Regeneration

Tissue Engineering, Maintenance, and the Time of Performance

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In 2000, Oron Catts and Ionat Zurr teamed up to create SymbioticA, an art-science collective and laboratory based in the School of Anatomy and Human Biology at the University of Western Australia. For the past 10 years, SymbioticA’s students and visiting artists have been in residence at scientific laboratories, researching the intersections of art and biology, and participating in a relatively new practice called bioart.¹ In bioart, living organisms, tissues, cells, and genes serve as media that are shaped by a range of techniques, both artistic and scientific, from painting and graphic design to cryopreservation and tissue engineering. Although many bio-artists foreground their use of biological material as artistic medium and laboratory techniques as artistic ones, scholar Robert Mitchell has argued that the definition of bioart should also

¹. Like many practices that cross genres, media, and the boundaries between art and life, bioart is difficult to define. For a more detailed discussion of precisely why it has been difficult to define, see Deborah Dixon (2009), Robert Mitchell (2010), and W.J.T. Mitchell (2006).
include art that deploys more traditional media such as painting or performance to thematize biotechnology (2010:20).

SymbioticA has played a crucial role in the development of bioart as a movement due in large part to the work of its most prolific and prominent collective, Tissue Culture and Art Project (TCA), a collaboration between SymbioticA cofounders Catts and Zurr. To celebrate the collective’s 10th anniversary and reflect on SymbioticA’s contribution, Catts and Zurr curated an exhibit in Dublin at Trinity College’s Science Gallery. *Visceral: The Living Art Experiment* showcased 15 works of art, all including living biomaterials, produced by SymbioticA artists over the past 10 years. The exhibit ran from 28 January through 25 February 2011 and showcased the diversity and complexity of bioart practices developed at SymbioticA—from sculptures made of living engineered tissues housed in bioreactors to a live performance that staged battles between viewers’ white blood cells (Catts and Zurr 2011). The exhibit began with an interdisciplinary conference and artist talks from members of SymbioticA’s graduate program, and it was reviewed in publications outside of the art world including *Science Magazine* (Dixon et al. 2011) and *Nature* (King 2011). Celebrated as an exhibit that “awakens views on the ethical and moral quandaries of biology” (King 2011:334) and “portends[s] a radical shift in the social order” (Dixon et al. 2011:860), *Visceral* marked an important milestone in the history of bioart and interdisciplinary art practice. In the wake of this 10th anniversary celebration, I would like to examine what scholars, artists, and critics have been saying about the bioart that has emerged from SymbioticA. How have we been making sense of this work? What kind of contribution do we think it has made? How has the conversation about the work evolved and what still needs to be said?

Catts and Zurr have argued that “artists need to comment on the world around them,” but scholars have disagreed over what, exactly, bioart has to say about this world (in Nadis 2000:670). As Deborah Dixon and Robert Mitchell have noted, one of the sources of discord has been the fact that much of SymbioticA’s bioart is not overtly didactic or technophobic (Dixon 2009; Mitchell 2010). The art’s ambiguity has led some critics such as Paul Virilio (2003), Francis Fukuyama (2002), and Carol Gigliotti (2006) to argue that most bioart is politically problematic, at times “a naïve validation of the worst excesses of a technoscientific biology” (in Dixon 2009:420). And even when bioart collectives like the Tissue Culture and Art Project craft more overtly political works that deploy irony and parody, scholars critical of bioart argue that, “their parody merely serves to replicate regressive practices” (420). However, other scholars and art critics, including Dixon, Mitchell, and Anthony King, have made a strong case for the work’s transgressive political power. These authors, along with many of the artists themselves, experience the work as engaged with a range of political issues. For example, King reads Abhishek Hazra’s contribution to the exhibit, *Let a Thousand Proteins Bloom* (2011), as a commentary on the weaponization of human biological materials (2011:334). Other works have been cast as highlighting the connections between biotechnology and Nazi eugenics since both rely on the language of engineering, which requires adopting a “mechanistic” view of life (King 2011:334). More generally, the work showcased in *Visceral* challenges anthropocentrism by asking us to consider what it means to live and act ethically in a more-than-human world (Dixon 2009:414).
If, as Catts and Zurr claim, bioart “break[s] down dominant discourses, dogmas, and metaphors to reveal new understandings of life and the power structure it operates within,” then what does bioart tell us about how gender, race, and class operate within biotechnology’s power structures (Dixon 2009:420)? How do gender, race, and class shape and get shaped by the act of “breaking down” biotechnology’s “dominant discourses, dogmas, and metaphors” (420)? Scholars, critics, and the artists themselves have not actively engaged with these questions in their writings about bioart. They have not had much to say about how the work that has come out of SymbioticA might draw attention to or challenge existing understandings of gender, race, and class in biotechnology. Nor have they positioned the work as a contribution to the diverse philosophical, aesthetic, and political projects grappling with these particular power dynamics within biotechnology.

I do not mean to suggest, however, that the artwork itself does not engage with issues of gender, race, and class. In fact, two of the SymbioticA projects included in the Visceral exhibit point to the ways in which one’s experience of gender, race, and class shapes how one’s body is offered up for instrumentalization by biotechnology. Hazra’s Let a Thousand Proteins Bloom (2011), for example, attempts to produce ammonium nitrate from breast milk. While the exhibit’s catalogue and Dixon, Straughan, and Hawkins’s Science review focus on the way the work “draws attention to the constraining logic of utility that frames scientific research” (Dixon et al. 2011) King’s Nature review notes the work’s successful critique of the possible weaponization of human biomaterials (2011:334). Hazra’s piece, however, might also be experienced as a commentary on the ways in which nation-states call on women’s bodies to do certain kinds of labor that are often intensified and transformed during wartime. The piece can also be read as drawing some of its affective charge from the energy surrounding current debates about when and how breast milk can be made public: In ice cream cones? In the workplace as a woman retreats to a break room or a hidden corner to pump milk for her absent child?

The Vision Splendid (2011), a work by Australian artist Alicia King, consisted of a glass bioreactor that housed a sculpture made from skin tissue taken from a 13-year-old African American female in 1969. While the Visceral catalogue and the reviews in Nature and Science discuss the work as an engagement with ritual, relic, and the miraculous, it also has strong ties to current conversations about Henrietta Lacks.

Lacks’s immortal cancerous cervical cells were turned into a cell line, called HeLa cells, in 1951. By far the most widely used cell line in history, HeLa cells were used to create the polio vaccine in 1954 and it is estimated that the total number of cells that have been propagated in cell culture now outnumber the cells in Henrietta Lacks’s body (Smith 2002:1). One scientist estimates that together the total number of HeLa cells ever grown would weigh over 50 million metric tons (Skloot 2010:2). Lacks died in 1951 at the age of 31 in Johns Hopkins Hospital’s segregated ward for black patients, and her husband and children were devastated when they finally learned what had happened to their mother’s cells. None of the Lacks family has ever been compensated (Smith 2002:1). The 2010 publication of Rebecca Skloot’s nonfiction book The Immortal Life of Henrietta Lacks, a New York Times bestseller that made it to the top of over 60 critics’ “Best of 2010” lists, brought Lacks and issues of race, gender, class, and biotechnology into much wider public debate in the US. Within this context, The Vision Splendid resonates as an opportunity to experience a personal encounter with cells that were donated anonymously but are nevertheless raced and gendered in a particular way. Spectators who visited The Vision Splendid had a chance to encounter some of the issues raised by the Henrietta Lacks case live and in the flesh.

I have highlighted these two works from the Visceral exhibition to give readers a very basic sense of how scholars, artists, and critics have positioned the work that has emerged from

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2. For a gloss of these debates within popular culture, see Monica Casper (2011).
Ben-Ary is an artist-in-residence at SymbioticA and a core member of the SymbioticA Research Group. He collaborated with TCA from 1999 to 2003.

SymbioticA and to point to other possible readings. But *The Vision Splendid* and *Let a Thousand Proteins Bloom* are by no means exceptional. On the contrary, the work produced at SymbioticA has, from the very beginning, provided fascinating perspectives on issues of race, class, and gender in biotechnology, even though the work has not been explicitly presented or discussed as such. One of SymbioticA’s early bioart works, Tissue Culture and Art Project’s 2002 *Pig Wings Project*, offers an opportunity for reevaluating what bioart has to contribute and how it is connected to other philosophical, aesthetic, and political projects.

**The Pig Wings Project**

After convincing laboratory director Joseph Vacanti to let them join his research team, Catts and Zurr became artists-in-residence at the Tissue Engineering and Organ Fabrication Laboratory in Massachusetts General Hospital at Harvard Medical School from 2000 to 2001 (Andrews 2007:69). Here they studied tissue engineering, the practice of using support systems built from artificial and biological materials to direct and control the growth of human and nonhuman tissues. As they learned, they started asking questions: “Who is going to make the decisions about the direction [tissue engineering] is going to take us? On what set of values are these decisions going to be based? Do we have the tools to evaluate what is good or bad in regard to biological technologies [...]?” (TCA 2008). As artists who pose complex ethical questions through the production and exhibition of visual art and performance, they got to work on what would become *The Pig Wings Project* (2002), which they hoped would inspire audiences to confront these very questions.

Catts, Zurr, and collaborator Guy Ben-Ary decided to use pig stem cells and tissue engineering technologies to grow pig tissue into the shapes of three different kinds of wings. To make the wings, the artists harvested bone marrow stem cells from a pig’s femur and differentiated these cells into bone and cartilage. The cells were isolated and the artists then engineered some of the cells to grow into the shape of a bat’s wings, an angel’s wings, and a dinosaur’s wings. The wings were significant in that they evoked the hype surrounding tissue engineering while representing what the artists thought were the three possible futures for the technology: good (angel wings), evil (bat wings), and neither good nor evil (dinosaur wings) (TCA 2008). When the artists completed the engineering process, the three sets of resulting wings each measured four centimeters by two centimeters by one half of a centimeter. While the engineering process may have been the most technologically sophisticated component of *The Pig Wings Project*, the artists faced a new round of challenges once it came time for the sculptures to perform.

Two years in the making, the *Pig Wings* performances took place over the course of 10 days during the 2002 Adelaide Biennale for Australian Art. The Tissue Culture and Art Project staged the piece within an installation constructed for the event at the Art Gallery of South Australia. The focal point of the installation was a small, cramped laboratory. Barely large enough for one technician, or two technicians with well-controlled elbows and knees, the lab was enclosed within a glass cube that resembled an oversized museum display case. One side of the cube was made of pliable plastic with a zipper running down its center. On the inside of the plastic wall, just to the left of is zippered entrance, a blue apron hung on a hook. A table with a microscope on it was set to the right of the entrance, and to the left a compact, microwave-sized incubator sat atop a small refrigerator. The incubator housed three petri dishes, each with a wing sculpture inside, and protected the sculptures from contamination and fluctuations in temperature. The incubator’s transparent glass door was aligned flush against the left-hand wall of the cube so that the sculptures were visible to those outside of the cube through the multiple

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layers of glass and plastic. Behind the incubator and the refrigerator, a laminar flow cabinet covered the entire back wall of the laboratory. Lit by several harsh, blue germicidal lamps and used as a sterile environment for feeding and tending to the sculptures, this waist-high glass-hooded workbench served as the stage upon which most of the performance’s visible action took place.

The performers in TCA’s works are the living, engineered tissues themselves, the artists who create and maintain them, and the gallery visitors who encounter them. These performances thus begin the moment someone enters the gallery and extend through the moment of the sculpture’s death. *The Pig Wings Project*, like many of TCA’s installations, demanded an unusual form of participatory spectatorship. Attending one of their works often feels more like visiting a premature infant in a neonatal intensive care unit than walking through an installation at an art gallery. When these small living sculptures are displayed, they reside in incubators and bio-reactors—carefully regulated environments full of glass, glare, and gear. Upon entering the *Pig Wings* gallery, for example, viewers had to peer through layers of glass and plastic and around networks of tubes and wires to catch a glimpse of fragile pale pink beings lit strangely by the red glow of a digital read out or the harsh blue light spilling out of the nearby laminar flow cabinet. The spectator’s viewing experience, like that of the ICU visitor, was also always under the threat of interruption. Periodically, repeatedly, and seemingly at random, trained technicians (Catts and Zurr), dressed in costumes specifically designed to evoke both a mechanic’s coveralls and a scientist’s lab coat, entered the space, unzipped the laboratory’s door, put on the apron, and engaged in the complicated task of feeding the wings. They began by carefully moving the petri dishes containing the fragile beings out of the incubator and into the sterile laminar flow cabinet. Using pipettes, they transferred a refrigerated nutrient solution into the petri dishes and then returned them to their temperature-controlled home. This sudden burst of activity,
interjected into long spells of relative stillness and performed along the back wall of the laboratory, obstructed the spectator’s view of the wings, but offered something new to observe: complicated, precisely orchestrated acts of maintenance. These acts of maintenance were not, however, theatricalized or stylized. They were simply the gestures and actions of scientists going about their daily work. They were the techniques that Catts and Zurr learned at Harvard and perfected in their own lab at SymbioticA. Incapable of caring for themselves, the pig wings relied on people and technologies to maintain them. Maintenance’s dual meanings—the action of keeping something in working order and the action of providing the means of subsistence or necessities of life—are appropriate here.4 In the Pig Wings installation, the changing needs of an emergent life, alongside the infrastructural needs of an institutional home, dictate the activities and temporality that structure the space and the outsider’s engagement with the space.

Growing, Feeding, and Killing Pig Wings

While TCA’s concern about biotechnology’s future developments and applications are often shared by political projects such as animal rights activism, environmentalism, conservationism, and anticonsumerism, TCA does not use performance as an explicitly political, activist tactic. Performance is, for TCA, an opportunity to train in ethical decision making, to practice collaborative critical thinking in the company of fellow spectators, “semi-living” beings, and their “techno-scientific bodies”—the people, devices, and structures that keep them alive (Catts and Zurr 2006:154). TCA has coined the term “semi-living” to describe the category of beings produced by tissue engineering. TCA describes the semi-living as “parts of complex organisms which are sustained alive outside of the body and coerced to grow in pre-determined shapes” (154).5 In most of their works, TCA creates semi-living beings in the lab and then puts them onstage to “perform” in art galleries and other art settings so that the lay public can encounter and interact with the beings and their techno-scientific bodies. Because the semi-living are always staged within the context of their techno-scientific bodies, the spectators interact with the choreographed interaction of a range of different actors and performing objects including humans, machines, tissues, and the exhibition space itself.

In some of their earliest projects, TCA found that they were not getting the results they wanted. They noticed that spectators were not engaging with the sculptures as a peculiar kind of life form or were not grappling with the ethical implications of the existence of such life forms. In order to help spectators use the performance to “reassess their perceptions of life” (Catts and Zurr 2006:161), TCA designed two actions to perform during the projects’ installation: “The Feeding Ritual” and “The Killing Ritual” (Catts and Zurr 2003:54). To perform “The Feeding Ritual,” the artists would enter the gallery dressed in costume and use the sterile laminar flow cabinet to feed the sculptures their nutrient media in the manner described above. To perform “The Killing Ritual,” the costumed artists would reappear, remove the tissues from their sterile containers, and hand them over to the audience to be touched and thus contaminated. Sometimes the sculptures would die immediately, and other times several minutes passed before they expired. TCA sees these carefully choreographed actions as a way to deploy the power of performance to spark ethical inquiry through the “disruption” provided by physical and affective interaction. TCA talks about their decision to include feeding and killing actions in some of their work as a move away from visual art towards performance, and they characterize this move as a successful remedy to the problems that spectators were having engaging with the work (2006:156–57).


5. I use the term “semi-living” because it is the artists’ name for the tissues, not because I agree with its ethical and scientific implications. A discussion of these implications follows later in the article.
Within a visual arts context, performance has earned a host of heterogeneous associations, many of which Michael Fried famously delineated in his 1967 essay “Art and Objecthood.” For Fried, performance appears under the guise of theatre and theatricality and is used to name minimalism’s corruption of modernism’s medium specificity, its privileging of the situated spectator’s encounter with the work of art, and the fact that this encounter is durational and cannot exist in “no time at all” (Fried 1967:145). For TCA, the turn toward performance, initiated by the introduction of feeding and killing actions, is a turn toward these particular associations, and thus becomes a way for TCA to draw the viewer’s attention to collaborative durational maintenance labor. TCA artworks that predated the feeding and killing functioned more like visual art, even though they did include semi-living “performers.” Not only did the entrance of costumed artist/performers during the feeding and killing actions disrupt the visual art viewer’s autonomous reflective space (because there was suddenly nowhere to stand that was “outside” the work of art), it also brought the viewer out of the time of visual art and into the time of performance. The added actions highlighted duration as a core conceptual component of the work in a way that visual art often cannot. These actions, like all performances, happen over time, revealing to the viewer something new about the semi-living. The slow precision involved in feeding and growing these fragile beings juxtaposed with the speed and ease with which they can be destroyed tell the viewer something about who/what the semi-living are. The actions draw attention to the fact that the viewer and the semi-living are spending time together, growing, changing, and dying together.

There were, however, certain aspects of performance from which TCA worked hard to distance themselves. Critical of the ways in which non-human beings are made to perform for their food in front of human audiences in zoos and circuses, TCA wanted to make sure that their feeding rituals did not resemble zoo or circus feeding spectacles. TCA even decided to abandon scheduled feeding times in their performances because the artists felt that set feeding times were a zoo convention that encouraged a spectatorship that demanded spectacle. Because scheduled feeding times allowed for spectators to plan to arrive for that particular aspect of the performance, they raised spectators’ expectations that something extraordinary, something “theatrical” was going to happen. Most significantly, then, performance was a way for TCA to demonstrate the everyday non-spectacular labor that goes into keeping the semi-living alive while implicating the viewer in this labor. Feeding and killing are the only perceptive actions taking place, and they are the only obvious actions in which viewers can participate. Thus, an encounter with maintenance labor becomes the primary context through which viewers begin thinking about the nature of semi-living beings.

Figure 3. Oron Catts conducts the feeding ritual. Pig Wings (2000–2001). Art Gallery of South Australia. Tissue Culture and Art Project. (Courtesy of Tissue Culture and Art Project)
During *The Pig Wings Project*, TCA’s desire to highlight the ways in which scientists care for the semi-living bumped up against the ways in which the Art Gallery of South Australia cares for works of art. This friction, however, proved productive. In order for the pig wings to remain alive throughout the piece, TCA needed to install a laboratory in the gallery that would house all of the devices used to keep the sculptures alive and also provide adequate space for Catts and Zurr to administer to them. After much deliberation, the gallery allowed TCA to install the small laboratory. Like many others, this gallery did not have policies and practices in place to deal with the set-up and maintenance of biological art. The simple prospect of creating such an installation raised many questions for the gallery staff. Would the structure of the gallery be damaged by the construction of this lab? Did the gallery’s insurance cover living works of art? What if something went “horribly wrong?” (Catts and Zurr 2006:159).

This gallery, like many others, had no experience turning one of its rooms into a laboratory, nor was it accustomed to exhibiting a work of art that grew and changed over time. One of the major questions that arose was how the gallery’s security guards should protect the exhibit: Would they be responsible for taking care of the sculptures? What would happen if they, or one of the spectators, damaged the sculptures? The guards and gallery staff knew how to protect certain kinds of sculptures and how to manage the technologies that support/constitute certain kinds of art — like the monitors and projectors used in video installations or the lighting used in live performances — but the technological support that the TCA sculptures/performers needed was different and intimidating to the guards and staff. TCA assured everyone that the guards were not responsible for caring for the sculptures. Instead, the artists would come into the gallery every day for the first 10 days of the exhibition to feed the pig wings. At the end of the 10 days, the tissues would die and the dead tissue would be put on display. This daily feeding performance was the maintenance labor that, were it of a different nature, would be assigned to the gallery. Yet this arrangement presented another obstacle for the gallery to overcome. When the boundaries between visual art and performance are clearer, the duration of performance works is structured differently. Either the artist comes in, installs a work of art, and then leaves, or the artist comes in performs for a set period of time — for 20 minutes or two hours or three days — without interruption, and then leaves until the next scheduled performance. The performer sometimes leaves documentation behind for the gallery to display and sometimes takes all of the set and props with him or her. *The Pig Wing Project*’s indeterminate status as a laboratory, visual art object, and piece of performance was a very unusual one for the gallery’s administrative, curatorial, legal, and human resources structures to negotiate.

Despite their initial hesitation, or possibly because of it, the festival’s curator and the gallery’s security guards grew attached to the semi-living sculptures and had a difficult time letting them die during the final killing ritual. As the end of the 10 days of feeding approached, the guards asked if they could learn how to feed the tissues for the duration of the exhibition so that the sculptures wouldn’t have to die prematurely. Citing health and safety regulations, TCA did not allow the guards to assume that responsibility. The wings were killed as planned. When it came time to kill the wings, Peter Sellars, the biennial’s artistic director, who was slated to perform the task, began to cry. He told Catts and Zurr that “each time he has to turn off the Bill Viola installation he feels how the artwork dies (until the next day when the video projection is turned on again) but he never thought that he would literally kill an artwork just by touching it” (Catts and Zurr 2006:159).

In an article about the performative strategies they have developed to help audiences engage with the semi-living, TCA highlight these two events — the guards asking to care for the sculptures and Sellars crying — as evidence of the rituals’ efficacy (Catts and Zurr 2008). The guards’ and curator’s emotional attachment to the sculptures and desire to keep them alive were, for TCA, indications that the actions worked; that the guards and curator had, in fact, reassessed their perceptions of life. In order to care about the fate of the sculptures, the guards and curator would have encountered the sculptures as living beings and as more valuable/interesting
alive than dead. They would have taken at least the first step in the process of interrogating how the existence of semi-living beings affects their understanding of life itself. If “an indifferent relation to the Other” is one of the attitudes that TCA is trying to combat with their work, then affective attachment is useful (Catts and Zurr 2004). Whether or not we agree that affective attachment is necessarily a good indicator of critical engagement, we can see — through the way that TCA diagnosed the limitations of their early work, devised solutions, and evaluated the efficacy of these solutions — how some of the questions relevant to the use of tissue engineering technologies emerge.

TCA turned from visual art to performance in order to highlight the role that maintenance labor and a certain kind of temporality played out in their work. Furthermore, the guards and curator — the people who spent the most time on the project, put forth the most collaborative effort to bring it into being, and worked the hardest to maintain it once it was installed — were identified by Catts and Zurr as the best examples of successful engagement with the work (Catts and Zurr 2008). The subtext underlying TCA’s choices (and written reflections on these choices) seems to be that spending time maintaining semi-living beings is the best way to come to terms with what engineered tissues actually are and begin to grapple with the various ethical issues that they raise. Since we need to radically transform our understanding of what is natural, human, and consumable in order to imagine and eventually create an ethical biofuture for tissue engineering, we must start spending time — a lot of time — engaging in the forms of maintenance specific to the semi-living. We must start building a relationship with the semi-living and those who create and care for them.

Feminist Maintenance Art

Conversations about technologically complex contemporary art are increasingly structured around the concept of the digital, so much so that the terms “New Media Art” and “Digital Art” are often used interchangeably. When critics analyze biological artworks, the temptation is to use theories of the digital and the connections between the digital and the genetic — connections made mostly through metaphors of DNA as code — to understand the different issues at play in the work. Feminist art historian Maria Fernandez describes this tendency within new media theory when she writes:

As with other live entities, humans are viewed primarily as patterns of information transferable to various media, such as computers. In this scheme of things, embodiment is secondary; the organism has been replaced by its code [...] Although a small number of theorists have cautioned against “forgetting the body” they are a minority. (2003:520)

The concept of the digital does not always help us get at what is most important in a work of biological art. Biological artworks do not always involve genetic or molecular interventions and those that do are often “about” much more than DNA-as-code. As Catts and Zurr have noted: “Life is not a coded program, and we are not our DNA” (2008:126). In the body, DNA functions within the context of the cell, the tissue, and the organ. It is from these relationships of the cell to the tissue and the tissue to the organ that Catts and Zurr seem to draw much of their artistic inspiration. They note that in cell theory, “Metaphors of community, labor, and the nation-state have been attached to the conceptual understandings for the way cells, tissues, and organs are operating within and without a body” (137). Catts and Zurr have found these metaphors to be useful ways of getting at what is most important about their performance work. They even characterize their tissue sculptures as, “rather humble, collaborative, dynamic living communities that are in need of care” (2003:7).

While they may be the first artists to connect artistic acts of care and maintenance with cell theory, Catts and Zurr are of course not the first artists to make art about the labor that goes into maintaining humble, collaborative, dynamic living communities that are in need of care. Since the 1960s, feminist artists such as Mierle Laderman Ukeles, Mary Kelly, and Betye
Saar have been using visual and performance art practices to examine this kind of labor. Their explorations, however, bring issues of race, class, and gender into our conversation about maintenance. Instead of naturalizing or essentializing certain kinds of labor, regeneration, and collaboration, Ukeles, Saar, and Kelly shed light on the work that goes in to assigning certain jobs to certain people, valuing some kinds of work over others, making some work visible and other work invisible. By looking at TCA’s work alongside signature pieces by Ukeles, Kelly, and Saar, we are able to further complicate our understanding of what maintenance work is, who does it, and what it accomplishes, potentially also demystifying the gendered labor that undergirds tissue engineering as a practice and as a financial product.

After giving birth to her first child in the late 1960s and noticing that her daily domestic responsibilities were commandeering the time and energy she had formerly reserved for her artistic work, Mierle Laderman Ukeles became frustrated with the polarization of her art and everyday life. Curious about the relationship between household maintenance and creativity, she began breaking down the “assumptions that estranged her work as an artist from her work in the family” (Phillips 1995:171). The result of this process was her 1969 “Manifesto for Maintenance Art,” which contested avantgarde and conceptual art’s claims to originality, development, individuality, and dynamic change by revealing the ways in which maintenance is disavowed in the work. She argued, “Avant-garde art, which claims utter development, is infected with strains of maintenance ideas, maintenance activities, and maintenance materials. Conceptual & Process art, especially, claim pure development and change, yet employ almost purely maintenance processes” (Ukeles [1969] 1996:124). Contrasting the drive to separate oneself and “follow one’s own path to the death” with the drive to work together to guarantee a larger group’s survival, Ukeles aligned the avantgarde with “the Death Instinct” and maintenance art with “the Life instinct.” She described “the Life instinct” as “unification; the eternal return; the perpetuation and MAINTENANCE of the species; survival; systems and operations; equilibrium” (124).

With the creation of this manifesto, Ukeles launched a maintenance art practice that she continues to this day. Her first major works of maintenance art were three live performances staged at the Wadsworth Atheneum in Hartford, Connecticut, in 1973. In these performances Ukeles scrubbed the inside and outside of the museum during visiting hours, orchestrated a collaborative cleaning of a display case, and took the museum keys and locked and unlocked various gallery and office doors at will. Staging and celebrating the “basic human operations” (Morgan 1998:57) that support the museum’s operation, Ukeles was also signaling that these basic human operations are in fact gendered practices. The fact that maintenance work is “women’s work” when it is done in private, is part of why we denigrate and hide the work when it is done in public, even when it is performed by men. Since the 1970s, Ukeles has continued to extend her feminist analysis of the gendering of artistic and maintenance labor to include public sanitation. As the New York City Department of Sanitation’s first and only artist-in-residence since 1977 (an unsalaried position), Ukeles has undertaken a number of large-scale multiyear performance and installation projects directed at the negative stereotypes tainting maintenance work by making maintenance a “shared concern” (Morgan 1998:57). She has also collaborated with local government sanitation services in Japan, France, and the Netherlands to create large-scale public performances and installations.

Ukeles’s early maintenance works and the larger arc of her career are significant in part because of the way that they connect feminized domestic labor to the maintenance of institutions and to the maintenance of cultural categories like the avantgarde or conceptual art. Her work helps us complicate the performance of and logic surrounding maintenance labor in The Pig Wings Project. Ukeles’s theory and practice of maintenance art not only illuminates gender more generally as a significant blind spot in TCA’s understanding of labor, but also invites us to look for the kinds of labor that do not appear (or appear to be valued) in TCA’s work. While TCA might value certain technically sophisticated aspects of the care of fragile living...
systems as high-status and enriching for spectators, they choose not to stage much of the work that goes in to running a lab or a museum. The museum’s guards, for example, only accidentally and covertly became primary collaborators in the *Pig Wings Project*. It was only as the end of the 10-day performance drew near that Catts and Zurr became aware of the extent to which the guards were caring for the sculptures. They claim that the guards wanted to keep the sculptures alive because the guards were present during every feeding ritual and during the conversations in which the artists expressed their “fears that the pig wings would get contaminated” (2006:159). While this may be the case, the artists fail to mention that the guards were also caring for the sculptures on a daily basis by maintaining the installation’s security and that this labor might have contributed to their feelings towards the sculptures.

Feminist artist and theorist Mary Kelly’s groundbreaking installation *Post-Partum Document* (1977) serves as a useful interlocutor with *The Pig Wings Project* in considering the relationship that the guards developed with the sculptures through the acts of caring for them and observing others care for them. From 1973 to 1979, Kelly painstakingly documented the development of her son from birth to age five. The documentation took the form of intimate handwritten typed notes, charts and graphs represented as scientific data, imprints of hands and body parts in clay, and other fragments of early life. When the piece was first installed in 1977 at the Institute for Contemporary Arts in London, the 139 pieces of documentation were organized into six sections and mounted to the gallery wall, along with an introductory text. *Post-Partum Document* was inspired, in part, by Kelly’s membership in a feminist group that she describes as committed to changing “the iniquitous conditions of ‘all’ women’s labor, blatantly enforced in the workplace […] and more subtly sustained in the home through the naturalization of the woman’s role in child care” (Kelly 1998:xvii). Considering the psychic structure of this sexual division of labor, Kelly created *Post-Partum Document* as a dialogue with Lacanian psychoanalysis that would illustrate the social construction of subjectivity through the day-to-day relationship between a working mother and her young son. The piece is, among other things, evidence of the daily labor that goes in to creating interpersonal relationships and thus subjectivity. The detail and precision apparent in each of the piece’s 139 individual elements (along with the simple fact that the piece has so many individual parts) visually represent the *amount* and *kind* of effort involved in building relationships/subjects. For Kelly, this process is a great deal of work and this work is difficult, skilled, and emotionally taxing.

For TCA, the labor of creating and sustaining semi-living sculptures is also plentiful, precise, and draining. But if the process of Mary Kelly caring for her young male child contributed to the creation of socially constructed subjects who were “working mother” and “son,” what kind of beings did TCA’s labor produce? And if there were certain social and political markers/consequences attached to “mother” and “son” in 1970s London, what are the social and political markers/consequences attached to the beings produced through the *Pig Wings Project*? TCA calls their tissue sculptures “semi-living” even though they are, technically, fully alive. The artists find this term useful because it designates the sculptures as ontologically different from but closely related to living beings (Catts and Zurr 2006). It also invites viewers to question for themselves what the difference actually is between semi-living and living things. For TCA, however, tissue sculptures are only semi-living because they have been separated from their “original” bodies, were created through significant human intervention, and are dependent for survival on support from other technologies and forms of life. While TCA might never suggest that full-fledged life belongs only to those who are self-sufficient, biologically whole, and cre-

6. During the 2008/09 academic year I had the opportunity to share this research with a group of stem cell scientists who were working with the Berkeley Stem Cell Center and the California Institute for Regenerative Medicine. The scientists were unequivocally and unanimously opposed to the term semi-living for several different reasons. The term is not only inaccurate — the tissues are unequivocally alive and “semi” is a marker of quantity, not quality — but also misleading and not at all productive given TCA’s goals for *The Pig Wings Project*. **Kelly Rafferty**
“naturally,” it is still problematic on many levels to suggest that dependency, technological intervention, discontinuity, and dispersal place organisms at a distance from the essence of life itself.

TCA asks their audiences to care for the tissue sculptures in a way that also generates both productive and unsettling relationships between humans and tissue culture. As evidenced by their choice to designate the gallery guards and curator as model spectators, the artists suggest that a certain kind of emotional connection between spectator and sculpture is ethically valuable. A connection that results in tears and/or a desire to go to greater lengths to protect and maintain the sculpture is, for TCA, better than one that does not. When, in our particular cultural and historical context, is it useful for those who care for tissues (both up close and at a distance) to become emotionally attached to them? When is this kind of attachment dangerous? When I discussed *The Pig Wings Project* with a group of research scientists affiliated with the Berkeley Stem Cell Center at the University of California, several scientists noted that the quality of their feelings towards the tissues with which they worked had a noticeable effect on the way they worked. When experimenting with human stem cells, these researchers found themselves working much more attentively than they did while using nonhuman animal stem cells. They also said that they were less likely to use more cells than they absolutely needed. While cost, availability, and material transfer agreements also influenced the way they handled these materials, the feelings they had about the nature of the cells themselves certainly played a significant role. This emotional attachment to human cells was described as helpful, ethical, and productive in that it respected some kind of innate value in the cells while also encouraging responsible use of resources. One of the women scientists, however, reminded the group that we have seen too many instances where an emotional over-investment in the fact that certain tissues are alive can wreak political havoc. President George W. Bush’s ban on federally funded human embryonic stem cell research and his practice of providing federal funds to a program that promotes the donation of cryo-banked embryos, which they call “adoptive snowflakes,” are just two examples of why it might not always be useful to encourage sentimental relationships with all forms of tissue culture simply because they are alive (Caplan 2003).7

While considering Kelly’s work in the context of tissue engineering helps cultivate an appreciation of the intense labor that goes into reproducing human stem cells *in vivo, in vitro*, and in the nursery, Betye Saar’s box assemblage *Liberation of Aunt Jemima* (1972) turns our attention toward the different ways in which living beings are valued economically and exchanged through markets. Betye Saar is an assemblage artist who describes her method as a process of recycling. She takes objects, stereotypes, emotions, and derogatory representations of African Americans and repurposes them as box assemblages, altars, and installations that explore race and gender. Saar’s artistic career took flight in 1972 with the exhibition of *Liberation of Aunt Jemima*, a work in which Saar armed a large figure of the pancake brand’s marketing icon with a broom, rifle, and pistol. Standing tall and squarely facing her viewer, this figure of Aunt Jemima is sandwiched between a Warholian panel of pancake ads behind her and a painting of a black female domestic worker carrying a crying light-skinned child in front of her. Bounded by these images but emboldened by the arsenal of weapons at her fingertips, Aunt Jemima is represented as a woman in the process of securing her freedom. By figuring liberation as a work in progress, *Liberation of Aunt Jemima*, along with Robbie McCauley’s serial performance *Confessions of a Black Working Class Woman* (1989), Kara Walker’s *The Battle of Atlanta, Being the Narrative of a Negress in the Flames of Desire* (1995), Carrie Mae Weems’s *Louisiana Project* (2004), and the Olimpias Performance Research Group’s *Anarcha Project* (2006) ask us to look for the residue of slavery that still sticks to care work in American institutions like medicine (*Anarcha*) and education (*Sally’s Rape* from the McCauley series) or in service-sector jobs (*Aunt Jemima*). They

7. See Lauren Berlant (2002) for a discussion of how certain kinds of sentimental attachment to embryos and fetuses affect political debates around reproductive rights in the US.
ask us to track the ways in which these histories are recycled and rematerialized in different contemporary environments. Assemblage, for Saar, allows for the interplay of drastically different times and contexts as objects from one place are layered over and framed by objects from another. Saar explains: “I am intrigued with combining the remnants of memories, fragments of relics and ordinary objects with the components of technology. It’s a way of delving into the past and reaching into the future simultaneously” (in Elizabeth A. Sackler Center for Feminist Art 2010).

The Time of Performance

How do tissue-engineering technologies reach into the past and the future simultaneously? How do living beings circulate through markets within the intersecting worlds of stem cell research and regenerative medicine? Biotechnologies like tissue engineering have proliferated and complicated what Catherine Waldby and Robert Mitchell have called tissue economies (2006:181). A tissue economy is, for Waldby and Mitchell, “a system for maximizing [the \textit{in vitro} productivity of human tissues], through strategies of circulation, leverage, diversification, and recuperation.” This economy involves “hierarchizing the values associated with tissue productivity” (31). The cells and tissues used in tissue engineering circulate differently and are valued differently than donated blood, organs, or gametes for reasons that have to do with how they are procured and what they can offer. They are, however, all implicated in networks of power and abuse:

[T]he redistribution of human tissues can also produce injustice and exploitation, because one person makes a bodily sacrifice in favor of another’s health and life. Often the transfer of tissues from one person to another follows the trajectories of power and wealth. (Waldby and Mitchell 2006:8)

A larger percentage of the American population is physically involved in tissue economies than one might expect. According to a 2006 \textit{New York Times Magazine} cover piece, tissue samples from over 278 million Americans are stored by the FBI, military, National Institutes of Health, university research labs, drug companies, and even cosmetic companies (Skloot 2006:40). These samples are usually collected without the “donor’s” knowledge or explicit permission. We discard our tissues during routine medical procedures such as blood tests, during major surgeries, and, sometimes, in death. The California Supreme Court ruled in 1990 that this act of separating our tissues from our bodies also divests us of our legal and financial control over these cells (Skloot 2006:42). A person’s discarded tissues are no longer his or her property. They belong to the person who picks them up and turns them into something new. Research scientists, government agencies, and biotech companies are free to recycle and repurpose our discarded tissue to cure diseases, develop groundbreaking research, test the safety of eyeliner, earn patents, or make profitable new technologies. While individuals do have property rights over sperm, eggs, and embryos, researchers can experiment on and commercialize any other tissues without soliciting the patient’s permission or granting him or her a cut of the profits. The most famous unwitting and uncompensated tissue donor was Henrietta Lacks, the source of the immortal HeLa cell line.

Stem cells, like Lacks’s immortal cancer cells, can be made to replicate themselves endlessly, but stem cells can also differentiate into different kinds of tissue. As a result of these unique regenerative capacities, stem cells are valued and circulated differently and are involved in different forms of exploitation and profit. The field of regenerative medicine combines stem cell science with tissue engineering; its goal is to use stem cells to reconstruct three-dimensional living organs and tissues \textit{in vitro} and then transplant them back into the patient’s body. Regenerative medicine’s stem cells can come from aborted fetuses, frozen embryos, and foreskins of circumcised children. Because totipotent and pluripotent stem cells, some of the most potentially useful and flexible cells, come from embryos that had been difficult to access under
the Bush administration, many researchers have proposed the use of therapeutic cloning to enable patients to essentially donate an embryo and thus stem cells to themselves. In 2007, however, scientists in the US and Japan were also able to create pluripotent stem cells from human somatic (non-embryonic) cells by inducing a forced expression of a gene in the cell. Scientists hope that these induced pluripotent stem cells (iPS cells) will perform as well as human embryonic stem cells (hES cells) and thus enable regenerative medicine to avoid the contentious debates around the ethical and legal status of the embryo in the US. Once stem cells are harvested from these various sources, they are cultured and encouraged to multiply into a three-dimensional form, usually with the help of bioabsorbable scaffolds. Ideally, the resulting organs and tissues are then transplanted into a patient’s body (Cooper 2008:103–4).

Physicians, researchers, investors, financial markets, governments, and other parties value regenerative medicine in very specific ways. Physicians and patients believe that it has the “potential to overcome the intractable problems associated with organ transplantation and prosthetics—immune reactions, the scarcity of transplantable organs, the limited life span and wear-and-tear of medical implants in the body” (Cooper 2008:104). Because tissue engineering harnesses the body’s regenerative capabilities, producing organs through the body’s ability to recreate itself, physicians are no longer limited by organ scarcity or use-by dates. The possibility of using therapeutic cloning to produce organs from the patient’s own stem cells also helps physicians avoid the immune system’s usual hostile response to transplanted tissue. While there are times when it is useful to conceptualize regenerative medicine as an “upgraded version” of the fields of organ transplantation and prosthesis, tissue engineering is working with completely different concepts of time, transformability, and value (104). In Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era, political theorist Melinda Cooper argues that tissue engineering operates in a different biomedical paradigm than organ transplantation and prosthetics. By looking closely at how this biomedical paradigm is constructed, we can eventually see how maintenance art arms spectators with the tools to assess and critique the most salient characteristics of this paradigm.

Cooper identifies several core elements of the tissue engineering paradigm, such as its topological (as opposed to metric) geometry and its conceptual affinity with the science of embryology, but I want to focus here on her analysis of the way engineered tissues circulate in markets, the time in which they operate, and the stories they encourage us to tell about our future. While organ transplantation relocates already given forms, tissue engineering generates form through what Cooper calls organogenesis (2008:111). During organ transplantation, doctors must suppress the body’s response to change in order to prevent the organ from dying and to prevent the patient’s body from rejecting the organ. Tissue engineering, however, works with and takes advantage of the body’s ability to change (111). The embryonic developmental sequence is the stage at which the human body is best able to change,
the time when it changes the most. The fundamental principle of regenerative medicine is “to recapitulate selective aspects of the embryonic developmental sequence [...] in which tissue initiation, formation, and expansion take place.” Theoretically, tissue engineering is capable of preserving permanent embryonic growth potential, of “reliving the emergence of the body over and over again, independently of all progression” (121).

Tissue engineering’s investment in repeatedly reliving the emergence of the body means that it exists in and creates a unique and non-chronological temporality:

Here it is not only spaces, forms, and bodies that become continuously transformable, but also the divisible instants of a chronological lifetime, so that any one body can be returned to or catapulted into any point in its past or future, and into any past or future it could have and could still materialize. [...] In principle, then, the adult body will be able to relive its embryogenesis again and again—including those it has never experienced before. (Cooper 2008:121)

The stem cell’s temporality, its never-ending emergence and unlimited potentiality, allow it to be incorporated into different economic infrastructures than those that predominate in other areas such as reproductive medicine or medical devices (140). While commodification was once the standard form of economic incorporation for biomedicine, financialization reigns in the field of tissue engineering. Cooper explains:

[What] has prevailed is not so much the commodification of tissues and processes—or a limited form thereof—but rather their integration into highly financialized, promissory forms of accumulation. [...] What is being constituted here, I suggest, is something like a market in embryonic futures, one that brings the promise of capital together with the biological potentiality of cell lines and attempts to conflate the two. (141)

What happens in this process is not simply the commodification of life but rather its transformation into a form of speculative surplus value that may index a commodity but is not equivalent to it (Cooper 2008:148). This financialization of human tissues, Cooper argues, is part of a larger shift away from a Fordist mode of production that focused on the reproduction of standardized forms to one that is invested in the regeneration of the transformable and emergent. Neoliberal biopolitics moves away from the Fordist model of production and its reliance on “the ideal of reproductive labor and the family wage as a national biological reserve” and instead attaches itself to the promise of “a speculative future, where the technological capacities of the biotech revolution are credited with overcoming all limits to growth in the present” (150). This hope rests, of course, on a foundational myth, a story that neoliberalism tells itself about biotechnology’s ability to overcome all ecological or economic limits. Imagining utopias of perpetual growth, regenerative medicine’s biopolitical perspective refuses to acknowledge the significance of two key elements: eggs and excess. The tissues that regenerative medicine uses to create this perpetually embryoid state either come directly from women’s bodies or are the result of their reproductive labor. As Cooper writes, “What embryoid capital demands is a self-regenerating, inexhaustible, quietly sacrificial source of reproductive labor—a kind of global feminine. Its mystification relies in the belief that the embryoid body is capable of regenerating itself” (150).

Echoing the “sourball” in Ukeles’s Manifesto for Maintenance Art who asks “after the revolution, who is going to pick up the garbage on Monday morning?” ([1969] 1996:124), I would add that embryoid capital’s mystification also rests on the belief that the embryoid body can clean up after itself. Looking at TCA’s Pig Wings, Kelly’s Post-Partum Document, Saar’s Liberation of Aunt Jemima, and Ukeles’s larger body of work together under the rubric of maintenance art spotlights the reproductive, technical, relational, janitorial, and curatorial labor that supports the process of emerging. These pieces perform the maintenance work on which regeneration relies. Of course each artist could not and did not accomplish this feat on his or her own; TCA does not explicitly thematize gender, race, or class; and Ukeles, Kelly, and Saar were certainly
not engaging with tissue engineering technologies. Joined together by the act of maintenance, however, these artists form a kind of transhistorical bioethical task force that refuses to let its audiences disavow the work of the global feminine, which props up regenerative medicine’s utopian fantasy. The artists also disabuse us of regenerative medicine’s utopian fantasy by helping us imagine tissue engineering’s possible dystopias. Unlike the nightmare of the systemic, mechanical breakdown that prevails in the Fordist model of production, tissue engineering’s dystopia is one of excess, a “crisis of overproduction” or the “excess vitality of cancer” (Cooper 2008:121). Ukeles’s *Turnaround Surround* (1989–present) and *Flow City* (1983–1991) bring spectators to a landfill and a waste transfer station respectively for an up-close encounter with our current crisis of overproduction and the techniques we have developed to stave off the arrival of the global wastelands represented in dystopic films like Disney/Pixar’s WALL-E.8 *Post-Partum Document*’s seemingly endless repetition of framed fecal stains and its graphs charting fluctuations in the volume of excrement produced by the child visually and spatially represent the frustration and fatigue that come with battling the body’s excess vitality day after day. TCA’s documentation of *The Pig Wings Project* indicates that the Art Gallery of South Australia’s staff also feared the regenerative capacities of uncontrolled tissues. As the artists negotiated with the gallery about how the work would be installed and cared for, one administrator asked TCA, “what if something goes horribly wrong?” (Catts and Zurr 2006:159).

Maintenance art also gives us a real sense of the ways in which tissue engineering produces and operates within a different kind of time. By staging the duration and unique temporality of the labor that goes into supporting life’s ability to replace and restore itself, these works provide spectators with an opportunity to dwell in the time of regeneration. Describing the time of regeneration, Cooper writes:

> What regenerative medicine wants to elicit is the generative moment from which all possible forms can be regenerated — the moment of emergence, considered independently of its actualizations. In what sense, then, are we to understand the term “moment”? [... Regenerative medicine] suggests that the “instant” even when reduced to an extreme point of suspense is always undercut by the continuity of transformation, change, or becoming. The instant, in other words, is never contained in itself, never present to itself, but (following Deleuze) perpetually about to be and already past, about to emerge and already subsided, about to be born and already born again. (2008:127)

In maintenance art, the actions staged are also perpetually about to be and already past. Mary Kelly hung 139 objects on the wall of an ICA gallery as a representation of the repetitive yet always changing work that went into caring for her child for only a fraction of his expected lifespan. In her collage, Betye Saar combined objects from multiple historical periods to represent Aunt Jemima as still in the process of freeing herself from the representations of racism and enslavement that both multiply and recede around her. Over the course of their 10-day performance, TCA repeatedly appeared unannounced in the gallery to feed their sculptures, completing the same tasks over and over again as needed, and then disappearing just as quickly and unceremoniously. Peggy Phelan famously described performance’s ontology as “becoming itself through disappearance” (1993:146). With maintenance art, aligned as it is by Ukeles with the Life instinct, this disappearance is coupled with the threat and promise (maybe even the necessity) of the never-ending emergence of fragile lives and the never-ending reappearance of those who labor to grow and maintain these lives. Maintenance art is ephemeral, but it is not an ephemerality that results from the avantgarde’s death instinct; its ephemerality emerges from the fact that in every instant, living beings, systems, and institutions are growing and changing, demanding different forms of care.

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References


