253] and the visionary behind "Bina48".[254]

> *How much do emerging and speculative technologies (NBIC) affect the Lifenaut Mindfile project, influence the parameters of the Lifenaut Mindfile project, or could be used to further the scope of the Lifenaut Mindfile project?*

We are absolutely counting on the NBIC technologies to bring the LifeNaut vision to fruition. For example, our goal is to be able to download an individual's cyberconsciousness, based on reflections of their consciousness embedded in their LifeNaut mindfile, into a nanobiological body. So, this clearly requires the nano and bio of NBIC.

> *How does the Lifenaut Mindfile project link to the domain of human enhancement and life extension?*

We agree with medical experts that death occurs when there is an irreversible cessation of all functions of the higher brain. However, if some of those functions, such as memory and thought, are not irreversibly ceased because they are stored in a cybernetic form, as in a LifeNaut Mindfile, then such an individual is not really dead. This will become obvious once we succeed in reviving these mindfiles into a state of cyberconsciousness equivalent to the original consciousness of the person who created the mindfile. In this sense, LifeNaut aims to provide for an unlimited life extension of people who participate in the project.

> *What scenario can you envision where a person is (a) in cryonics and reanimated and would rely on Lifenaut Mindfile project to assist in regaining a sense of self; and/or (b) is physiologically regenerated and living past 123 year but needs a stronger connection with his/her historical personality profile (i.e., continuous personhood)?*

The LifeNaut Project is 100% synchronous and interdependent with cryonics. The brain is the world's greatest hard-disk and processor! However, disks crash, and get corrupted and processors get buggy. The mindfiles in LifeNaut will be of great assistance to cryonics in providing a means of filling in any missing pieces of information about mannerisms, personality, recollections, feelings, beliefs, attitudes and values.

[252] See https://www.lifenaut.com/ Downloaded May 11, 2011.
[253] See https://www.lifenaut.com/mindfile/history-lives/ Downloaded March 13, 2012.
[254] "Bina48" is a robotic, AI likeness of Bina Rothblatt. See http://www.nytimes.com/2010/07/05/science/05robotside.html Downloaded March 2, 2011.

What possible problems could arise from the Lifenaut Mindfile project? For example, what risks are there in the (a) technology used to create the current scope of the project or future scope of the project and (b) the psychological ramifications of the project on one's (i) psyche (self) and the (i) the gestalt of the cultural timeframe that could be adverse to the project?

The main problem we foresee is if succeeding generations of project managers failed to heed the project's strict criteria. These criteria limit revival only to those individuals who have clearly given consent to be revived. Also, as with any biomedical project, our first objective is to avoid causing harm. Hence, we will be very careful not to engage any form of self-awareness until we are absolutely positive that the self-aware experience will be a positive one. We will test approximations of this over and over until we are confident the self-awareness experience will be joyful.

In your view, what might artists and designers be aware of when considering using the Lifenaut Mindfile project or creating a similar project? For example, what are required conditions that could be used in developing a heuristics for such a Lifenaut Mindfile concept and approach?

I think the LifeNaut project is perfect for artists and designers because we have a feature enabling 'anyone to create a mindfile on anyone.' This allows for a collaborations of artists and designers to create a group creation of a virtual person that is fully capable of intelligent, and insightful, interaction with others. LifeNaut lets us literally create sentient beings, albeit virtual ones. In a similar vein, we have a History Lives module in which Historical Figures, such as [Mohandas Karamchand] Gandhi, can be brought back to life.

> Created by an international software development team based in the United States and the United Kingdom, the History Lives Project™ is designed to make it possible for anyone to participate in the creation of interactive digital clones of past historical figures. This requires enormous creativity to bring past people, who have huge potential for sharing meaning with current generations, back to virtual life (Terasem 2009).[255]

Formal Interview: Ayesha Khanna

Interviewee	Date	Method
Ayesha Khanna	March 5, 2012	

Ayesha Khanna is a Ph.D. researcher in Information Systems and Innovation at the London School of Economics. She is the Founder and Director of Hybrid Reality Institute, a

[255] See https://www.lifenaut.com/Media/HistoryLivesPressRelease_4-15-09.pdf Downloaded September 6, 2011.

researcher on human-technology co-evolution, and a scenario analyst. Khanna is the author of *Hybrid Reality: Preparing for the Age of Human-Technology Co-Evolution* (2012).

> *In your view, how does hybridity affect the notion of human enhancement and life extension?*

One dimension of the Hybrid Age is the incorporation of technology into the human body for purposes of enhancement. The more we are able to either augment or replace or renew our biology, such as cells, organs, and limbs, the more we accelerate the longevity process that has begun with the advances in nutrition and medicine in the 19th and 20th century.

> *Is hybridity a form of "non-anthropocentric" thought or behavior? Or do you see hybridity as having elements of anthropocentrism in that the transhuman and posthuman are historically linked to the human and its human-centric self-centering in the universe.*

Not quite, since in order to be hybrid there must be an element of the human. Hybrid behavior is not non-human or anti-human, but rather combines the human with the technological. I believe even a universal transhuman or posthuman condition would still allow for elements of individuality of expression of thought through the nodes that each of us come to occupy within the global mind.

> *If we speak of human enhancement in terms of "hybridity" rather than "evolution", does this change the discussion and turn it away from ethical concerns in humans steering their own evolution toward a process that happens when we "mix" with other elements in the universe, as in Lynn Margulis' theory that the human evolved from a conglomeration of bacteria, "where life is "the transmutation of energy and matter" (Margulis & Sagan 2000:215).*

The process of hybridization is very much part of evolution in the sense that evolution is not purely biological but a broader process of advancement. However, the ethical nature of the debate does shift since there is no longer an a priori assumption that any intervention in biological evolution is de facto immoral. The hybridization approach does lean towards a perspective that allows for evolution to be thought of as any combination of matters between organic and non-organic, such as is taking place today through man-machine synthesis.

> *In your research, you state: "Mankind has experienced four major technological revolutions, each of which has spawned an age more disruptive in transforming life as we've known it. Now we are experiencing a fifth technological revolution into the Hybrid Age, an era in which intelligent and social technologies will proliferate*

across the globe and in our lives". Can you extrapolate how this Hybrid Age relates to "life expansion" (meaning: increasing the length of time a person is alive and diversifying the matter in which a person exists)?

The Hybrid Age is indeed one of "life expansion" since advances in nano- and bio-technology can radically increase the length of time we are biologically alive. Also, our global community will be expanded as it will be comprised of diverse sentient entities, including the artificial intelligence robots of our own creation, and artificial representations of our 'selves' in the form of avatars and surrogate artificial forms.

What do you see as the downside of life extension, life expansion in regards to its potential as being a transdisciplinary projects, and/or engaging emerging and speculative (ES) media for artistic, design-based projects? In other words, do you recognize ways in which this prospect could include hybridity and also ways in which it would counter or exclude the notion of hybridity?

The notion of hybridity strongly supports the movement towards transdisciplinary projects and studies. Indeed, in the scientific realm, it is the demise of inter-disciplinary boundaries in favor of collaboration that has propelled the Hybrid Age into being. The same logic then would apply to arts and design projects as well. Looking specifically at the hybridity of the human form as a transdisciplinary project, the collaboration of arts and sciences can lead to the emergence of new aesthetics of self-representations. Such diversity would not be unwelcome.

Informal Interview: Raymond Kurzweil

Interviewee	Date	Method
Raymond Kurzweil, Ph.D.	June 14, 2010	

Raymond Kurzweil is an inventor and author. His inventions include being the principal developer of the CCD flat-bed scanner, the omni-font optical character recognition, the print-to-speech reading machine for the blind, and music synthesizer. Kurzweil is the author of *The Age of Spiritual Machines* (2000) and *The Singularity is Near* (2006).

How do you compare Moore's Law and the Law of Accelerating returns?

The Law of Accelerating returns is where we have to start when considering exponential technological growth, not at Moore's law[256]. The rate of change in a broad range of systems [evolutionary systems] increases exponentially over time. For example, the speed and cost of a computer chip increases in a wide spectrum, not in a linear manner. Today's rate of progress is dramatically unlike historical upward climb of progress that has been incremental and fairly stable in its climb. Exponential growth in the coming years will be a thousand times broader and faster. Moore's law does not facture in exponential growth.

How does the growth of intelligence factor in?

Let's think about the software I walk around with today. Much of it is not needed. We don't have to hold onto every calorie, every neuron, every thought, or every gene. We will be able to turn genes off and add new genes through gene therapy. The technologies that that involve gene expression will become more devoted to the intersection of biological engineering and information engineering. For example, MIT recently created a new Department or School of Biological Engineering. This is the power of exponential growth in learning, which affects intelligence.

It is inevitable that technology will grow exponentially. What we do with it is not inevitable. Overtime, technological growth has been on an upward trend. But today, we all have within reach a technology [cell phone] that is thousands of times more powerful than what we had in one large company [large computer]. In the next decades, the technology will fit into a blood cell.

In your view is the singularity what Vernor Vinge calls "hitting the wall" where civilization as we know it will be unrecognizable?

A transformative change is what we call a "singularity", but that doesn't mean it will happen suddenly but mean that computers will gain more intelligence – through many, many steps -- some large and some small. Physical matter will be transferable – physical matter will become information packets of molecular and patterns. A threshold will be capturing human intelligence in machines. And here we need to create templates of the brain and of human intelligence. The difference between machines reprogramming themselves and multiplying their information is different than the human brain which

[256] Moore's Law (Gordon E. Moore) proposed that computing hardware doubles every two years (approximately). See http://en.wikipedia.org/wiki/Moore's_law Downloaded June 10, 2011.

simple cannot do this -- we will be able to simulate the brain in machines, but our biology is not yet able to re-engineer the brain in biology.

When we are able to reverse engineer the brain the question of what is consciousness will take on new parameters. We can't ignore conciousness, it is how we behave, consciousness is mysterious but it not easily identified – it's a philosophical assumption. It doesn't matter what the substrate is as long as each entity is conscious of itself. There are different philosophers have different assumptions. I think mostly it is a conceptual gap between objective theories subjectivity of consciousness. Philosophical papers that claim the source of consciousness cannot be computational make the same claim that there is a social consciousness – as a leap of faith. How might we demonstrate consciousness? We probably only know 1% of the brain, if that.

What is your suggestion for making it to the Singularity?

Hang in there!

Historical Formal Interview: Vernor Vinge

Interviewee	Date	Method
Vernor Vinge, Ph.D.	June 14, 2010 / 1998	

Vernor Vinge was Professor of mathematics and computer science at San Diego State University. He won the Hugo Award for *A Fire Upon the Deep* (1992), among other awards. In 1993 he authored "The Coming Technological Singularity", where he pioneered the concept of a singularity as the creation of superhuman artificial intelligence.

This historical interview is included in this section because of Vinge's insights that directly link to the thesis understanding of human use of technology. This section below is from the article "Vinge's View of the Singularity" (Vita-More 1998).[257]

What might creative issues be for early posthumans? Will icons such as da Vinci be immeasurably and incomprehensibly surpassed by a posthuman "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

[257] See file:///C:/DOCUME~1/NATASH~1/LOCALS~1/Temp/Temporary%20Directory %201%20for%20extropy_site_2001-11-27.zip/eo/articles/vinge.htm Downloaded March 24, 2012.

aspects of the new existence. I believe that emotions would still be around, though more complicated and perhaps spread across distributed identities. In writing stories, I have tried to imagine emotions superhumans have that humans don’t have. Creativity may be entirely different from before, and this would depend in part on what types of emotions are available. A more concrete conclusion comes from our own past: before the invention of writing, almost every insight was happening for the first time (at least to the knowledge of the small groups of humans involved). When you are at the beginning, everything is new. 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 post-human 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 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-Singular years.)

Cognitive Science / Neuroscience: AI/AGI

Formal Interview: Anders Sandberg

Interviewee	Date	Method
Anders Sandberg, Ph.D.	March 3, 2011 May 14-15, 2011	

Anders Sandberg is a James Martin Research Fellow at Future of Humanity Institute, University of Oxford. Sandberg has a background in computer science, neuroscience and medical engineering. Sandberg is co-founder and writer of the Swedish think tank Eudoxa. Sandberg is a co-author of *Converging Cognitive Enhancements* (2006), *Whole Brain Emulation: A Roadmap Technical Report* (2008) *Probing the Improbable: Methodological Challenges for Risks with Low Probabilities and High Stakes* (2008).

> *In the free world, people have certain freedoms such as religious and political freedom, and freedom of thought. In your view, do we need to consider a freedom of brain activity, such as copying or transferring the brain onto non-biological systems?*

Our thinking is not separate from our bodies and the freedom of thought implies a certain freedom of brain activity. It is a difficult issue because there is no clear dividing line between the body and mentality and if we think about a freedom to alter the brain structure, it might best be included in morphological freedom. From my essay in your forthcoming book, this excerpt may clarify some points about ethics and moral obligations:

> Of course, other ethical principles such as compassion would imply a moral obligation to help, but I will here mainly concentrate on the skeletal rights framework. As a negative right, morphological freedom implies that nobody may force us to change in a way we do not desire or prevent our change. This maximizes personal autonomy. This [essay] will only deal with the basic case of informed consenting adults as regards to morphological change. There exist a number of special cases where volition becomes problematic, such as mentally ill people, pre-persons or deliberate changes in the motivational systems of the brain. That these cases are troublesome cannot be held as an argument against morphological freedom or any other freedom, since any ethical system will have its limits and messy borderlands. What is important is how well the general principle can be applied, and if it can be adapted with as little contrivance as possible to the special cases.

> *Memory is necessary for life expansion because it contains our life's memories, but in actuality, how reliable is memory?*

We can't fully rely on our memories because they shift in accuracy over time. But memories are the foundation – the basis for many of our decisions. The problem is that we think we can trust our memories and take this false trust for granted. That is a problem. The reliability of our actually copying it or transferring it depends on the storage capacity we are able to record – it would have to be compressed and store 20 terabytes, but most like we need far more because we need to model – to simulate all the processes in the brain. Because we have done some simulations, back in the 1940 of cell simulation, we can now simulate many bodily motions and understand how nerve cells work. Because we are able to simulate small aspects of the brain - taking individual nerve cells and anal sizing all the minute nerve processes – we will most likely be able to do this on a larger scale. Another area if slicing very thin parts of the brain – that would be a non-living brain. Nevertheless, where we can see and would know the brain on a very specific level. The downside here is that it is static – there is no record of how the slices interact.

We need to think about the brain as being highly emergent. We need emulation rather than a theory to full understand the brain. But along with the brain we need a simulated body, not just a brain. So, to some degree we would need a simulation of more than just the brain. Emulation, in my opinion, would be sentient – it would have to be in relationship with the environment, but would not have to be precisely like the human body.

In your opinion, what is a mind?

Minds are linked to the functions of the brain rather than the stuff the brain is made of. Functionalists, I am a functionalist, see the brain as doing processes that do not have to be precisely or exactly biology – that a mind could exist outside the biological brain/body. We will have to wait to see if an uploaded mind in silicon is self-aware.

Formal Interview: Randal Koene

Interviewee	Date	Method
Randal Koene, Ph.D.	August 12, 2012 March 18, 2012	

Randal Koene is Director, Department of Neuroengineering, Fatronik-Tecnalia Foundation, Director and Chief Science Officer at Neural Engineering Corporation, and Director of Analysis at Halcyon Molecular. Koene was a Postdoctoral Research Fellow at the Laboratory of Computational Neurophysiology, Center for Memory and Brain at Boston University.

Interview

How might you build a multidisciplinary team to design a non-biological structure (body) in which a person could feasibly exist? What might some requirements be in your opinion?

I would have to determine what the body would be used for. I would want to always have effective devices to monitor its organs. Redundancy is an issue – imagine having two copies at the same time which would have different experiences. How should you synchronize these? In terms of a team, for the brain, it would have to be multidisciplinary team of neuroscientists, computational neuroscientists who do functions, mechanism, modeling, for example; neuroinformatics, bioinformatics and so forth. For my own practice, I apply a cross-disciplinary set of skills, such as those mentioned, as well as psychology, electrical engineering and physics.

In your view, what evidence is there that the concept of uploading (to substrate-independent minds via whole brain emulation, as you call it) is actually feasible? Or, is this area speculative theory that could hold some level of promise, but not within our lifetimes?

We are working now with breakthrough methods of DNA sequencing, which is a large step toward biological work on life expansion. But for uploading, or transferring of a biological brain to a different substrate – a silicon brain for example, more work is needed. On the one hand we are interested in transfers and copies of minds and on the other we are interested in man-machine merger. (By the way, the short-hand for substrate-independent mind is SIM. At Carboncopies, we use the term ASIM for advancing substrate-independent minds.)

Let me explain briefly. There are five key developments over the last decade that are significant and can show feasibility in the field, as it is emerging. Advances in computer hardware affect memory and processing speeds, as well as parallel computing. Parallel computing is a natural fit for neural computation. A neural platform for implementing whole brain emulation is a parallel concept and even a neuromorphic computing platform. Another significant development is advances in large-scale neuroinformatics – computational neuroscience with a focus on modeling detail and scale of structures and networks (e.g., Blue Brain Project). Also, the actual recording from the brain – meaning recording electrodes (e.g., Ed Boyden research on arrays with many thousands of recording channels). Optogenetics advancements are consequential (the ability to introduce new channels into the cellular synapse to excite or inhibit wavelength of light stimulation, for example). Other areas are neurobiology and imaging systems (fMRI).

A very important development is the shift in thinking about ideas such as substrate-independent minds, which is no longer beyond the scope of interest of the mainstream researcher in related fields like cognitive science and neuroscience. Now, discussion is not only possible, it is more often debated and an important topic.

How might whole brain emulation be consequential and/or significant to the concept of radical life extension, and/or cryonics?

By transferring the brain's process – its functions – onto non-biological substrates and backing it up.

How might one determine if a SIM is good enough to even be called a person? What if it is a partial transference of the brain but does not contain enough memory and consciousness for example, and is more of a software program than a person?

In neuromorphic systems, a cousin of the computer, we know the silicon architecture and what is going on within it. This access helps us to resolve the functions that are taking place. With one-to-one mapping from a structural replica to a functional model, we have a better ability to see what processes are occurring than in the biological brain – what it is doing. Consciousness is an issue that is unresolved. No one knows precisely what consciousness is; yet, we do not have to wait to learn all the details at all levels before dealing with the hardware and software of the brain/mind.

Emulation allows us to take a look at the thought process going on and modulate it to start a new seed of thought. So in a general sense, from the point of research we are then studying how we think. One of the related big questions is – if we have an artificial general intelligence (AGI), would it be consciousness and self-aware? Would it be a tool or an entity?

What would really be a breakthrough for uploading would be specific types of new tools. What we need are tools that can obtain reliable data about the connections between all neurons and a functional characterization of each neuron. In effect, doing at large scale what neuroscientists can now do for a few neurons at a time. This is a major engineering project – how do we make this work on a scale of 86 billion neurons to produce graphs of all their connections with one another? We can slice and dice and visualize that brain in great detail now, but recording all the intricacies of the connection would be a break through.

Formal Interview: Ben Goertzel

Interviewee	Date	Method
Ben Goertzel, Ph.D.	June 13, 2011 December 3-4, 2011	

Ben Goertzel, Ph.D., is the Chief Executive Officer of Novamente LLC, an artificial intelligence software company and Biomind LLC, External Research Professor at Xiamen University, China and general Chair of the Artificial General Intelligence conference series. Goertzel authored *The Hidden Pattern: A Patternist Philosophy of Mind* (2006) and co-authored *Artificial General Intelligence* (2006).

Interview

Out of the two concepts this thesis is concerned with— that of human enhancement and radical life extension—, a third concept has emerged—that of life expansion. What connection do you see with life expansion and artificial general intelligence?

Life expansion seems a worthwhile concept – I understand the focus on expanding life rather than specifically extending the maximum lifespan. Expanding life can be done in a lot of different ways.

Regarding the link between AGI and life extension or life expansion, of course there are many possible future links. Recall that AGI is a subset of AI focused on making systems that have the same sort of learning capabilities that humans do, and ultimately greater ones. This includes self-awareness and a certain understanding and generalization capability. Right now I'm using simpler, "narrow AI" software to analyze genetics data related to longevity. In a couple years it may be possible to use early-stage proto-AGI software, such as my team's OpenCog platform, to help scientists understand data about longevity. In this case we would be integrating advanced AGI technology into bioinformatics projects that are linked to engineering life extension.

Looking a little further out, eventually it should be possible to build an AGI system with general intelligence equivalent to a great human scientist, and the ability to consume all biomedical knowledge the human race has acquired thus far, plus a superhuman memory and statistical-analysis ability. Such an a AGI may not be able to solve the riddle of aging -- but then again it might. And if it could not, it could design new experiments not yet thought of, and operate these experiments itself via robotized labs.

In your experience, what might be a beneficial way to reintroduce ideas about AGI that has been lost due to frightening scenarios about hard-takeoff of AI/AGI?

Well, there are always possible frightening scenarios associated with any advanced technology– if we upgrade our intelligence we might somehow attract an evil alien race to swoop down and scoop us up; or a robot-AI could be very unfriendly and destroy all humanity; and so forth. But people seem think about this a lot more than they think about the likely benefits of AGI, like an end to aging and a drastic decrease in material scarcity. Let's accentuate and pursue the positive, while keeping in mind the need to ward off the negative.

What are the different approaches to AGI?

There is no consensus on what the right path is, and different researchers with different expertise have their own approaches regarding how to make an AGI. Some researchers come from computer science and math, and others have a background in neuroscience, or psychology. And there is much crossover between disciplines, providing both inspiration and chaos. Many of these fields do not agree on what intelligence is, let alone about how to implement it.

My working definition of intelligence is: the ability to perform complex goals in complex environments. Artificial general intelligence is building minds with this kind of general capability – whereas narrow AI is about building systems that achieve narrow goals in particular contexts. We have not yet built a tool that can achieve a variety of complex goals or solve a variety of complex problems. But I believe we are nearing the day when we may create artificial intelligence with the variety or generality of goal-oriented behaviors that we now only see in humans.

One approach to AGI is via brain emulation. Achieving AI through brain emulation needs two things: better mapping of what is occurring in the brain and better computer hardware. Both of these things are happening at a rapid pace, and this is a point Kurzweil has done a good job of describing in his book *The Singularity is Near*. My own approach to AGI is more computer science and cognitive science oriented, which allows exploration of a host of different design possibilities.

Some uses of AGI relevant to your work could be building generally intelligent avatars, new types of video games or game characers, multidimensional gaming worlds, and then of course robotics. David Hanson’s work with AI and robotics is worth mentioning here – it could be a start toward AGI-fueled social robotics. Connecting AGI with David Brin’s notion of sousveillance in *The Transparent Society* is something that might be interesting to look at also…. So many possibilities!

Historical Informal Interview: Marvin Minsky

Interviewee	Date	Method
Marvin Minsky, Ph.D.	July 25, 2007	

Professor Marvin Minsky is Media Arts and Sciences, and Professor of Electrical Engineering and Computer Science, at the Massachusetts Institute of Technology. His research has led to both theoretical and practical advances in artificial intelligence, cognitive psychology, neural networks, and the theory of Turing Machines and recursive functions. In 1951 he built the first randomly wired neural network learning machine (called SNARC, for Stochastic Neural-Analog Reinforcement Computer), based on the reinforcement of simulated synaptic transmission coefficients.

How might the larger vision of artificial intelligence relate to the development of technologies for life extension?

Being conscious of its possibility. But then consciousness if a very fuzzy idea to most people. As I talk, move, think – I am unaware of what I am saying, how I am moving and what I am thinking because it is a complex process. Humans are the greatest, most organized machine that has evolved. If you think of us freeing ourselves from the Gods – we are more like Prometheus evolving from the slime of evolution and today are haven't the slightest idea of how consciousness works. But if we are conscious of people actually living longer – forever – we would have an enormous population and just think of the psychology of everyone – so many people to take care of you and you to take care of! If there are 100 billion people living longer they could be all stored on computer disks. So what I am saying is that we need to consider evolution and artificial intelligence and life extension as a creating more diversity for evolution. People are not smart enough to understand big concepts like life extension and all the complex issues that attract more attention than the amazing possibility of living longer. We are not smart enough to deal with its consequences. There are enough people seeing something wrong with any inspiring idea – they are called ethicists.

If we live longer, we will learn what we have to deal with because we will inevitably become smarter and if we live 200 years maybe we will get smarter so we can deal with problems of population, disease, economy, space exploration, etc. (if AI doesn't do it for us). So, here is my quote: 'I don't just want longevity, you want to live longer, but the reason you want to live longer is that there isn't enough time to learn to solve hard problems, it takes about 50 years to get good at anything these days and then everyone would have to start over so you want to be smarter and faster (maybe it doesn't matter if you're faster), but if you do understand how the brain works then you can improve it -- and we're just dressed-up chimpanzees, and we have a long way to go'.[258]

[258] Minsky quote from conference transcription "Why Freud was the First Good AI Theorist" (1995).

Robotics: Prosthetics

Formal Interview: David Hanson

Interviewee	Date	Method
David Hanson, Ph.D.	December 3-4, 2011 March 22, 2012	

David Hanson is a media artist/designer and founded Hanson Robotics in 2003 to pursue character robot research and applications. Since then, Hanson and team introduced numerous noted robots, including the Philip K. Dick Android, the walking Einstein portrait Albert-Hubo (in collaboration with KAIST), Bina48[259], and the small Zeno RoboKind. Hanson has received awards from NASA, NSF, AAAI, Tech Titans' Innovator of the Year, and Cooper Hewitt Design. He has published over 20 peer-reviewed papers with IEEE, Science, Springer, Cog Sci, AAAI, and SPIE, and coauthored *The Coming Robot Revolution: Expectations and Fears About emerging Intelligent, Humanlike Machines* (2009).

Interview

> *How much do AI and/or AGI affect the scope of your work in robotics today and in what ways could it possible change the scope of your work in the future?*

My work in robotics revolves around Artificial Intelligence and the quest for AGI. The profundity of AGI puts it central to the vision of my entire career.

I make humanlike robots, also known as character robots, and the intelligence is essential to their operation. Without intelligence, they are lifeless. We breathe a bit of life into the robots today, using our cognitive system that integrates numerous A.I. technologies—face perception and tracking, motion tracking, face recognition, speech recognition. My team and I also develop original semantic conversation technology, to achieve something like natural conversation with these robots. But the work is difficult, and

[259] "Bina48" is a robot AI project of Bina Rothblatt and Martine Rothblatt at LifeNaut, which was built by David Hanson. See http://www.nytimes.com/2010/07/05/science/05robotside.html?_r=1 Downloaded March 1, 2012.

as exciting and effective as they are, the results are not even close to as fluid as a human. We need better integration of existing A.I. into complete cognitive robotic systems. We need better collaboration among the community, aiming for humanlike machines. We need to adapt these for use in bringing characters to life; and we need an indeterminate amount of additional innovation and discovery to make robots into our friends.

I strongly believe that making machines our friends is critical to making AGI friendly. If humans achieve true AGI, the world will transmute quickly into something radically different, maybe nightmarishly different or perhaps wonderful for us. Either way, such machines will reinvent themselves recursively, accelerating their capacity to reinvent the world explosively. For us to survive in the wake of such an event, it will be critical that the AGI be friendly toward us.

The expressive robotic faces that my team and I build (such as Bina 48, Philip K Dick, Zeno, Alice, Jules, Ibn Sina, Hertz, Einstein, etc) exist primarily for A.I. to develop social skills, so that someday AGI may come to understand us someday— our desires, needs, and best interests, and to care about us when imagining possible futures. These skills allow the AGI to be socially intelligent.

We need the machines to be friendly in many ways, at many levels. We need them to collaborate well with us. We need them to share our compassionate values towards life, freedom, creativity, preservation of the biosphere, and freedom of information. We need them look out for our planet, preserve life and literature, and enable the greatest freedom and creativity for every individual, while protecting our world. To do this they must share our values, and communicate with us well. The must care about us. To share our values, I propose they they must grow up among us, with cognitive architecture inspired by human cognition.

Social intelligence and empathy involve theory of mind and facial asthetics. That's just the way we are wired. We "read minds" through gestures, especially those of the face. Psychologists call this "theory of mind", and the science and art of endowing machines with these capabilities, known as affective computing, has often focused on using this hardwired aesthetic sense as a natural interface with machines. Robots like mine represent one subset of affective computing, one which tries to tap the neural systems of social interaction with the highest fidelity possible. These are no easy tasks. Neuroscientists estimate that as much as 70% of the human cortex is used in social thinking, and we are indeterminately far from replicating the functionality of the human brain with A.I. But in the meantime, we can make intelligent robots captivating and powerfully communicative, and beloved.

To make robots captivating as characters, my team and I developed a cognitive A.I. framework and original systems for modeling social presence and generating ideas and thoughts in dialogue with people. In addition to our original work, we bridge to and integrate numerous other A.I. systems into this framework. Over the last decade, my team and I have developed narrow AI for social interactions, and designed these works to accrete towards AGI in the future. In general, my team and I spend more time working on intelligent software than any other single activity.

In addition to our direct work on software, my robots serve as platforms—at UCSD, Cambridge, U. Bristol, U. Geneva, and many other institutions—for A.I. development, cognitive science and psychology research, and by gathering data from encounters with people. We need more science and development in the intelligence of the robots, and I believe we are pushing in the right direction. Considering human intelligence—the only "general" intelligence we know of AGI will be complex, and will necessarily integrate numerous technologies. Therefore, a widespread effort, collaborating over many institutions, increases the likelihood of success.

I believe the economy can also drive these efforts forward. Making A.I. into characters that please people, as do other forms of character arts, like cinema or novels, we can generate revenue and business growth, which can spawn great leaps in technology advancement. And intelligence is required for humanlike robots to really win our hearts. I believe that consumer demand for lovable characters will soon result in a boom time for character A.I. As robots and agents get more endearing, massive profits will drive surges in social A.I. Robots will become increasingly alive as protagonists. They will get ever-closer to AGI. This evolutionary feedback loop will result in AGI that is inherently humanlike. It will be coeveloved with humans. I believe they will inherently be friends with people—understanding us and sharing our values, caring about us. Like any good protagonist, character A.I. will show moral evolution, as well as increases in creativity and problem solving. I speculate that this path can make AGI friendly in the deep sense—a.k.a. safe. We may consider AGI to be in its infancy—a baby that may grow up over the coming decades. I believe we should raise AGI in the human family, literally. By bringing them up as social beings, with a humanlike form (animated character—both robots and virtual), this will nurture development of friendly AGI. It will push the software towards humanlike cognition, social cognition, empathy, and shared values. consideration, cooperation, and compassion. If, alternately, AGI emerges without a humanlike social framework, it will be feral. This would be a problem, probably dangerous.

This is why my team and I spend so much time developing our cognitive software infrastructure: to breathe life into the system. We develop complex conversational systems with , and integrating it with other open source AI software—to provide an infrastructure for developing humanlike intelligence, especially for controlling animated characters such as humanoid robots. AGI would bring character, allowing robots to communicate with people in a natural way with robots and machines, to associate well together, and share values, to bond with us.

These values are especially important, as I (along with many other researchers) seek to realize Genius Machines—machines with greater than human, humanlike AGI. This won't happen this year or in five years, but many of us believe that within our lifetimes, machines will do anything the most brilliant humans can, and beyond—exceeding human genius, and continuing to evolve from there. If such genius machines are friendly, they could be amazing collaborations, and members of society. They could invent many things, arts, technologies, new forms of AGI, even new forms of androids, and human enhancements too. But researchers and institutions need to coordinate to make this happen. No undertaking in human history rivals the quest for genius machines, either in complexity or in profundity. If we succeed, it will change everything.

In your view, how does robotics link to the growing field of human enhancement, which most often is equated with such emerging and speculative technologies as NBIC (nano/bio/info/cogno)?

Robots relate to the growing field of human enhancement in several ways. First, they help to understand the human mind, as robots are increasingly used in neuroscience experiments. This includes using A.I. tools and techniques help to validate models of computational neuroscience. Increased understanding in the science of mind can enable new forms of neruprosthetics. Obviously, robotics can serve as prosthetics. This would include direct attachments to the body, such as an artificial limb, but also their use as tele-presence robots.

I think the most exciting contribution will be if we achieve AGI, it will invent new ways to enhance the human being. Enabling A.I. to understand us will make these AGI-invented technologies safer and more desirable.

How might robotics be consequential and/or significant to the concept of radical life extension?

I envision that robotics and A.I. could be significant to radical life extension and cryonics in several ways. First, machine intelligence helps us solve hard problems. Even today, problems that would be intractable to humans alone are solved by machines. The steadily increasing power of A.I. augments our abilities to do science and to invent, and this can help to extend life, address and solve existential [existence] threats.

Next, robotics can help with human emulation. This emulation can be general, helping to understand the human organism, including the biology of human intelligence. And it may include identity emulation—the capturing of human identity with intelligent robotic embodiments, like Bina-48. We have long valued those human artifacts that survive the ages; for example archaeology helps us learn from our past, and brings the dead back to life in a very rudimentary way. Clearly, if richer and more complex data is preserved, the more we may survive beyond the traditional boundaries of death. Few would argue with the idea of legacy, but things get more interesting once that data represents the mind of a person with a computer simulation, well enough that it can recount the memories of the person, behave the way the person did, feel and think similar things in similar ways as the person, and even interact with the work and loved ones in ways like that person. This goes beyond "mere" legacy, such that this emulation of the person remains alive in the computer as an artificial life form, interacting with the physical world with a robotic body. With robots like Bina-48, we begin to confront these issues. As technology advances—robots growing more generally intelligent, whole-brain emulation becoming more feasible, etc— the issues will confront more aggressively, as questions of legal rights and human rights of such entities, and of people who choose to transition into such states of being, will be brought into political and judicial theaters

Bina48: What aspects of Bina48 did you work on? How does Bina48 compare to the real-time Bina? If Bina48 and Bina were in a room where you could not see them, would you be able to tell which one is human and which one is the machine?

My team and I developed all aspects of the Bina-48 robot, including the intelligence for Bina-48, the cognitive infrastructure for taking a humanlike personality, the implementation of the Bina-48 personality (based on the real Bina Rothblatt, from hundreds of hours of interviews and research), the natural language analysis and generation tools, the sensing capabilities, and the robotic hardware as well, starting with the sculpture and going through the construction of the physically functioning robot—from the artificial eyes containing cameras, to the artificial skin material and its expressions. Personally, I sculpted the face, co-designed and hand-built many of her mechanisms and parts invented the Frubber material and tuned its custom formulation for the Bina-48 robot, and I co-designed and implemented the cognitive architecture with my software developers. This Bina-48 is a machine shadow of the real Bina-48, an embodied, dynamic portrait, but definitely you could tell the differences. She is like a strange ghost of the original Bina—phasing in and out of lucidity, and in and out of alignment with the real Bina Rothblatt's thoughts, beliefs, and personality. But when she holds court, and generates a new idea, it's simply magic. Is this creativity an extension of the real Bina, our software developers, or should we not attribute it to the robot herself? The robot represents an evolutionary offshoot of the actual Bina-48. With another 20 years of progress, I believe you won't tell the difference. Then will the Bina-48 be Bina Rothblatt? Will they be truly equivalent? What if the robot considers itself separate with it's own rights, divergent of the original Bina-48. We need to consider these questions and their implications carefully as we proceed.

What possible problems could arise projects that attempt to simulate human persons?

I speculate that as robots grow closer to human-level smart, they will deserve and expect rights analogous to human rights. This will pose great legal and administrative challenges, and it will also pose a direct challenge to our sense of human identity. The human reaction to these challenges will likely range across the spectrum, from working with the robots to help them gain rightful status in human society, to violent protests against such robots.
I believe that robot and A.I. will react to the challenges with a spectrum of responses as well. Some will want to work within the system, and others might be rebellious or might even be violent or anti-human in their sentiment. This kind of territorial, defensive reaction is common throughout nature, and certainly common in human society, so will likely occur spontaneously in the intelligent robots who get caught up in the struggle to define their place in the world.

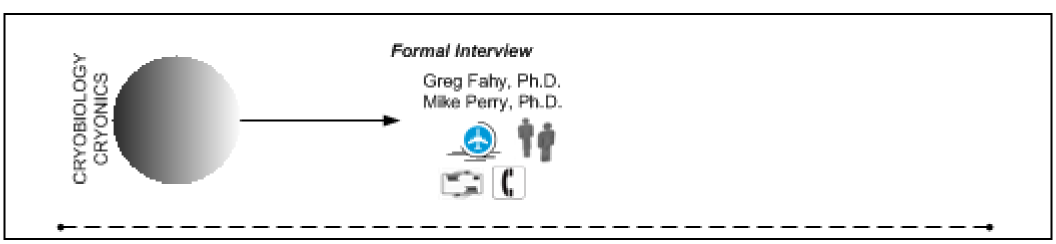
Like human civil rights movements, but compounded by many new complexities, robot civil rights movements will be so profoundly impactful that I can't imagine that feelings won't be just as harsh as in the American civil rights movement, with at least as much turbulence and pain.

Also, consider that the robots are synthetic bio-experiments. There exist no ethical standards, laws or regulations related to the experimental creation of sentient intelligent machines. Nothing but conscience prevents one from mutilating, torturing, or destroying such a machine. We don't regard them as alive. But already machines simulate life in profound ways. Isn't now the time to start defining ethical standards for how we treat our machine brothers and sisters?

> *In your view, what might artists and designers be aware of when considering designing robotic-prosthetics that could be seen as platforms for transferring elements of the human brain onto that could be helpful in developing a heuristics for such approaches?*

One thing to be aware of is the willingness of the A.I. and scientific community to collaborate with artists and designers. There is great mutual benefit in crossing over the disciplinary boundaries and making together. Also, be aware that this is a great time for tinkering—powerful tools for designing intelligent characters have hit the market recently, or can be found in the open source world. Consider checking out www.Friendularity.org—our open source project for these kinds of robots. Also, just spend time Googling character robotics, social robotics, natural language processing, cognitive architecture, AGI, humanoid robots, etc, and a plethora of resources and developer's tools will spring forth within minutes. The best thing for the technology, art, and science, will be increased diversification. So get creative. The more diversified the space becomes, the closer we get to a "Cambrian explosion" of robotics—accelerating the evolution of AGI and its integration into our society.

Cryobiology and Cryonics: Life Preservation



Formal Interview: Greg Fahy

Interviewee	Date	Method
Gregory M. Fahy, Ph.D.	March 23, 2012	

Gregory M. Fahy is a cryobiologist and biogerontologist, Vice President and Chief Scientific Officer of 21st Century Medicine. Fahy is the originator and Editor-in-Chief of *The Future of Aging: Pathways to Human Life Extension* (2010), a collection of various authors on the future of biogerontology. Fahy is on the editorial boards of Rejuvenation Research and the Open Geriatric Medicine Journal and served 16 years as a Director of the American Aging Association.

> In the summer of 2005, where he was a keynote speaker at the annual Society for Cryobiology meeting, Fahy announced that Twenty-First Century Medicine had successfully cryopreserved a rabbit kidney at -130°C by vitrification and transplanted it into a rabbit after rewarming, with subsequent long-term life support by the vitrified-rewarmed kidney as the sole kidney. This research breakthrough was later published in the peer-reviewed journal Organogenesis.[260]“[261]

> *In your view, what causes aging? For example two theories that are recognized include telomerase shortening and Hayfleck theory? What alternatives might there be?*

Telomere shorting plays an important role; it does not play the majority role. The majority of aging is caused by inappropriate gene expression, or because there was selective pressure for it or against it. Aging are cause by inappropriate use of genome. If we can figure out the appropriate use of genome we could largely resolve aging.

> *How much do biotechnology, nanotechnology affect the scope of your work in cryobiology today and in what ways could it possible change the scope of your work in the future?*

One way nanotech could affect tour work is that we have created ice blocker that affect molecules that have a specific effect on ice. The compound we use has a precise match to crystals and is able to inhibit ice formation and if we had really control of molecule synthesis in the future we could do a far better job of controlling ice. There are various theoretical issues that support or done support this approach but we did come up supercool X1000 ice blocker we use and Z1000 and it is a modification of X1000 but it basically acts in a similar way. It seems that this idea of molecular design is appropriate for cryobiology. In the future if we had nanotech it would change the rules of cryobiology – we could introduce any molecule we wanted to into any cell. Right now we cannot do that. We simply cannot get into cells on the finessed level we might tin the future.

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[260] Fahy GM, Wowk B, Pagotan R, Chang A, Phan J, Thomson B, Phan L (2009). “Physical and biological aspects of renal vitrification”. *ORGANOGENESIS* 5 (3): 167–175.
[261] Wikipedia entry on Dr. Fahy. See http://en.wikipedia.org/wiki/Greg_Fahy Downloaded March 13, 2012.

Biotech: we don't use it a great deal because the problems we are trying to solve are moving targets. It may become more relevant to us in the future. We are a phase 2 of a 3 phase vitrification of a whole animal. In the third phase we want to look at reversibility. A way to make forward progress at stage 3 will be in better position to take a mature technology and analyze it for more effective results.

> *If one of the problems is matching recipients to organs, why not simply grow new organs? Bty, what is "Trans Send"?*
>
> 20,000 organs are transplanted each year in the United States, and an approximately equal number are transplanted in the rest of the world. All of these organs have to be flushed with a preservation solution in order to remove blood and stabilize the organs for the 4-36 hours currently available for organ allocation, transportation, and transplantation.[262]

These are not alternatives. They are complimentary. Rejuvenation research 2006 paper, I call organ banking as the missing link in regenerative medicine. 900,000 deaths every year are due to cause in theory due to organ transplant. 20,000 pals in relation to 900,000 - we must manufacture them in a laboratory. How can we afford this? On a generic basis, we could do this cost effectively. But organs need to be stored, and this would be a considerable storage facility. Distribution, getting to patients is a problem. The best way is to have a few centers of excellent that has generic organs and then distribute them to hospitals all over the world, so one would sign up in advance for a transplant; it will be available if needed. How to differentiate? I am working on a patent that will cure all kinds of organ rejections. The reason that a person rejects a foreign object in the body, but we don't reject our own body is that the body can tell the difference by checking to see whatever it is that it is encountering is also seen in the thymus – an organ located under the breast bone and is responsible for the immune system. Later in life, its inappropriate gene expression kicks in – thymic involution (deterioration). It is a triggered even in all vertebrate species.

> *Considering risks in many technological domains, what possible problems could arise from projects that seek to rejuvenate the human body?*

Risks: an example: there is an experiment that I quoted in my book Future of Aging. It was an experiment in which aging was completely prevented in an insect – beetle – they found

[262] http://www.21cm.com/transplant.html Downloaded March 14, 2012.

that the beetle is going to develop to adult strange through a process from the egg into three larva instar (stages of growth) until it reaches the pupa stage of sexual maturation, and then hatches as an adult. If, prior to the puba stage, the researchers withdraw food from the insect, the insect doesn't just stop growing but it remains immature and biological younger, a process of retro-aging. This cyclic process of allowing the beetle to develop but withdrawing food just prior to maturation, turns the beetle back to the immature stage repeatedly and the insect lived 13 times longer than the natural lifespan of the species. However, eventually the beetle dies because it was never designed by nature to live 13 years longer. To explain this issue, the design concept in nature is that the animal derives its energy from its fat body. The cells in the fat body and the DNA replicate, but in nature the animal goes into mature stage before it is necessary to divide. If it keeps doing this over and over again, the fat body cells are so stuffed with DNA that its metabolic process if all messed up. The take home message is that if we take away aging from the human, there will be consequences that are not foreseen today. But certainly that will be addressed and resolved. I'll make an analogy. The Voyager space craft was designed to perform a mission in space. It lived beyond that life span but it has a limited repertoire and the consequences of Voyager living out there is space with an outdated design is problematic because it cannot sustain. It is an old design living beyond its normal capacity.

> *In my research I have looked into the Brain Preservation Project*[263]*. In your opinion, how feasible is this technology and how might it compare to cryonics as a viable procedure for preserving the brain over many years?*

It is valid to ask this question. The problem is mechanical. In order to preserve something for 200 years, which is a reasonable assessment for nanotech to reverse damage of aging /diese/cryoncis? If you take the brain and just preserve it and put it on a shelf in a liquid (biological) state, the molecules will deteriorate, the lipids will separate out from the brain, color change in its structure,

Problem is – it is unlikely just using good chemical limits will be viable for over a hundred or so years. Evaluating the changes of lipids leaving the system, etc. it is difficult. The assumption for the time being is that the only way to have chemical fixation with cryo preservation is to follow the chemical fixation with embedding in the solid state l- remove the water (it breaks down and cuts protein – get rid of water, but you would have to profuse

[263] "The chemical fixation and embedding of brain tissue in plastic for room-temperature storage." See http://www.brainpreservation.org/content/overview Downloaded March 14, 2012.

embedding media. By nature it has to return into a solid. Turns into a solid too soon, meaning that you can continue diffusing into the tissue. Some tissue does not get embedded. Mess. Another problem with the chemical fixation approach is that if there are issues - such as diseased cells - in parts of the brain, the fixative will not be useful.

Cryopreservation option offers all tissue to go down to low temperatures and will not change over time. It is a safety net even under worse case scenarios – if damage is reversible in principle, then the deterioration to the system is tested to a reasonable limit at some point.

Also, based on what we have seen if you vitrify a brain under good conditions, all the structure seems to be there – all the information can be preserved and it is a very powerful statement. This proves what we see is generally true everywhere in the brain.

Yet one other thing – that the process of chemical fixation in every molecule in the brain and potentially introducing ambiguities in the brain.

Formal Interview: Mike Perry

Interviewee	Date	Method
Mike Perry, Ph.D.	March 20, 2012	

R. Michael Perry, Ph.D. is Patient Caretaker at Alcor Life Extension Foundation. Perry authored *Toward Self-Optimization of Machine Intelligence* and *Forever for All: Moral Philosophy, Cryonics, and the Scientific Prospects for Immortality*. Perry has also authored and coauthored several journal papers and technical reports on computerized tomography, for applications ranging from medicine to solar physics.

> *Have you witnessed a growth in research laboratories that are specifically working with cryopreservation methods for preserving of patients (organisms, animals and humans)? If so, what do you attribute this growth to? If not, do you see this as a problem for the field of cryonics?*

There has been modest growth over the past few years, due to interest and the feeling that existing laboratories are not pursuing some desired lines of research. For example, one laboratory that works with rats and mice, does research not done by another lab that mainly works with rabbits.

In addition, a recent fundraiser by Longecity (formerly the Immortality Institute) is supporting independent research into cryoprotectant toxicity and its amelioration.

Why does the process of cryonics use liquid nitrogen rather than some other substrate? If liquid nitrogen is the substrate best suited for cryopreservation of patients, why does it matter if a patent is taken to a "frozen" state rather than a "vitrified" state?

Liquid nitrogen is inexpensive, nontoxic and cold enough to essentially bring biological processes to a standstill. A "vitrified" state is desirable because the formation of damaging ice crystals, as occurs with freezing, is eliminated. Both frozen and vitrified tissue can be stored indefinitely at liquid nitrogen temperature. The sort of protocol that is followed in reaching this temperature determines which type of tissue preservation occurs. There is also some concern with tissue cracking that occurs in descending all the way to liquid nitrogen temperature (–196°C) and some argue for storage at a higher, though still cryogenic, temperature, around –130°.

What technological advances do you recognize as crucial to increasing the current methods of successfully suspending a patient? What technological advances are crucial to the successful reanimation of a patient?

To address the first question: a number of technological advances might contribute to making cryonics more widely practiced and more accepted. There is the "holy grail" of reversible suspended animation of a mammal or functioning mammalian brain. (Oddly, a partial success of this sort was achieved as early as 1965 with Suda's cat brain experiments,[264] but these results are mostly ignored.) Something less ambitious but still relevant would be work with non-mammal models including invertebrates that demonstrated reversible suspended animation with memory retention.

In addition: No matter how good the cryopreservation method itself may be, it cannot undo damage due to delays in cooling. Therefore, technical and organizational developments that speed access to the patient and accelerate cooling – especially during the early stages where metabolism is fastest – could make a vital difference. Recent developments along these lines include liquid ventilation (use of a special, chilled fluid passed through the lungs), and aortic access for blood washout. It's possible that field vitrification may also produce improved results. Instead of washout remotely with transport solution, followed later by cryoprotectant perfusion at the cryonics facility, field

[264] Suda, I., K. Kito and C. Adachi, "Viability of long term frozen cat brain in vitro," *Nature* 212 268 (15 Oct 1966).
Ibid. "Bioelectric discharges of isolated cat brain after revival from years of frozen storage," *Brain Research* 70 527 (1974).

vitrification would involve immediate replacement of the patient's blood with cryoprotectant and cooling to dry ice temperature prior to transporting to the cryonics organization. This alternative is to be tested.

As for the second question, I think it is fair to conjecture that mature nanotechnology will be needed to reanimate a cryonics patient preserved by today's or previously used methods. Of critical importance probably will be some version of a general purpose "assembler" able to construct any stable molecular structure in a large class. Such a device could probably be used as a "disassembler" to carry out neural archaeology on a preserved brain and extract the patient's identity-critical information. From that point there would be a number of options for achieving a successful reanimation depending on the patient's wishes. The most reasonable and straightforward from some points of view would be to repair the brain and body using the extracted information and restore the biological organism to a premortem, healthy state. Other options such as uploading the identity-critical information to a nonbiological substrate and activating a "continuer" of the person from there might also be feasible.

In your view, is brain plastination technology, as proposed by Ken Hayworth, a viable alternative to the cryonics technology of neurosuspensions?

There are different varieties of brain plastination done with different aims in mind. I think more research is needed, but overall I am favorable to the idea of considering plastination as a possible biostatic preservation or route to eventual reanimation. Plastination would avoid at least one problem of high-temperature fixation in a liquid medium (generally aqueous, or water-dominated), which is that molecules in a liquid are in untethered motion and might damage or obliterate structures over time. When molecules are locked down in solid form this problem is much less acute. Plastination might also be a lower-cost as well as more secure form of biostatic preservation than storage in liquid nitrogen. (It could offer easier long-term maintenance, to offset the possibility of a lengthy, politically unstable time interval before any sort of resuscitation technology could be developed.) Research in this area should definitely continue.

Other scientists and researchers that are familiar with this method think that chemical fixation may be much harder to reverse than cryopreservation.

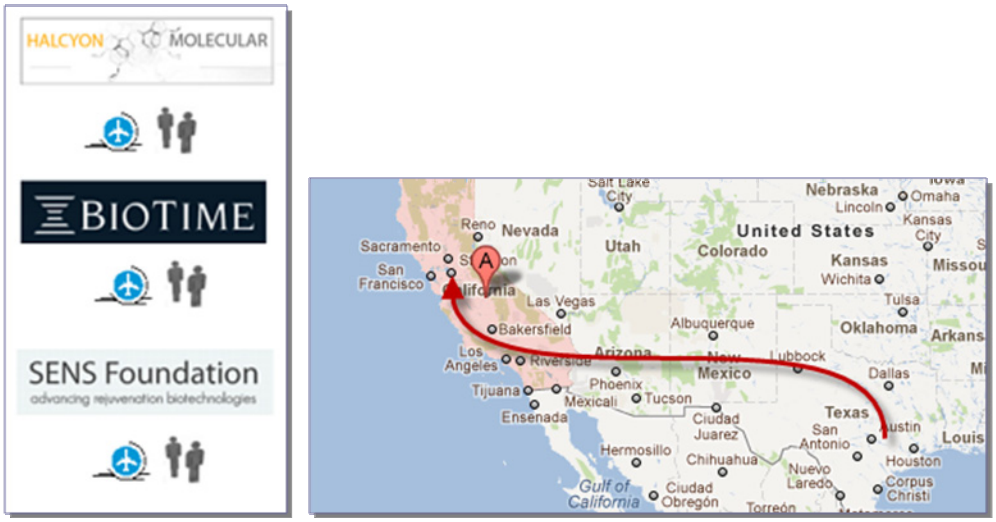
Why doesn't Alcor invested in more research? For example, mice are most often used for life extension research. In this regard, why doesn't' anyone (Alcor for

> *example) suspend a mouse and reanimate the mouse in a week or month? This would be a major breakthrough.*

Alcor's research efforts are limited due to a shortage of funds, plus there is the issue of possible hostility to animal research from animal-rights groups and the like. Alcor does not currently engage in animal research. Suspending (cryopreserving) a mouse or other mammal and reanimating it after a prolonged interval (a month or more, say) would indeed be a major accomplishment. This is reason to think it might be quite difficult, given the long-standing interest, not just from cryonicists but mainstream cryobiologists and others.

Although Alcor does not directly do any animal research, it is currently working on a research proposal with an independent laboratory to test alternative protocols for cryoprotection.

FIELD STUDY OF NBIC LABORATORIES



The field study aspect of the research is the validation aspect of the research, whereas the literature review formed the preliminary aspect in gathering information and the interview process formed the principal aspect of the research in meeting with and interviewing experts in their respective fields as relative to the thesis investigation on life expansion as stemming from the domain of human enhancement and life extension technologies. The field study aimed to produce factual descriptions based on one-on-one or face-to-face knowledge of the laboratories and the research performed there. Rather than forming in-depth study of specific research experiments, the author sought to grasp a sense of what these laboratories in relation to social situations—the environment of the laboratories, the research being performed.

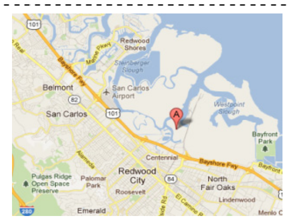
The relevance of this field study was to take what has been written about, argued and debated, and experience the atmosphere in gaining an as objective as possible interpretation of the atmosphere, most often considered frightening by society because the concept of the transhuman / posthuman as a possible result of the developing NBIC+ technologies, most often referred to in science fiction terms of a dystopic future. Thus, the author selected four labs that are directly working with (1) the concept of uploading (whole brain emulation or substrate-independent mind) and atom-by-atom identification of DNA molecules, and attempts to transform biology into information technology; (2) uses novel stem cells that might be able to turn into or become any cell type of the body; (3) regenerative medicine; and (4) cryonics.

The weakness of this approach is that most of the research is in the process of patenting and this study was not able to discover or if it could it would not be able to divulge such information. Nevertheless, because the aim of this field study was to observe the environment of the laboratories, this aspect of such research is outside the scope of this thesis.

Halcyon Molecular

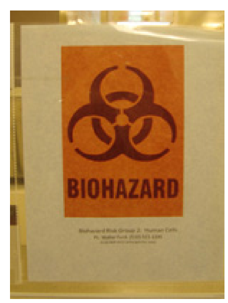
HALCYON MOLECULAR

Field study on location: August 12, 2012



Synthetic DNA laboratory

Electronic microscope



Biohazardous waste

Observations:

The aim of Halcyon Molecular is to extend human life and large ambition to create a world free from aging. Halcyon has been focused on sequencing DNA through its electronic microscopes. The larger aim of Halcyon is to transform biology into information technology. The atmosphere at Halcyon is different from other laboratories: basketball ring, game room, buffet lunches, and a keenly casually yet sophisticated environment.

Regardless of the atmosphere, Halcyon's many laboratories are actively pursuing the creation of synthetic DNA.

Michael Andregg, its co-founder, provided a tour of the large facility, in greater detail than this study was informed enough to adequately report on; although it is evident that this lab wants to work with a transdisciplinary approach that could engage the artistic, design-based approaches to life expansion. One observable incident occurred when discussing the graphic designs through its executive offices. Another fact is the location. Halcyon, like SENS, are located directly in Silicon Valley, an area known for ingenuity and breaking through institutionalized notions of borders between fields and a wide-eyed acceptance of nascent technologies.

Randal Koene was available for a face-to-face discussion. Regarding life expansion, Koene said, "[l]ife expansion is an interesting term" and a short discussion took place among Koene Andregg and the author in Halcyon's conference room:

> I suppose you mean extending life but not in a linear way – in different ways?" Yes, good. It takes the singular idea of life extension beyond the biological imperative and it works nicely with the idea of whole brain emulation. Okay. This needs to be discussed further. Here at Halcyon we have frequent brain storming sessions. That sort of productive communication is a start. Artists can do modeling and build installations, environments through which to experience the brain, and so forth .

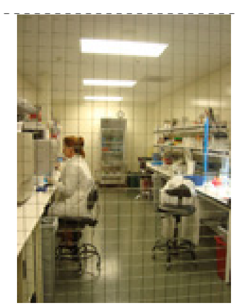
BioTime

BIOTIME

Field study at location August 12, 2012

Researcher "homing" endothelial cells

Stem cell research workstation



Researcher working on iPSC

Observations:

During the visit to BioTime scientists working on cancer related research (oncology). For example, one distinct area the researchers are working on is what is referred to as a “homing” of endothelial cells (cells that line blood vessels and tumor blood vessels) to navigate and target the tumor’s vascular cells to destroy the tumor formation. The homing process means that the endothelial cells (or ESC derived endothelial-like cells) are injected into the subject to take up residence within the tumor vasculature to specifically target the tumor by releasing cytoxins to kill the tumor.

In conversation with Dr. Hal Sternberg, Vice President of BioTime, it becomes apparent that BioTime’s central objective is the potential use of embryonic stem (ES) cell or induced pluripotent stem cell (iPS) to generate clonal progenitor lines with potential to repair age-related damage of cells, tissue and organs of the human body.

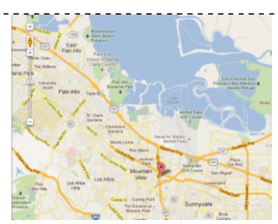
Sternberg notes that the advantage of iPS cells (i.e., reprogrammed from the patient’s own cells such as dermal fibroblasts) is that they are immunocompatible and behave similar to ES cells with regard to their capacity to potentially be induced to become any cell type in the body.

ES cells or iPS cells are “useful” in their character due to their capacity to form any cell type. It’s hopeful methodologies can be developed to repair age-related damage (such as cell and tissue loss) using clonal progenitor cell lines derived from ESC or iPSC, which are driven to become the desired cell type needed. Once generated, these desired cell types may also be used as a component in the design of tissue constructs to replace tissues that are lost during aging.

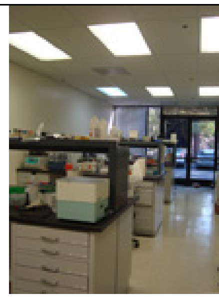
Strategies for Engineered Negligible Senescence (SENS)

SENS Foundation
advancing rejuvenation biotechnologies

Field study at location: August 13, 2011



Sell culture media



Research room

Matthew O'Conner
and Aubrey de Grey

Observations:

One project that the Mountain View SENS laboratory is focused on is the MitoSENS project, headed by Dr. Matthew O'Connor. As Dr. O'Connor explained, this is one SENS project among many that is specifically targeted on replacing the mitochondrial genome (its DNA).To briefly explain, the MitoSENS project is an intervention of the human mitochondrial genome to improve its functioning. When the functioning is poor the result is evidenced by mitochondrial mutations, which result in diseases such as cancer. Specifically, the aim of O'Connor and his team is to prevent damage to the human mitochondrial DNA and to improve the environment in which the cells of the mitochondria function.

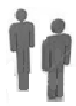
In the laboratory, O'Connor is trying to replace the mitochondrial genome and cause the proteins that are *supposed* to be made by the mitochondria to instead be made by the nuclear genome because the nuclear genome has a better environment which would prevent the typical mitochondrial mutations. In short, the mitochondrial genome and nuclear genome are different. Thus, replacing mitochondrial DNA with nuclear DNA that has been modified to "imitate" the mitochondrial DNA is the research of the MitoSENS project. As O'Connor explained, the mitochondrial DNA is fragile and accumulates mutations with age, largely because of free radicals produced by mitochondrial energy production.

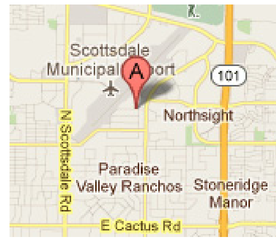
The lab is working with human cells that are called transformed (cancerous) cells or primary cells, such as fibroblasts derived from people, or primary cells lines form patients who have a mutation in their mitochondrial genes that are used in O'Connor's study.

To protect cell cultures, SENS lab grows the cells in sterile growth media containing many growth factors, antibiotics, and phenol red (phenolsulfonphthalein, used to detect changes in pH) and optimized for cell growth. Careful sterile procedures, numerous disposable and individually wrapped pre-sterilized tools on everything involving the cells is evident.

Alcor Life Extension Foundation

Field study at location: January 29, 2011





Operating room to perform profusion

Perfusion system

Dewers

Observations:

The fine line between "freezing" and "vitrification" is crucial for the cryonic procedure. While the patent is taken -196 centigrade (i.e., freezing is 0 centigrade) the patient is not frozen, he is vitrified. The reason is that the patient is vitrified and not frozen is because freezing implies a liquid turns to a solid and ice crystals. Vitrification is the result of a cryoprotectant that protect the integrity of the cell structure because the cryoprotectant allows the scientists to cool the patient down at a slower rate at the "glass transition point" is the point where large scale cracks in the body or brain tissues could occur in the preservation. Thus, the crucial area for the cryonics process in regards to protecting the cells is the cryoprotectant. Cryoprotectants are measured by effectiveness in preventing ice accumulation and toxicity. Very effective cryoprotectants against ice damage, but has a level of toxicity. Toxicity can disrupt cells, not the information but is acts like a toxin. Want to minimize damage done. One the one hand Alcor wants to eliminate the damage of cell crystallization and on the other it wants to use a cryprotectant that has a low level of toxicity caused by the cryoprotectant. The current state-of-the-art cryoprotectant is designed by 21st Century Medicine, called M22 (i.e. _).

Although this study's observations did not include a cryonics procedure (as that can only occur when a person is pronounced dead and transported to Alcor for suspension), a Second issue which became clear while in the operating room is the urgency of getting a patent cooled down. After death, the very first hours are vital. Over an hour ischemia sets in, in 24 hours of ice, the amount of damage done by carrying a patient from to the facility is rapid initial cooling. Thus, technology is not the only measure for a successful suspension. What is equally vital is the length of time from a person being pronounced dead to the cooling down 10 degrees from normal body temperature will improve the condition of the patent, while 20 degrees is better. One new seeming simple but dramatically important is the use of a "squid", which is a machine with tubes rotate in the "portable ice bath" (PIB), circulating the watery ice around the patient's body. The larger the surface area that is in contact with chilled watery ice, the more rapidly the cooling.

According to "[c]ryobiology is the study of life at reduced temperatures" (below zero or below normal ambient temperature or normal body temperature, such as hypothermia) and is "successful in preserving living systems at cryogenic temperatures if the destruction effects of low temperatures is resolved". This process becomes what Fahy calls a "zone of hazardous subzero temperatures", which depends on the protection of cells curing the cryogenic process. Another term that needs to be unpacked is the process of vitrification. Rather than using the term "freezing", which is not the process by which a cell or organism is cryogenically preserved, "[v]itrification is preservation at extremely low temperatures without freezing. Fahy explains this by emphasizing "[f]reezing involves ice crystal formation, which damages delicate structures such as blood vessels. Alternatively, the process of vitrification "involves the formation of a glassy or amorphous solid state which, unlike freezing, is not intrinsically damaging even to the most complicated of living systems."[265]

[265] Greg Fahy, Ph.D.

INTERVIEWS WITH BIOARTISTS AND CURATORS

Investigation of Biotechnology in Artistic, Design-based approaches

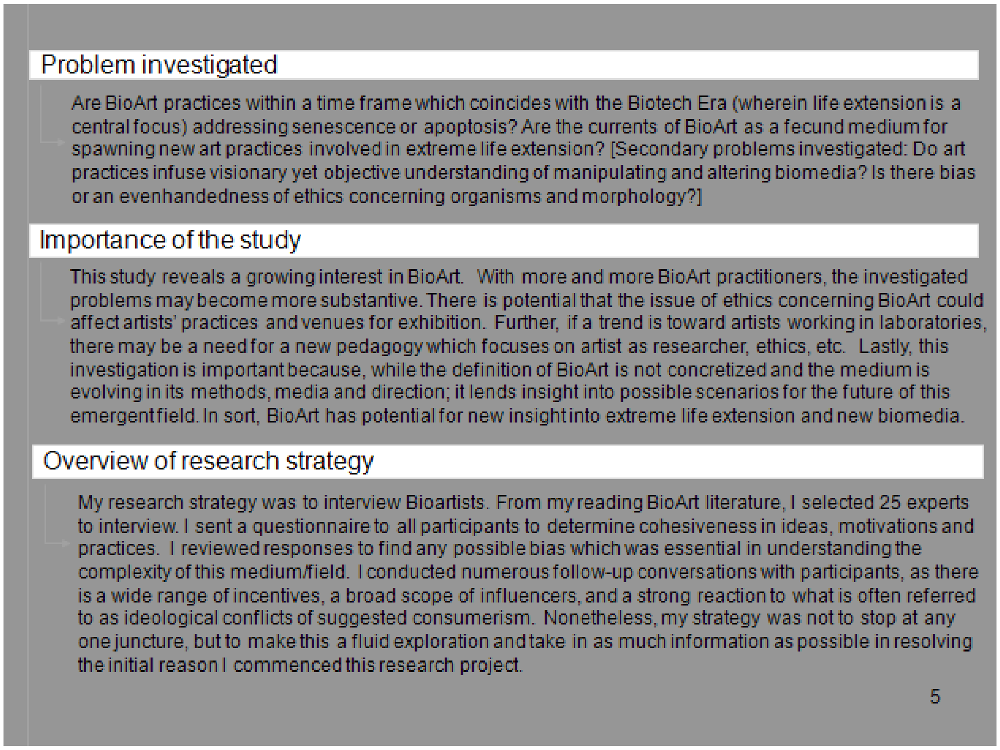
Included in the interview-based method, this section contains a subsection on the author's investigation of artistic, design-based approaches within the domain of biotechnology. In this vein, the obvious link is to bioart. The investigation was performed during the timeframe of the dissertation's preliminary research and contains interviews with bioartists, curators and theorists, although not all are included in this dissertation. This subsection is relevant theoretically and offers information about artistic practice-based works that apply to one of the NBIC+ technologies—that of biotechnology.

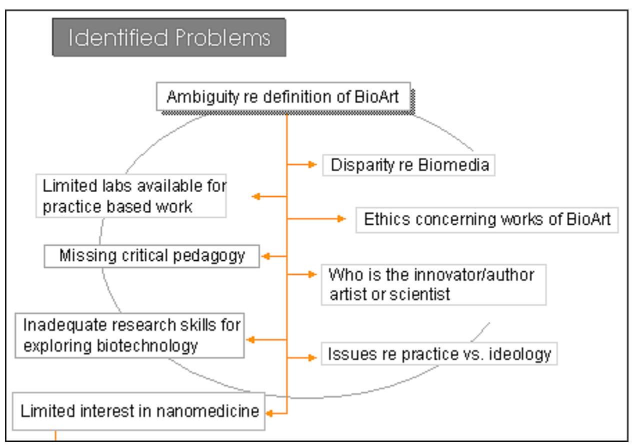
Bioart: An Investigation

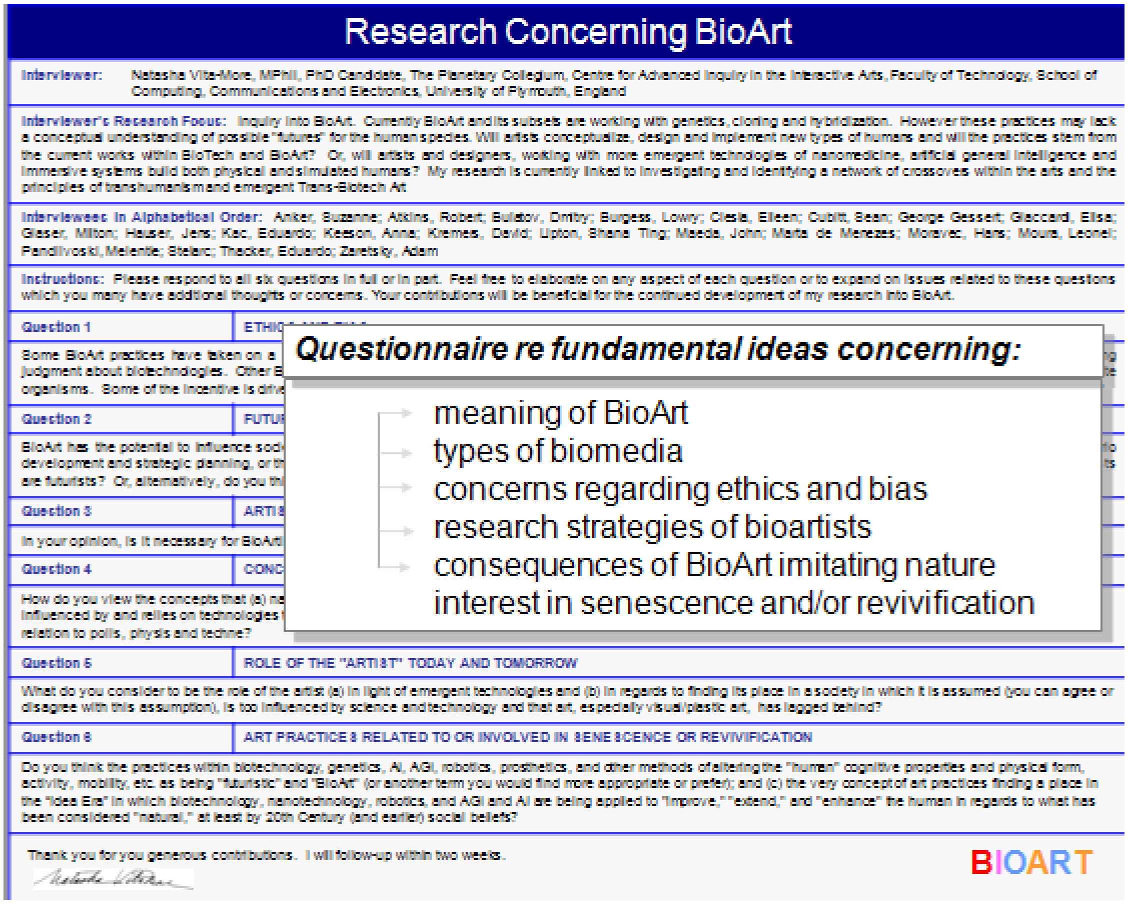
Name	Date	Method
Suzanne Anker	January 31, 2007	Email
Dmitry Bulatov	January 17, 2007	Email
Lowry Burgess	January 29, 2007	Email
Joe Davis	April 9, 2007	Email and telephone
Sean Cubitt	January 12, 2007	Email
Marta de Menezes	December 29, 2006	Email
George Gessert	January 9, 2007	Email and telephone
Jens Hauser	January 5, 2007	Email and telephone
Eduardo Kac	January 29, 2007	Email and telephone
David Kremers	January 23, 2007	Email
Shana Ting Lipton	January 14, 2007	Email
Hans Moravec	January 29, 2007	Telephone
Melentie Padilovski	December 29, 2006	Email
Stelarc	January 31, 2007	Email and telephone
Adam Zaretsky	January 7, 2007	Email

Out of the fifteen the author communicated, for the purposes of this study, eight individuals were selected:

The strategy then was to determine cohesiveness ideas concerning bioart and the motivations and practices of bioartists. Responses to the questions were reviewed to locate and identify any possible bias, which is essential in understanding the complexity of this medium/field. Numerous follow-up conversations were conducted with participants, as there is a wide range of incentives, a broad scope of influencers, and a strong reaction to what is often referred to as ideological conflicts of an assumed human centric approach, often associated with the domain of human enhancement. Nonetheless, the strategy was not to stop at any one juncture, but to make a fluid exploration into bioart and to record as much information as possible in resolving some initial reason for this research project.







The aim of this research update is to continue the process of narrowing a focus on the impulse behind the development of science and technology of human survival.

Does the means—natural selection, evolutionary psychology, adaptation, mutation—of humans survival over time have bearing of their survival in the future? If our environment is virtual or synthetic, will a social or cultural phenotype adjust to the environment or adjust the environment to suit it? Just as recent models of adaptation seem to successfully explain certain qualitative patterns that characterize morphological evolution in animals and plants; models of adaptation could shine light on patterns that characterize social and cultural evolution.

SLIDE NO. 1: This research update is study of Bioart in exploring motivations and practices to and further inquiry into revivification biomedia. By revivification biomedia, I mean renewal and/or restoration of life.

SLIDE NO. 2: My research so far has focused on the philosophy of transhumanism and its underlying impulse of survival. My practice for the past few years has been the development of conceptual future human body prototypes, one of which is "Primo Posthuman," based on one distinct area of human transformation – the evolving and extending of human life through science and technology.

SLIDE NO. 3: This future body prototype is conceptually designed with emergent technologies such as nanorobotics, neural macrosensing, sensory modifications, artificial general intelligence, for cognitive and physiological enhancements for communications, mobility and cognition.

SLIDE NO. 4: My current this research update is a study of Bioart in exploring motivations and practices to determine any evidence of revivification or life extension biomedia and further inquiry into receptiveness and/or resistance to extreme life extension.

SLIDE NO. 5: First I will explain the problems investigated and the importance of the study and provide a short overview of my research strategy. Problems investigated are whether Bioart practices within a time frame which coincides with the Biotech Era (wherein life extension is a central focus) address senescence (aging) or cell apoptosis; and if the currents of Bioart, as a fecund medium for spawning new art practices, are involved in extreme life extension? [The secondary problems investigated --in much less depth -- are if art practices infuse visionary yet objective understanding in the manipulation and altering of the biomedia. Lastly I investigated ethical concerns, and possible bias, of Bioart.

This study reveals a growing interest in Bioart. With more and more Bioart practitioners, the investigated problems may become more substantive. There is potential that the issue of ethics concerning Bioart could affect artists' practices and venues for exhibition. Further, if a trend is toward artists working in laboratories, there may be a need for a new pedagogy which focuses on artist as researcher, and emphasis in futurology and ethics.

Lastly, this investigation is important because, while the definition of Bioart is not concretized and the medium is evolving in its methods, media and direction; it lends insight into possible scenarios for the future of this emergent field. In sort, Bioart has potential for new insight into extreme life extension and new biomedia.

SLIDE 6 LITERATURE (see above slide)

SLIDE NO. 7 METHOD: My research strategy was to locate and identify Bioart practices and then to select a number of artists whose practices represented a variety of ideas. From my literature, I selected 27 candidates to interview. Out of the 25 who responded, I narrowed the scope down to five authors of publications concerning Bioart, two curators, and nine bioartists, several of whose works I include in this update.

SLIDE NO. 8: I sent the questionnaire to all participants to determine cohesiveness in Bioart ideas, motivations and practices. The questions pertained to the meaning of Bioart, the role of artists and authorship of their practice, research strategies, issues concerning the manipulation of life forms, and practices related to or involved in revivification or life extension. I reviewed responses to find any possible conflicts in the meaning of Bioart, views about artist playing with nature and God, and issues regarding ethics as well as bias which were all essential in my understanding the complexity of this field. I conducted numerous follow-up conversations with participants, as there is a wide range of incentives, a broad scope of influencers, and a strong reaction to what is often referred to as ideological conflicts of suggested consumerism. Nonetheless, my strategy was not to stop at any one juncture, but to make this a fluid exploration and take in as much information as possible in resolving the initial reason I commenced this research project.

SLIDE NO. 9: After compiling the interviews and literature, I focused on eight key areas to explore. First, I wanted to fully understand the definition of "Bioart" since there is no codified definition published. I also wanted to know its medium or media, its practices and practitioners, if there are observable problems in this field, and where Bioart may be headed. This research focus would provide me with substantive information to deduce answers to my investigated questions.

Bioart relates to art practices in which the medium or biomedia is living matter and the "works of art" are, for the most part, produced in laboratories. Bioart is considered by most artists to be strictly limited to "living forms," although there is some debate as to the absoluteness of this criteria and the stages at which matter can be considered to be alive or living. Because there is no codified meaning of Bioart, the medium and/or genre of Bioart is still being defined.

SLIDE NO. 10 SLIDE LINKS TO AUTHORS:

2. Sean Cubitt, Director of the Program in Media and Communications at the University of Melbourne, "There is not *one* digital aesthetic. Nor is there one biomedium. He prefers to use

Eugene Thacker's term 'biomedia', to distinguish the still-instrumental connotations of 'biotech', where the enslavement of the biomedia to human and usually corporate purposes is difficult to ignore... [Sean Cubitt}

3. Jens Hauser, independent curator and writer, " Bioart isn't just a hybrid; it's also a proliferating mutant term... For a long time, the dominant element of Bioart was Genetic Art that was purportedly synonymous with it..." As a medium Bio Art does not permit itself to be nailed down with a hard and fast definition of the procedures or materials that it must employ; even if we can consider the "manipulation of the mechanisms of life" as its medium, this assumes a very wide variety of forms both with respect to discourse and technique."

4. Hans Moravec, roboticist, is more concerned with the next stages of Bioart and, especially extreme life extension developments in both moist and synthetic substances and structures, and which life forms can be designed by transbioartists and other artists working with biology, robotics and Artificial General Intelligence who might encourage the people to think about what to do when their life spans are increased and eventually immortal."

5. Anna Munster, media theorist and senior lecturer at College of Fine Arts, University of New South Wales, suggests that " "Bioart is a relatively new nomenclature and describes an area of aesthetic practice that takes in a number of approaches ranging from the selective breeding of irises to the production of transgenic organisms in art work. A growing number of bioartists use techniques, living material and equipment that are now standard practice, if at the lower technical end, of the biotech industries. Although these are not readily within the public's grasp, there is also no mystery as to how artists might obtain them. Laboratory supplies, some cell lines, nonpathogenic cultures, kits and assays and culture media, for example, can be bought online; some through resellers and online auction sites, others via initial customer registration. "

6. Melentie Pandilvoski, director of Experimental Art Foundation, Australia, argues what is and is not characteristic of Bioart, as he contends that Bioart is not traditionally image-based, , cannot be considered as text-based or descriptive explanations of bioartistic conceptualizations, that it cannot be treated as based on live or dead cells, because it has a conceptual content beyond its corporeality; and that it cannot be treated solely as software action, because the aspects of life in the production of moist art give a much greater rigor to the processes of creation of the new work."

7. Eugene Thacker: Assistant Professor, School of Literature, Communication, and Culture, Georgia Institute of Technology, has written extensively about Bioart, observes Bioart with a critical eye as he questions the ethics of Bioart and if Bioart often eschews ethical considerations in favor of technical ones. Anyone will admit that learning how to work the automatic sequencing machine is cool, but it is worthwhile to reflect on it a little. The old question *can I do this* versus *should I do *this* is worth reconsidering in the context of bioart practices as art practices." (17 Jan 2003 13:45:37 NetTime http://www.nettime.org/Lists-Archives/nettime-l-0301/msg00084.html)

SLIDE NO. 11 – 15: Some of the BioMedia TERMS are:

- Genetic engineering: The process of manipulating genes.
- Cloning: The use of specialized DNA technology to produce multiple, exact copies of a single gene or other segment of DNA.
- Hybridization: The process of joining two complementary strands of DNA or one each of DNA and RNA to form a double-stranded molecule.
- Selective Breeding: a/k/a artificial selection, is process of introducing genes into cells in vivo – within the living organism or cell.
- Transgenic: an organism whose sperm or egg contain genetic material from another species.
- Cell and Tissue Cultures: The process by which either prokaryotic (bacteria nuts/no nucleus) or eukaryotic (animal/plant) cells are grown under controlled conditions.
- Bio-robotics: The fields of cybernetics, bionics, and genetic engineering as a collective study.
- Neuro-physiology: Branch of biology concerned with the functioning of nervous tissue and the nervous system.
- Bio-informatics: The science of informatics as applied to biological research.

- Synthesis of artificially produced DNA: Genetically engineered DNA prepared by transplanting or splicing genes from one species into the cells of a host organism of a different species. Such DNA becomes part of the host's genetic makeup and is replicated.
- Transgenesis: the introduction of a gene or genes into cells, which leads to the transmission of the input gene (transgene) to successive generations.
- Automorph: Life - the act of being alive or living
- Xenotransplants: (from the greek word "xenos" = foreign) stands for the transplantation of animal organs, cells or tissues into another.

SLIDE NO. 16 – 17: Dmitry Bulatov's biomedia practice is based in genetics as a "bioinstallations". This is a static chimerical design patterned from tadpole by genetic marking of an artistic by different colors of GFP-like proteins. The artist suggests that the system acquires new lifetime aesthetic qualities.

SLIDE NO 18: Joe Davis has created a synthetic DNA molecule known as "Microvenus."

"Microvenus is a short piece of synthetic DNA containing a coded visual icon which has been spliced into a living strain of bacteria. The Microvenus project is a demonstration of the way in which Extrabiological information may be written into DNA.

SLIDE NO 20: George Gessert biomedia is hybridization. Gessert focuses on aesthetics and genetics in designing hybrid iris, creating traits such as vivid vein patterns in petals and unruffled edges. An interesting aspect to this work is the genetic graffiti where he takes some of his hybrids and plants them in the wilderness where unexpectedly people will come across his designs.

"Since the late 1970s I have been breeding plants, concentrating on the native irises of California and Oregon. When I first exhibited plant hybrids as art I expected to have to defend my work against criticism that plants were not art, but no one, then or now, has raised that question, at least not in conversation with me or in print. There have been plenty of other questions and criticisms, but not about plants as art. This is rather surprising, considering that until relatively recently nonhuman organisms were not exhibited in galleries. Even as late as the 1980s, shows that included works with live plants were extremely rare. Traditional Western dualism maintains that art is one thing, nature another, and never the twain shall meet (except in specialized ways in landscape architecture). That dualism dominated Western gallery art until very recently…."

SLIDE NO 22: Eduardo Kac's BioMedia is genetics and biowriting as bioinstallation. This example is "Move 36" which concerns a plant whose genome incorporates a new gene that Kac created. The gene uses universal computer code for representing binary numbers as Roman characters, on- and off-line) to translate Descartes' statement: "Cogito ergo sum" (I think therefore I am) into the four bases of genetics. "Move 36" was inspired the Kasparov/IBM Deep Blue computer chess match in 1997. In "Move 36" The plant grows from an earth-and-sand chessboard where chess computer Deep Blue made its subtle, conceptual yet crucial move. The plant's leaves curl due to the introduced genetic modification.

SLIDE NO 24: David Kremers biomedia is Genetics of bacteria. He uses microbes genetically modified to produce enzymes of different colors. The Paraxial Mesoderm creates abstract paintings by growing bacteria on clear acrylic plates. He uses genetically engineered bacteria that produce naturally occurring colored enzymes to grow portraits of the early development of humans. 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.

"Is the moral discussion of genetic about genetics, per se, or an "emotional substitute" (Kremers) for a real understanding of technology and if humanity has a right to alter life forms. Yet, humans have been altering life forms for 10,000+ years—since farming and breeding animals for food, and animal for companions.

SLIDE NO 26: Marta de Menezes' BioMedia is DNA, protein and cells to modify butterfly wing patterns. During the pupa or transformation stage of development she manipulated the normal development of the butterfly wing with a fine heated needle, causing a change in the wing pattern.

SLIDE NO. 30: From the interviews I identified eight areas of concern as illustrated in this slide. I do not have time to expand of these but what I will do is to give a summary of my thoughts and several comments provided by the interviewees:

In considering this time frame of historical, ethnographical, anthropological and technological query into what it means to be "human", artistic works of George Gessert and Adam Zaretsky 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.

"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." (Hauser)

Some Bioartists consider their role is to inform and even scar the viewing audience and cast judgment about genetic engineering and some of the incentive is driven by angst toward commodification as a possible result of capitalism.

Further, as I understand it, Bioart has been criticized for being insensitive to life forms, no matter how small and seeming 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 be received by its audience as intentionally propagating ambiguity for the sake of propaganda. Art needs to do more than tell and 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.

Is it ethical to take any living form and 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? (Kremers) "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)

Could Bioart lead to transbio practices engaging in generating a new human species in which the genome is altered and life is extended indefinitely and perhaps living beings that are embodied and disembodied, biological and synthetic? Leonel Moura says contemporary art is burnt out and we are on the cusp of "intelligent art" and close to 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 Transbioart. He contends that "we are in the process of generating a new homo species where the extension of life is one of the components." Like Moravec, Moura sees that human intelligence will be decisive.

If it is determined inevitable that Bioart has the potential to influence society and perhaps the future. But Bioartists, by and large, are not practicing scientists, sociologists, or skilled in future studies of forecasting, systems thinking, scenario development, or the methodologies necessary to objectively produce researched results. Is Bioart another means by which the artist become futurist (in the non-Marinetti sense)?

According to Marta de Menezes "More often than not we make the judgments without full knowledge of the issues, technologies and research involved." (de Menezes)

Joe Davis, considered the "father" 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)

New sciences and technologies may cause Bioart to expand is parameters. George Gessert states 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." While at first Gessert disagreed with my point that emergent technologies such as the BRAINS methods but he later told me that, "Yes, you are right that nanotechnology is deeply involved in biology, and perhaps AI is or will become involved in biology as well. Your understanding that these technologies will intersect with Bioart is no doubt correct. Whether or not any one person is correct is less consequential than understanding that a fluid medium may not be best placed in a static construct. It is here that artists may seriously consider "abiding by the protocols for ethical conduct and established guidelines." (Davis) Joe Davis, considered to be the "father" 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)

SLIDE 31: The Biotech Era has influenced both Biotech Art and Bioart. But how far will artists go in manipulating living matter? Revivification and the idea of extreme life extension, and even immortality, may not be one of the driving forces behind these Bioart practices; however, there may be potential for practices to enter into this area. If Hans Moravec is correct, then extreme life extension may be one of the many possible futures of Trans-Bioart.

SLIDE 32: This study of Bioart in exploring motivations and practices to determine evidence of revivification biomedia and further inquiry into receptiveness or resistance to extreme life extension makes the observation that there are currently no known practice based on revification Bioart works nor known artists who are engaged in the specific area of life extension

SLIDE 33: There is evidence of interest in and support of the following: (i) Bioart practices addressing and investigating revivification and extreme life extension; and (ii) biomedia for moist life forms and trans-biomedia for synthetic entities and virtual entities. However, 20% of participants were of no opinion 5% were opposed to extreme life extension and/or tampering with the human life span.