

# Experiments for *'vital force'*: A Productive Art/Science Collaborative Model

*Trish Adams*

## ABSTRACT

Issues relating to the potentials and practicalities of meaningful art and science convergences and intersections are addressed in this paper through the articulation of a productive art/science collaborative model between a visual artist and a biomedical scientist. The methodologies described exemplify the hybrid amalgamation of research practice and research subject that transpired in conjunction with the constantly evolving collaborative art/science model. Particular emphasis is placed on the conceptual rationale underpinning the artist's use of her own stem cells in an immersive strategy that contravened the accepted norms of so called objective research practice. The sequential processes are outlined and discussed in relation to the concerns and protocols of the disparate disciplines and the specialties and aims of the artist and the scientist that contributed to the productive collaborative paradigm.

## INTRODUCTION

### Project Elements

The three part *'vital force'* series of quasi-scientific interactive art installations was framed within the matrices of an innovative collaborative art/science research model and the evolving processes of practice-led arts research. It incorporated both practical and theoretical investigations into cellular responses and developed as an aesthetic enquiry into the impact of contemporary experimental biomedical engineering techniques on expressions and representations of corporeality. The cross-disciplinary exploratory research was discursively located within the *system/environment* paradigm. This allowed for boundaries between the philosophic and scientific disciplines of: epistemology - ethics and aesthetics - biology and technology to become nodes in a relational network associated with: sentience and consciousness - conceptions of humanness - living and non-living. The ability to hold the discrete project elements in disequilibrium and creative tension endorsed a model of rupture and open-ended, non-authorial practice processes reflecting hybridity and methodological fluidity.

### Collaboration Overview

The productive collaboration between the artist, Trish Adams, and the biomedical scientist, Dr Victor Nurcombe [1], evolved through evaluation and critical discussion over time. During this art/science collaboration the artist's stem cells were cultured *in vitro* and changed into mature, beating cardiac cells. The resulting time-lapse digital videomicrograph image data was incorporated into the culminating installation: *'machina carnis'*. There the cardiac cell image data was programmed to beat in response to the sound of the participant's own heartbeats creating an immersive interactive artwork that implicated the viewer in its completion. The project theoretically and visually articulated the processual pioneering research model, involving the artist as both researcher and 'human guinea pig'.

## ESTABLISHING THE FRAMEWORK

### Artist's Aims

I was seeking an art/science collaborative opportunity to explore the impact of contemporary developments in biomedical engineering on notions of corporeality and the 'self'. Dr Nurcombe was researching newly discovered capacities to modify adult stem cells, to make them 'change fates', to become other types of cells. This appealed to me as a potential area for a collaborative, experimental research project – one that would allow me not only to break new ground in arts research but also to engage with 'cutting edge' science from the perspective of a visual artist – I wanted to know what would happen if I took stem cells from my own body and changed them; how they would look, what they would do, how I would feel during the

process and what members of the public would think and feel when they interacted with the artistic outcomes of my experiments.

### Scientist's Response

When I approached Dr Nurcombe to propose a collaboration he responded with surprise and curiosity. He regarded the invitation as arguably the most unusual he had ever received within the parameters of his scientific role. His willingness to explore the unknown possibilities is significant because it opened up essential discussions of how our respective interests, aims and specialties might impact on an innovative art/science collaborative model, the development of a shared 'language' and the potential outcomes. Dr Nurcombe reflected on the nature of the disparate disciplinary constructs thus:

“(t)he unconscious flow of associations which seem to me to be essential to Art – and the collisions of associations which seem to give us insight – are also important to the scientist, but must be tamed in a very rigid way. I'm not sure how the freedom that Art demands can be confined to scientific practice. Maybe the inputs have to be during the association phase?” [2]

### Implicit Informality

The inputs during the discursive association phase of a productive science and art collaboration such as ours fostered an emergent cyclical awareness and reciprocity that contributed to our open research paradigm. However Dr Nurcombe and I had the luxury of collaborating within an informal framework; customarily the practicalities of art/science collaborations are likely to be complicated by the financial imperatives of scientific research grants which habitually support expensive contemporary biotechnological research. The specific agendas and time-lines of these grants are not conducive to flexible paradigms with discursive spaces to incorporate an artist. In Dr Nurcombe's view:

“(t)his sort of 'opening' will take some time to develop, and probably can't happen - or rather can't properly develop - at publicly funded institutions without a great deal of help. Modern Biomedical research is extremely expensive, and the majority of scientists feel the pressing need to deliver utilitarian outcomes efficiently for their share - of the taxpayer's dollar”. [3]

### First-person Perspective

It is possible however that the introduction of more open first-person perspective research methodologies within the sciences might generate further opportunities for collaborative cross-disciplinary projects. Currently the field of contemporary techno-scientific research into consciousness acknowledges that the third-person perspective is an unsatisfactory model [4] and the science of endophysics addresses such issues as “observer-relativity, representation, and non-locality to the world seen as merely an interface” [5]. Individual scientists have also found it necessary to adopt the first-person paradigm to expedite their research [6]; so precedents do exist for the immersive, endophysical model employed in both my research processes and installations which Dr Nurcombe describes thus:

“(y)ou have entered into the heart of a research project as a core participant. You were at once subject and object, forced to be objective about your very 'ground state' – your own material”. [7] (Fig. 1).



**Fig. 1: A doctor takes blood from the artist's arm. This blood sample, represents the artist's "own material" and was subsequently taken to the laboratory for the extraction of stem cells.**

## NAVIGATING THE PRACTICALITIES

### Ethical Clearance

I considered that the pioneering and unconventional use of my human cells was essential to the visceral, immersive character of the planned installations and I hoped that the opportunity to experiment on human tissue would also be of interest to Dr Nurcombe however the use of my "own material" was fraught with obstacles. In fact I encountered bureaucratic resistance

immediately I proposed using unscreened human tissue as the medium for my art, regardless of the fact that it would come from my own body [8]. Even within a university accustomed to the protocols of bio-techno-science, the research was subject to rigorous, statutory ethical clearance requirements which took approximately a year to complete. Dr Nurcombe respected my determination to use cells from my body and I relied on his considerable perspicacity to negotiate the repeated frustrations that arose during the ethical clearance application process. Eventually we expedited this process by changing from the use of tissue, as we had originally planned, to the use of stem cells from my blood [9].

### “Spirit of ‘What If’ ”

Another issue of concern was the potential of my participation to generate a meaningful contribution. I was apprehensive that this potential would be predominantly perceived as quite limited since I was an untrained participant in ‘cutting edge’ research developments in the field of biomedical engineering. As Stephen Wilson points out in his assessment of the extent to which artist-researchers might contribute to techno-scientific debates, “scientists and technology researchers who have devoted their entire professional lives to educating themselves about topics being investigated might be sceptical...(can) artists learn enough to engage in research at a non-dilettante level?” [10]. Dr Nurcombe responded to this statement as follows:

“I don’t see the collaboration between you and I as anything like as quotidian as “research at a non-dilettante level”. It could only really be considered as ‘research’ as I understand it, at a much more esoteric level; I would have thought we set out to do something quite ‘other’, something more open-ended. Research with other scientists is usually extremely focused and conducted within tight parameters; it’s not about possibilities so much as progressively excluding as many possibilities as possible. Our work was conducted much more in the spirit of ‘what if?’ ”[11].

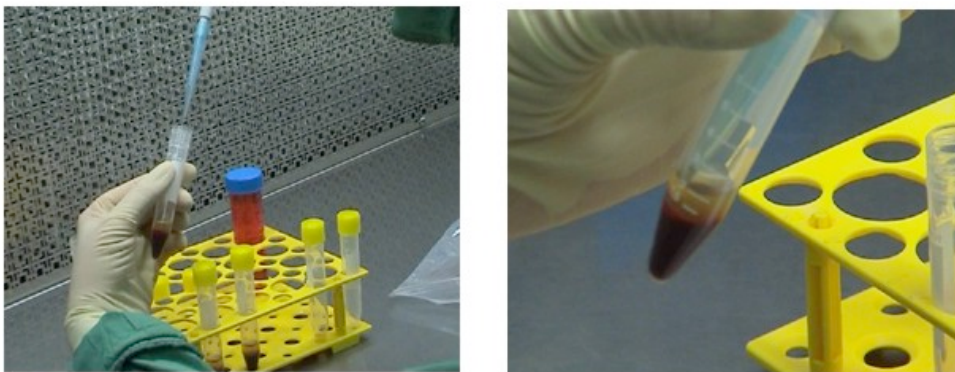
### “Something Quite ‘Other’ ”

This response highlights the significance, referred to earlier, of collaborating with a scientist who is willing and able to look outside the rigid disciplinary constraints of strategic scientific research and embark on an open-ended collaborative project. It also encouraged me to continue my cross-disciplinary project in the belief that our collaboration had value since it was in fact creating “something quite ‘other’ ” outside customary research parameters which would make an original contribution to the evolving art/science research paradigm.

## DEVELOPING THE METHODOLOGY

### Research Practice/Research Subject

In the aforementioned “spirit of ‘what if’ ” I adopted an experimental model incorporating an open-ended collaborative methodology and entered a very different, specialist domain – that of pioneering biomedical engineering – bringing to it the disparate creative skills of a visual artist. (Fig. 2)



**Fig. 2: The artist entered a very different specialist domain, that of the biomedical scientist. Under the direction of her scientific collaborator Adams isolates stem cells from her blood in the laboratory.**

The strategy of direct participation in the experimental techniques of contemporary stem cell research overcame the “dilettante” position of a passive observer referred to above. It contravened the accepted norms of so called objective research practice through the use of Adams’ stem cells as the source material for the experiments, resulting in the hybrid amalgamation of research practice and research subject. Rather than seeking to emulate the established, modernist, scientific model; open-ended flexible dialogic research afforded a re-interpretation of the research paradigm and a re-appraisal of the structuring and meaning of ‘knowledge’ for our specific purposes. This approach fostered the production of shared space for the mutual exchange of skills, leading to new understanding about, and appreciation of, the contribution of artistic research in the wider disciplinary, collaborative context.

## Open-Ended Process

Of particular relevance to our evolving, innovative research model was the introduction of qualitative research methods in some areas of the social sciences that have clearly had an impact on the humanities. A shift from deductive to inductive methods has been introduced where the difference is defined as being “not in the percentage of structured and unstructured questions but in how open-ended the research process itself is” [12]. Significantly, feminist researcher Patti Lather heralds this “decline of the absolutes” as “postpositivism”, (which) “has cleared methodology of prescribed rules and boundaries” [13]. More open research methods appealed to me because they could enable an interested artist, such as myself, to research within a receptive scientific context. These findings supported my role as an independent investigator bringing different perspectives, complementary skills and a contemporary methodology to the reified field of conventional disciplinary research practice.

## EXPLORING THE CONTEXT

### Intersections of Art and Science

In seeking to further define the extent to which such collaborations could contribute to new knowledge, I turned to the roots of each discipline. I discovered that the conception of art and science as discrete disciplines arose in the nineteenth century when the more distinct epistemological foundation of science developed and the term ‘scientist’ was introduced. Notions privileging objectivity developed, based on the burgeoning impression that the analytical sciences held the answers needed to accurately explain the workings of the universe. The recent trends towards a convergence of science and art are various in their intent and structure; tending to be driven by curiosity, pragmatics and corporate imperatives – developments that appear to be welcomed by some and resisted by others; for “with their separate cultures, approaches and practices, the capacity of art and science to really intersect and talk to each other is vehemently contested by scientists, artists and cultural critics alike” [14].

### Successful Prototypes

Since the burgeoning field of contemporary art/science research collaborations is in its infancy protagonists are still striving to develop practical models that yield mutual benefits. To create successful prototypes the following questions need to be addressed: “(w)hat must artists do differently than they have always done to prepare to participate in the world of research...the appropriate contours of this involvement are not yet defined...how can research settings learn to be open enough to benefit from the unorthodox contributions artists might make?” [15].

### Emerging Model

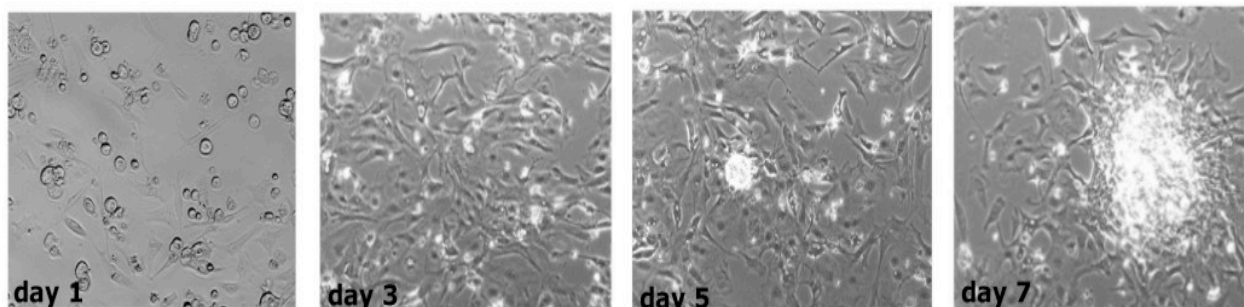
Exploring the conceptual and technical challenges involved in developing an emerging model of the artist/researcher in a scientific laboratory has enabled me to contribute to the definition of these “contours of involvement” through both my practical experience and the culminating artwork: ‘*machina carnis*’. Of particular note during my investigations was the following statement by the British based science-art agency: *The Arts Catalyst* [16]

“...we see art as directly applied to the scientific environment, not simply illustrative of science, (and) are interested in artists who need the active participation of scientists in their work and, particularly, wish to engage actively with day-to-day scientific research, (and believe that) the process of an artist’s engagement with science is often as interesting as the final product ...”

This statement endorses the notion of the artist/researcher who participates in scientific research, and who collaborates with scientists to actively engage with processes via a hybrid, unconventional collaborative model.

### Complicating Cartesian Dualism

I believed that by planning this immersive strategy of engagement my participatory role of artist/researcher would allow me to “probe the technology whilst existing in the new contexts created by it” (Fig 3).



**Fig. 3: This chronological sequence of digital videomicrograph time-lapse still images shows the stem cells from the artist’s blood changing into cardiac cells *in vitro*. The stem cells, newly separated from all other material, were placed**

**in culture on Day 1. The chemical growth mix was added to the stem cell culture on Day 3 to change them into cardiac cells. By Day 5 the maturing cardiac cells are forming pulsing clusters. They are ‘programmed’ to seek each other out and link together. On Day 7 a large mass of cardiac cells has developed *in vitro* and has synchronised its beating.**

With this model in mind during the conceptual and structural development of the ‘*vital force*’ series of installations I made a decision to complicate the so-called “Cartesian dualism” of the “disembodied eye” [17] through the introduction of my own cells on which I carried out the experiments. [18]. In other words, through the use of my body as a research site, myself as researcher and my human cell image data in the installation context, I would be entrenched in both the research process itself and also in the artwork source material as demonstrated in the installation: ‘*machina carnis*’.

## **DEVELOPING THE WORKING MODEL**

### **‘Human Guinea Pig’**

During this research collaboration and contrary to accepted scientific protocols I, the artist and scientific investigator, would also become the ‘human guinea pig’. Using the skills and knowledge of the artist, I incorporated my human cell image data in immersive interactive installations as a reference to the biology of individual participants that would engage and resonate with them. This bi-relational link between viewer/interactor ↔ installation structure/data is a pivotal conceptual and aesthetic concept that underpins the ‘*vital force*’ series of artworks. In planning this series of works I considered non-linear, layered, rhizomatic structures, an important feature of which is the provision of multiple entry points [19]. Moreover, by adopting an open-ended, discursive methodology, characterised by multiple entrances I implicated the viewer in the recontextualising of the scientific data mediated through art.

### **Individual Viewer Experience**

In sum, essential strategies consistent with the experimental nature of the project were identified as flexibility of installation structures – considered here to constantly evoke a sense of disequilibrium and rupture – and the implication of the viewer in the work. These strategies were advocated as a means of fostering diverse readings, encouraging “a return to the field of origin” (which) occurs when the authorial voice is not seeking authority since “the work of initiators of discursivity is not situated in the space that science defines; rather, it is the science of the discursivity which refers back to their work as primary coordinates” [20]. Following this model, the research outcomes would rely on the viewer for completion but this completion is never final; rather, it is individual and subject to change both in response to the impact of the viewer feedback on future works and in the unique characteristics of the individual viewer experience itself.

## **INTERPRETING THE ‘LANGUAGES’**

### **Recontextualising Scientific Data**

The issue of how an artist might interpret and recontextualise scientific research data in ways that would retain its impact, whilst moving away from the documentary context, was of primary concern. When considering innovative ways to make the data meaningful in my chosen context I was mindful of Foucault’s assertion that during the nineteenth century “scientific discourses” were “received for themselves, in the anonymity of an established or always redemonstrable truth” [21]. His argument that knowledge and the notion of discovery itself are socially situated constructs supports a deconstructive imperative. Located in signifying systems and cultural practices, representations have always reflected their source and scientific data and images are no exception to this.

### **Situated Knowledge**

During the scientific experiments both Dr Nurcombe and myself made anthropomorphic, descriptive references to cellular behaviours; an outcome of our situated knowledge and the common experiential vocabulary at our disposal. It has also been noted that other scientists such as Crick and Watson used terms like “beautiful” for instance and privileged the concept of aesthetic symmetry during their documented investigations into the structure of DNA and their model constructions of the double helix [22]. Thus, scientific ‘discoveries’ could be understood as contingent upon the ways in which they were reported and discussed in the public domain. During my collaboration the serious implications of the epistemological and ontological complexities of the stem cell research encouraged me toward an increased focus on individual viewer interpretation of the recontextualised human cell data itself as a site for reflection, identification and empathy.

### **Conceptions of Corporeality**

I was aware that the human body is currently visually mediated by technology so profoundly that we are “beginning to ...foresee a new conception of corporeality and the human body: the appearance of the terminal body that separates between self (internal machine) and body (external machine)” [23]. In response to these changing perceptions generated by technological developments the ‘*vital force*’ installations problematised the ways in which bodily structures represented as scientific data are customarily regarded as accurate source material for analysis within that discipline. Consequently, their

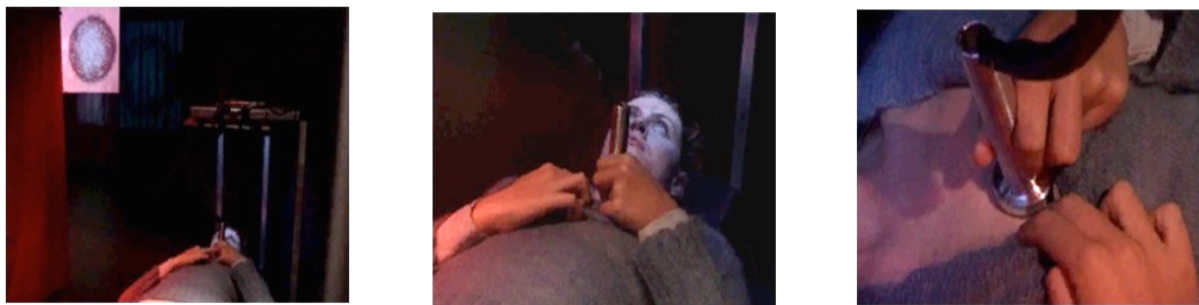
significance lies in the re-privileging of the aesthetic experience of corporeality in the discourses surrounding genetic manipulation. The implications of the issues raised by biomedical engineering processes were expressed as a very physical, tactile encounter. These encounters engendered a multi-sensory experience for the individual viewer, who, when thus immersed in the aesthetic, corporeal installation environment as a participant, completes the artwork through their engagement.

### Privileging an Emotional Response

This sensual reading of the scientific experience constituted a purposeful re-introduction of the Baroque aesthetic, so long rejected in favour of literate understanding:

“(i)t is precisely the baroque’s subversion of the dominant visual order of scientific reason that makes it so attractive in our postmodern age. . . in its disparagement of lucid clarity and essential form, baroque vision celebrated instead the confusing interplay of form and chaos, surface and depth, transparency and obscurity” [24].

Accordingly, in the ‘vital force’ series of installations the nature and definition of corporeality, including the different forms in which it can be represented, were foregrounded by privileging an emotional rather than an analytical response to the scientific image data. (Fig. 4).



**Fig. 4:** The installation is structured to provide interactive, immersive experiences. An individual participant lies on the couch and places the modified stethoscope over her heart so that the sounds of her heartbeats resonate through the gallery space. The heartbeat sounds signal the programmed installation technology to trigger the cardiac cellular image data to move in response; thus appearing to “beat” in synchrony with the participant’s heartbeats.

### Exploring the Nature of Physicality

When adopting this more open-ended model for presenting the experimental ‘findings’, where the viewer is implicated directly in their evaluation, I decided that I would regard the data I collected through the use of time-lapse digital videomicrography as more than a form of photography - as not merely visual but emotionally evocative and tactile also. Consequently I adopted a process of exploring this physicality on different levels so that the data-images became in those contexts a sequence of in-depth exchanges between: myself ↔ my cellular image data ↔ the viewer. My contentions are that empathy was engendered by our generic characteristics of ‘humanness’, thus engaging participants with the underlying issues, such as consciousness and sentience, through their individual responses. In the final installation: ‘*machina carnis*’, the time-lapse digital videomicrograph image data of my human stem cells symbolised more than impersonal scientific outcomes, they were imbued with intimate traces of their human, personal origin. (Fig. 5).



**Fig. 5:** When the participant lies down she looks up at a PC monitor showing digitized images of the cardiac cells which were cultured from the artist’s stem cells. Her facial image is captured by web cam and superimposed in this cellular image frame. When she locates her heartbeats the programmed technology causes her facial image to pulse on and off; thus this image also responds in synchrony to her heartbeat trigger.

# EVALUATING THE OUTCOMES IN RELATION TO THE CONTEMPORARY RESEARCH CONTEXT

## Transcending Disciplinary Boundaries

The innovative experimental processes and outcomes of this project foster a unique structural relationship which transcends accepted disciplinary boundaries. Therefore the project's significance within the developing contemporary context lies in the manner in which it constantly fluctuates between existing parameters to instigate a ground-breaking model which impacts on the current discourses. The research theoretically and visually articulates a unique processual model where the artist undertakes the dual roles of researcher and 'human guinea-pig' in order to immerse herself at the very core of the work. The re-privileging of the aesthetic experience of corporeality in the discourses surrounding genetic manipulation with regard to the plight of the genetically engineered human was a focus of contemporary cultural critique throughout.

## Non-Object Based Outcomes

The digital videomicrograph time-lapse cardiac cellular image data shows cells that originated from the artist's body recontextualised within '*machina carnis*' through an interactive installation format. This innovative, non-object based immersive approach enabled the viewer to enter an organic, relational network as a participant who effects its symbiosis. The essential strategies consistent with the experimental nature of this project and its overall significance to the art/science research paradigm are identified as:

- a receptive cross disciplinary environment – in this case an accommodating scientific collaborator
- open-ended methodology and conceptual structures – underpinning the hybrid nature of the project
- organic, flexible installation structures – evoking a sense of disequilibrium and rupture
- the implication of the viewer in the completion of the artwork – thus the non-object based research outcomes would rely on the viewer for completion[25].

Consequently '*machina carnis*' represents a practical, aesthetic enquiry that contributes to the contemporary debates surrounding the relationship to and implications of biomedical engineering on constructs of 'humanness' and the 'self'.

## CONCLUSIONS

The cross disciplinary art/science collaborative model that evolved between Dr Nurcombe and myself has generated a productive, innovative prototype and its' original contributions to the research field have already been acknowledged [26]. The collaboration developed momentum over time within an organic, flexible framework as we established the structure in response to changing parameters. Through this eclectic, fluid approach the focus constantly shifted from the position of the 'I' searching after 'truth' to that of the multi-perspective artist/researcher transcending the borders between a theoretical model and its application to contemporary research. Spaces were created for a visual artist to engage with 'cutting edge' biomedical research and recontextualise the outcomes in the public domain. The entire project was grounded in the interconnectedness between biotechnical research and twenty first century perceptions of the 'self' – both emotional and biological. It accommodated individual experiences through a scientific matrix of interactive, immersive installations that implicated the viewer by arousing personal emotions and socio-cultural issues. From Dr Nurcombe's point of view the collaborative experience was "(e)normously stimulating, and profoundly frustrating because we have barely scratched the surface. We haven't even explored how we think about all the possibilities" [27]. Whatever the future possibilities may be our productive collaborative model has already contributed to the developing field and thrived on the "spirit of 'what-if' ", reminiscent of the erstwhile natural philosophers [28].

## Appendices

### Appendix i

#### An informal overview of Dr. Nurcombe's cell preparation & culture stages

The mononuclear stem cells from the artist's blood were spun down to the bottom, collected and washed twice in saline. (Live cells hate having fragments of dead cell around because burst dead cells release metabolites and destructive enzymes). The mixture of cells was put into flasks for a while to recover from their ordeal of being removed from a warm body environment. The white cells that have stem cell properties started to put a variety of 'marker' (i.e. characteristic) proteins onto their surface – the key marker is called CD34. This has the advantage that specific antibodies can then be used to both detect them, and, if you attach magnetic particles to the tails of the antibodies, also pull the 'labelled' stem cells away from the rest of the non-CD34 expressing cells in a magnetic field. The other cells, now rendered unmagnetic, were simply poured away, with the magnetised cells being held inside the test tube. These stem cells were further purified and those carrying the CD34 marker were selected for efficiency and replated onto specially treated (by coating their growth surface with the sticky protein gelatin) plastic surfaces, which made them more receptive to being manipulated. The CD34+ cells are probably a subset of endothelial (blood vessel-forming) stem cells which are just now being understood. On the third day they were exposed to the drug 5'AZT & a mixture of cardiac differentiating factors, which have been shown by others in the field to push many cells into cardiac-like fates. The drug is very good at 'switching' on the genes which make the proteins

characteristic of heart tissue. We also added another, ‘secret’ ingredient: a species of a biologically active sugar, an extract made from embryonic heart. The sugars – Dr. Nurcombe’s specialty – cross-link active ingredients together into complexes with a real kick to them. Heart cells specialise in the cardiac-specific proteins which have contractile (beating qualities). – these are things like cardiac-specific actin, myosin, troponin – as well as the ion channels (cell surface gates) which start the beating cycle off. Finding these proteins was essential to the evidence that we had turned naive cells into something we wanted. What distinguishes one cell type - and one tissue type - from any other is the signature protein combinations within it. Almost all cells carry DNA which codes for every protein the body, yet inappropriate proteins are actively ‘suppressed’ from being made in the wrong places - you want a liver cell only making liver proteins when it’s in the liver, for example. After enough time in culture, we had several million cells, and they began to spontaneously organise their beating. The heart has a very special communication system - the cells have to beat (contract) in synchrony. They have a system for getting messages sent through the cardiac network efficiently (called gap junctions) - a syncytium (network). It takes a stem cell about a week to make all the relevant proteins, grow up enough for the cells to start touching each other, form the network, start beating - not independently, but in huge coordinated ‘waves’.

## Appendix ii

### Description of the interactive installation: ‘*machina carnis*’

‘*machina carnis*’ involves both cutting-edge scientific stem cell research and an immersive, interactive installation. It aims to probe the role of interactive new media art in crossing the consciousness divide.

It is a pioneering project for which the artist used stem cells from her un-screened blood for laboratory experiments. The university ethics committee took almost a year to grant ethical clearance but despite this lengthy process Adams considered that the use of her own cells was vital for developing viewer identification and empathy with the cellular image data to be shown later in the installation. It also created a unique model where she became a ‘human guinea pig’ and was both the subject and the object of the research.

At the entry to the ‘*machina carnis*’ gallery space viewers are presented with a video of the scientific processes. These include documentation of the laboratory experiments and digital videomicrograph time-lapse footage of the stem cells from Adams’ blood developing into cardiac cells *in vitro* and subsequently clustering and beating in unison after seven days in culture.

It is intended that, having had the opportunity to familiarise themselves with the ‘cutting edge’ scientific processes, the viewers will then focus on the experience of the ‘*machina carnis*’ installation itself.

The interactive technology is designed to be discrete, user-friendly and to enable the ‘*machina carnis*’ installation structure to implicate the viewer both physically and emotionally. The software: ‘Max MSP/Jitter’ is programmed to activate, via a Mini-Dig ‘i-cube X’:

1. A hidden touch pad at the head of the couch which is programmed to respond when a participant lies on the couch and change the projected image and that on the PC monitor above the couch from randomly flashing cells to a cluster of cardiac cells.
2. A modified stethoscope which the individual viewer places on their bare skin over their heart so the sound of their heartbeats resonates loudly around the installation space and the cardiac cell images appear to “beat” in response to this sound trigger.
3. A webcam which captures their facial image to superimpose it on and off in the cardiac cell image frame so it also appears to pulse in response to the heartbeat trigger.

When participants leave the installation space a second video is available. This is composed of captured frame grabs from the ‘*machina carnis*’ installation webcam showing each participant’s indistinct facial image superimposed in the cardiac cell image frame, along with the sound of their individual heartbeats. This video is also streamed to the Internet. Each day’s new participant data is added so that the video represents a combined outcome reflecting the cardiac cellular processes themselves. This compilation of participant data forms a tangible, organic residue of the ‘systems’ – both biological and social – thus creating a parallel relational network.

‘*machina carnis*’ focuses on the interconnectedness between biotechnical research and twenty first century perceptions of the ‘self’. The installation employs contemporary interactive New Media technologies in a discrete way. This use of technology accommodates each individual’s experience through an interactive, immersive installation format, arousing personal emotions and questions about contemporary stem cell research in relation to current socio-cultural issues.

## Acknowledgements

Dr. Victor Nurcombe was my invaluable scientific collaborator and we were able to carry out this project thanks to extensive in-kind support and laboratory facilities provided by the School of Biomedical Sciences, The University of Queensland, Brisbane, Australia. The Brisbane Powerhouse generously provided a venue and in-kind support for the ‘*machina carnis*’ installation. During the process I received an Australian Postgraduate Award through Griffith University, Brisbane, Australia. Laboratory still images courtesy Dr. V. Nurcombe. ‘*machina carnis*’ documentary video photography, post-production and still images courtesy Ben Wickes.

## References and Notes

1. During our collaboration Dr. Victor Nurcombe was an Associate Professor at the Dept. of Anatomy & Developmental Biology, School of Biomedical Sciences, The University of Queensland, Brisbane, Australia. He has subsequently relocated to The Institute of Molecular and Cell Biology, Singapore, where he is Principal Investigator..
2. Nurcombe, V. E-interview by Patricia Adams, in Adams, P., "The Implications for Artistic Expressions and Representations of Corporeality of the Experimental Techniques of Biomedical Engineering", Doctor of Visual Arts Thesis, Griffith University, (2005), appendix v.
3. Nurcombe [2].
4. This paradigm shift occurred since we only know consciousness exists through our own experience of it; experiments that rely on physical measurements give no indication of its presence. Barnaby, W. (1995) "Consciousness: Its Place in Contemporary Science", <<http://www.absw.org.uk/Briefings/consciousness.htm>> (15 March 2005).
5. Weibel, P. "Endo & Nano – Over and Beyond the Limits of Reality" in *Endo und Nano - Die Welt von Innen*, K. Gerbel, & P. Weibel, eds, (Linz: Verlagsgesellschaft, 1992) p.8.
6. English neurologist Sir Henry Head became so "frustrated with the difficulties he encountered in testing sensory loss in patients with peripheral nerve damage" that he went to extreme lengths and "persuaded his colleague, the surgeon James Sherren, to divide two cutaneous nerves in his [Head's] left forearm" <<http://www.whonamedit.com/doctor.cfm/705.html>> (10 April 2003), p.2. Australian physician and recent Nobel Prize winner: Barry Marshall, drank bacteria to prove his controversial theory that bacteria, not stress, cause peptic ulcers <<http://www.usnews.com/usnews/doubleissue/heroes/marshall.htm>> (10 April 2003) p. 1.
7. Nurcombe [2].
8. From a hygiene perspective, there is a danger of transmitting life-threatening diseases when unscreened human material is put into equipment or cultured in the laboratory and, in many cases of bio-tech research, there are also complex moral and ethical issues related to social values and ownership of intellectual and other property that institutions may prefer to avoid.
9. Protocols already existed at the adjoining School of Human Movement Studies, The University of Queensland for a doctor to take blood for analysis. This process fell within the ethical clearance guidelines and was a less invasive process than the proposed hospital biopsy. Details of the Ethical Clearance Processes are available in Adams, P., "The Implications for Artistic Expressions and Representations of Corporeality of the Experimental Techniques of Biomedical Engineering", Doctor of Visual Arts Thesis, Griffith University, (2005), appendix i..
10. Wilson, S. "Art as Research" <[http://www.sfsu.edu/~swilson/papers/artist\\_researcher.html](http://www.sfsu.edu/~swilson/papers/artist_researcher.html)> (1996, 13 March 2000). p. 3.
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25. As has already been discussed in the section: Developing the Working Model this completion was never final; rather, it was individual and subject to change both in response to the impact of the viewer feedback on future works and in the unique characteristics of the individual viewer experiences.
26. The penultimate vital force interactive installation: 'Wave Writer' was included in the Critical Interdisciplines category at ISEA 2004 that investigated "how researchers, artists and other practitioners collaborate or collide to create new knowledge". In addition, the ISEA2004 committee qualified their intention for this curatorial category by explaining that "too often a boundary crossing between a cultural practice and a field of research is taken as a value in itself regardless of whether new knowledge, understanding of experience is created" <<http://www.isea2004.net/themes>>. In other words the outcomes of such cross-disciplinary collaborations are what really count.
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## **Author Biography**

*Trish Adams has been working at the nexus of art and science since 1998. She was awarded her Doctor of Visual Arts in 2005. Her practice-led doctoral research explored the impact on expressions and representations of corporeality of experimental techniques in biomedical engineering. These investigations took the form of a three-part quasi-scientific parody of the nineteenth century search for the 'vital force'. This doctoral scientific experimental research involved changing stem cells from the artist's blood into beating cardiac cells in vitro through a pioneering, productive art/science collaboration with a biomedical scientist at the School of Biomedical Sciences, The University of Queensland, Brisbane, Australia.*

## **Author Email and Postal Address**

Dr. Trish Adams (arts researcher and practitioner)  
Email: [digitalpla@telstra.com](mailto:digitalpla@telstra.com)

School of Biomedical Sciences,  
Skerman Building,  
The University of Queensland,  
St Lucia,  
Brisbane,  
Qld. 4072,  
Australia.