## Fugitive Moments

Report of the research project undertaken as part of the Wellcome Trust People's Award: awarded to Drs Beau Lotto and Sarah Rubidge (2004-2006)

(Written by Sarah Rubidge from the artistic collaborator's perspective.)
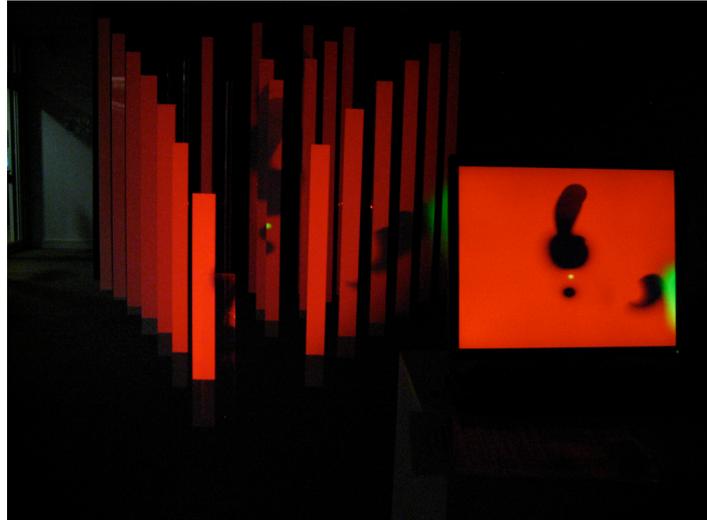
Fugitive Moments 1   Fugitive Moments II

Images of the installations created at the end of this research project.

Aims
The original research intentions for this project were: a) to explore the possibility that viewers' physiological responses to digital imagery which emphasises movement and colour could be used to modulate that imagery through an interactive interface; b) to develop a generative system that would create an open-ended feedback system between the viewer's responses to an image and the generative system, c) to explore further a radical abstraction of human motion as the foundation for the development of visual imagery d) to explore the use of wearable sensors in the context of 'smart' clothing

Preliminaries
Fugitive Moments was an R&D art project, initiated by Sarah Rubidge (hereafter referred to in the first person) and grounded in a collaboration between the arts and the sciences. The initial idea for the project was derived from observations by viewers of *Time & Tide (2001)* and *Sensuous Geographies (2003)*, both collaborative artistic installation works involving computer technologies (see www.sensedigital.co.uk). In both instances viewers/participants had reported that the installations made them feel sensations in the body more strongly than other installations that they had experienced. It also continued my ongoing artistic research into the 'open' work, which commenced in the mid-1990s, moving it into the field of generative systems as the grounding for such works. This constituted an extension of the complex open-ended, but not generative, systems that I had worked on in previous interactive installation projects.
(Passing Phases;1995-199), Halo-in-Performance;1998,Sensuous Geographies;2003) .

In order to explore the possibilities offered by the above further I had decided that the starting point for the imagery in this R&D project was that it would be highly coloured and that its flow of motion would have qualities that could be associated with human movement, that is the imagery would 'dance'. These starting conditions were based on the intuition that a) colour had an effect on physiological systems and b) watching movement also affected the viewer's physiological state. As such, I surmised, physiological responses could be used as the interactive interface in an art work. This builds on the intuition held by dancers for many years that the observation of some movement generates a similar physiological

response to that experienced in the active performance of a movement, an intuition now being supported by neurophsyiological research (e.g. the work of Gallese et al. on mirror neurons).

Having found a collaborator in Dr Beau Lotto, of *lottolab* (at the Institute of Ophthalmology, University College London), a specialist in colour and motion from a scientific perspective, refinements of the original idea commenced. Preliminary discussions with Lotto, led to the development of the original idea such that it incorporated the notion of using an interactive artificial life (ALife) programme to generate and modulate digital colour imagery in response to biometric data such that it would exhibit the qualities of human motion if at all possible. The use of an ALife programme was drawn from Lotto's notion that the imagery could constitute an evolutionary 'life form', and would evolve, and thus be a direct reflection of, a sub-conscious dialogue between viewer and imagery. The aim was that the shifts in biometric data introduced from the physiological responses of the viewer to the evolving imagery would be responsible for the direction of evolution of the ALife programme.

I was also interested in using unencumbered interfaces for the sensors that would collect the biometric data, initially through researching the possibility of using 'smart' clothing as the site of the sensors.

Stage 1
The first five months of the project saw two ALife programmes being developed simultaneously by three PhD students (Richard Clark, Daniel Hulme and David Malkin) who were based at *lottolab*. For the students this was a standalone 6-month project that constituted part of their PhD programme. The prototype programmes they developed comprised one which was designed to test the biometric feedback system (*EvoIm*), the other a prototype art system that would use biometric feedback as an interactive interface. A second programme (*EvoCritters*) was designed to measure the effect of physiological response to still imagery, and by virtue of that response evolve a tendency for the programme to choose imagery of one type rather than another. This programme was, at one level, specifically designed to test the efficacy of the proposed biometric interactive interface. At another level it could potentially be used to evolve a composite image from a multitude of smaller still images (and thus become a kind of 'art-machine').

As the programmes were being developed I undertook extensive research into scientific studies relating to: various kinds of biometric data (heart rate, skin conductivity, temperature, etc); the use of biometric data as an analytic tool to ascertain (say) emotional affects of imagery; scientific experiments concerning neural behaviours when both enacting and viewing movement; experiments using imagery as the generator of physiological responses; experiments using colour as the generator of physiological responses. This information was fed back to the programmers and Lotto as a means of understanding precedents for work within the area; what might and might not work with respect to the interactive interface; potential new directions for development, and so on, and also used in choice of imagery from programme *EvoIm*.

As noted *EvoIm* was designed to measure the effect of physiological response to still imagery. I developed and organized banks of still imagery using various forms of subject matter (from the obviously arousing (e.g. erotic/violent) to more neutral imagery (e.g landscapes, flora/fauna/colour) for use in *EvoIm's* tests of the measurability of biometric data. It was anticipated that exposure to different forms of subject matter in the imagery would precipitate different kinds of physiological response in a viewer.

The other programme, *Evocritter*, was designed to evolve a moving colour image which was in a constant state of motion and colour modulation, and which evolved in response to interventions from biometric data from the viewer. A prototype of the programme was developed by the three programmers in close consultation with Lotto and myself, Lotto advising on the principles and techniques underlying ALife/evolutionary programmes, myself advising on the colour and motional qualities of the imagery from an artistic perspective. With respect to the former, modifications were made to the programme as it developed to ensure that the programming principles used to generate an evolutionary system were appropriate to this project. With respect to the latter, the visual output of the programme was initially explored so that the evolving imagery potentially lay within, or close to, implicit boundaries of the kinds of qualities that were consonant with my aesthetic.

During the course of the discussions with Lotto and the programmers it soon became clear to me that, in the context of ALife, the more open-ended the programme was the better. However, as an artist I still wanted to maintain some control over the qualities of the imagery (tempo, colour range, etc.) and thus personalise it to my aesthetic preferences, whether through setting up the original conditions from which the evolution would commence, or deciding the constraints within which that evolution would take place. Consequently the programmers built a GUI (graphical user interface) into the program to allow me to set

initial parameters for the imagery such that a variety of potential colour and motional worlds could be generated for use in an art installation. As such there were three levels to the programming: the code that gave rise to the evolution of the ALife programme; the code that gave rise to the detail of the visual output; and the custom built 'programmes' that were created by the artist/user to give rise to individual colour-systems (the settings of which determined the kind of visual output that would emerge). At a conceptual level, it became apparent that the actual visual output displayed in any resulting art-system (or artwork), the detail of which was programmed by the artist, would not on its own be 'the work'. Rather the 'invisible' evolutionary systems that drove it was integral to the artwork. Nevertheless, these systems were not themselves the work either, because the invisible system could be programmed by artists to refine its internal behaviour, and thus the character of its visual output. Consequently both programmers and artist-users were 'authors' of each artistic manifestation of the underlying evolutionary system.

(Lotto's aim is that both these programmes will be able to take any input and potentially give out different forms of output (for both artistic and scientific purposes – e.g. to test activity of neurons in relation to colour, to evolve a composite image from still images) and thus become generic programmes for use by other artists and scientists. This would be of considerable value to artists, as it means that individual artists do not need to start from scratch with new collaborators when embarking on projects that use ALife systems.)

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The programmers involved in the first prototype spent six or so months on the project and then continued with their own PhD research. When the programmers completed their involvement in this prototype programmes, although *EvoIm* and *EvoCritter* were successful in terms of a basic structure, they did not yet incorporate sufficiently stable programming to allow the use of biometric data as an interactive interface between viewer and system. Further research was needed.

Stage 2
Two to three months after the completion of the first prototypes, Erwan Le Martelot, a French Masters student who was undertaking a placement in Lotto's lab completely reprogrammed the two ALife systems as part of his Master's project, building on the principles developed by Lotto and the previous programmers, and incorporating systems that would allow biometric data to be used as an interactive interface in these interactive programmes. He too worked in close consultation with Lotto and myself, and was able to take advantage of the experience of the other PhD students involved in developing the programme who were still working in the lab. The qualities of the imagery in *EvoCritter* were slightly different in the revised programme, as was the interface. The GUI provided a multitude of modifiable parameters and combinations of parameters, some developed in response to my questions and ideas. The programme was now even more flexible and allowed the user to control the combination of colours, the tempo and general shape of the moving imagery, and so on. For an artist this was becoming a system which could produce many different qualities of image, transforming the programme into a medium (rather than 'art-machine') from which to generate imagery.

For me, ascertaining the extent to which the artist could usefully be directly involved in scientific experiments took up a part of the first 18 months of research, as did negotiations concerning the division of labour between two main investigators (Lotto and myself) with respect to the nature of their collaborative roles.

When the two programmes were near to completion (approximately 15 months after the commencement of the project) preliminary experiments to test the efficacy of the imagery to initiate biometric data sufficiently powerful to effect a modification in imagery were undertaken. At this stage we were still using 'off the shelf' wireless biometric measuring devices. Unfortunately, due to a change in the organizational structures for the lab at which a second collaborator worked (he would have been responsible for the smart clothing aspect of the project) he was not able to continue with the project. As the lab at which this part of the

research would take place would have provided a substantial amount of 'in-kind' support with respect to expertise and equipment for use in the development of smart' clothing, this aspect of the project became less realizable. On hearing this news I made contact with researchers working in the field of smart clothing and unencumbered biometric interfaces both in the UK and North America to see whether he could be replaced. I found that within this field of research that the ideas we were pursuing here were highly speculative, and that working with smart clothing was not possible within a) the financial constraints we were working under and b) the time span available to us. We therefore continued to use affordable, encumbered, wireless sensors in the research.

Initially I undertook the experiments to test the efficacy of the programmes with respect to reading biometric data, Lotto's understanding being that this was to be a part my research role. (As in all new cross-disciplinary collaborations the best way to approach the collaboration could only be discovered through trial and error, and through gradually coming to know the preconceptions with which each entered the project.) However, it fast became apparent that my knowledge of the scientific principles underlying the significance of the rates of biometric data were insufficient to enable me to read and interpret the output of the experiments. This became extremely frustrating and slowed down developments in the project. Additionally the programmes needed to be continually modified by the programmer in response to these results to refine their responses to biometric data.

After discussions with Lotto concerning the best way forward at this stage in the research the two collaborators devised a division of research labour. This decision was made that Lotto undertook the scientific experiments and interpretation of their results, and made recommendations to the programmers on that basis, and I took responsibility for the artistic aspects of the project. The latter included: experimenting with the parameters built into the ALife programme which allows the tempo, colour, quality of movement to be modified to produce different nuances of imagery; collaborating with the designers to generate 'holders' of the technology which reads biometric data from the body which go beyond the functional designs used commercially; experiment with modes of displaying the imagery (screens, projection, etc); designing the installation environment which will house the ALife programme. All these would be developed in consultation with Lotto to ensure that the qualities of the installation are satisfying to both collaborators. Consequently 15 months into the project the two collaborators were at the point of commencing the final months of research with their respective roles clearly defined, although the blurring of the roles recurred during the final stage of the project.


Stage 3
The final 9 months of the research were spent a) doing final testing on the biometric input systems, b) testing and refining the *EvoCritter* programme and c) developing a prototype installation (in terms of both the colour systems used and the physical environment) that would constitute the main output of the project.

With respect to the former, proof of concept was achieved for *EvoIm,* inasmuch as the selection of types of imagery displayed by the programme evolved in response to the biometric input from the viewer. Tests on this were inconclusive in *EvoCritter,* in part because the imagery was far more subtle and did not generate as strong a response as the emotive imagery used in *EvoIm,* in part because it was difficult to find subjects and sufficiently controlled conditions to run them in. I ran the experiments on myself, colleagues and some members of the lab. As the most available subject I tested the system on myself more than others. However, my age militated against this as variation in frequency and amplitude of heart rate (the measures we used) diminish substantially as one ages. As I was 58/59 years old the results I achieved would not have been particularly informative with respect to the efficacy of this particular programme in generating readable biometric data.

My explorations of the possibilities that *EvoCritter* offered to an installation artist, and the process of designing with Lotto two installation environments for the exhibition at the Otter Gallery in Chichester, took up the rest of my time during the final months of this third stage of the research project. During this stage Le Martelot, who had returned to the lab as a PhD student a few months after the completion of his MA project, continued with the programming for this research on a very part-time basis, refining it as and when needed under Lotto's supervision.

During this period my dialogues with Le Martelot re *Evocritter* became more and more concerned with artistic aspects. As I explored the range of possibilities the system offered I discovered aspects of the programming that had not been built-in consciously. (e.g. if one changed one value to a negative one

could generate a full colourfield, interrupted by black 'holes', on the screen, rather than globules of colour which emerged from a black background.)
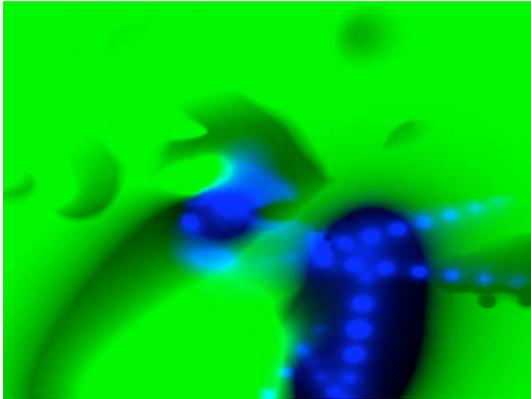
*Fugitive Moments image emerging from full Colourfield (screen shot)*
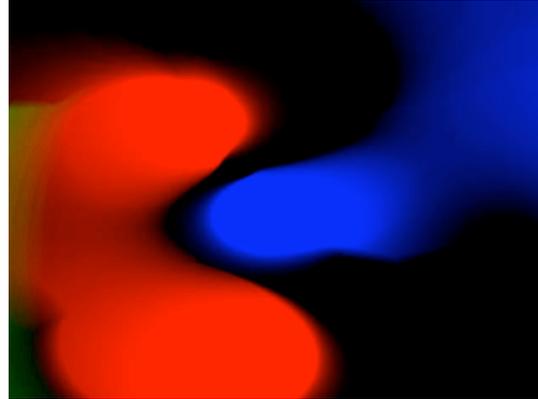
Fugitive Moments image emerging from a black ground (screen shot)

Such discoveries gave me an artistic flexibility that was very satisfying. We also discussed possible changes to the programme which would allow me to set the starting conditions for, and constraints within, with respect to the detail of the evolution of, the system in such a way that the system would generate the kind of imagery that I preferred to create as an artist. Although possible, Le Martelot was able to undertake the programming for many of the ideas we discussed due to lack of time. For example, I wanted to be able to constrain at will the range of the different colour-axes (RGB) in the computer colourspace (the motion of the critter through this space generating the evolving colour field). In this way I hoped that I could exert some kind of control on the range of the colourfields produced, allowing me to generate more subtle colour fields than were available when the full range of the 3-colour colourspace was available to the critter.

However, I experimented with the system as it stood and towards the end of this period I was developing colour systems that moved at the kind of pace I was interested in (generally smoothly and slowly), used either a single (Red, Blue or Green) colour axis to create a single-colour image, or a dual colour axis (RedGreen – produced RG and Yellow, BG, RB). I decided not to use the three colour system as the colour range that emerged from this was too wide ranging for my artistic tastes.

The final stage of the research project entailed me developing seven nuanced custom built colour systems for two installation environments, and the mounting of the exhibition of the work-in-progress.

One installation (*Fugitive Moments I*) comprised three slow moving single colour systems, red green and blue.
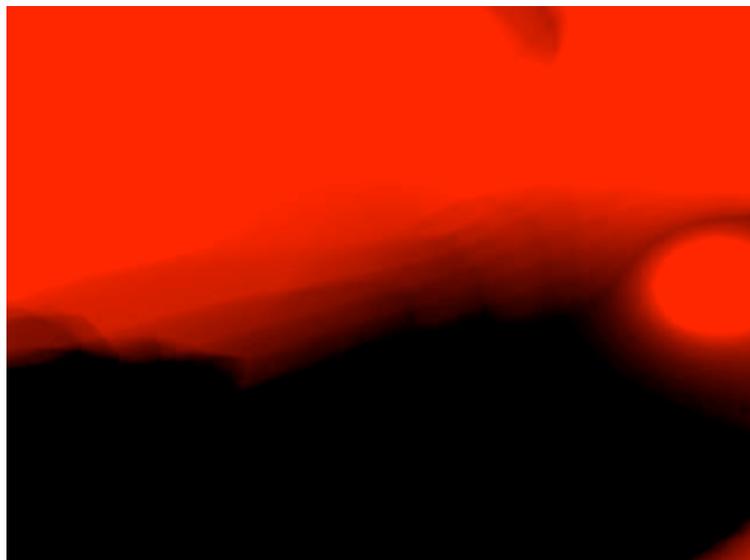
*Fugitive moments II, Red (screen shot)*

These were displayed on a single LCD screen embedded in a black velvet wall, and mounted in an enclosed, dark space that was lined with velvet.
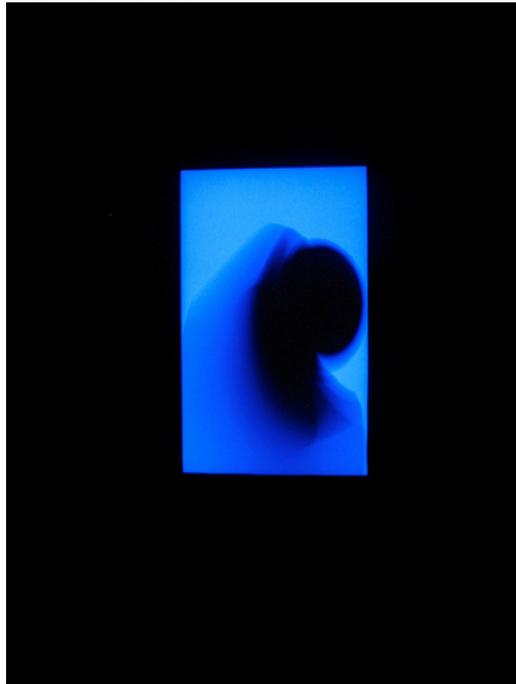
Fugitive Moments I, Blue (in situ)

The systems and installation environment for Fugitive Moments I (which contained no visual distractions, the only image available to sight being the slowly moving colour image) was specifically designed to facilitate the diminishment of reliance on the sense of sight to make sense of the work, and an increase in the ability to notice the way the image made one feel. Some viewers (particularly dancers) found this easier to achieve than others.

The second installation (*Fugitive Moments I*) comprised four dual-colour systems (RG, GB, RB) projected onto a three dimensional factured screen (conceived by Lotto and designed by Lotto and myself) to serve as a projection surface. This was created from some 25 strips of semi-opaque Perspex, hung in such a way as to emulate visual perceptual mechanisms. The result was a three-dimensional wedge shape, which when viewed from the front looked like a flat screen (no gaps being detectable between the strips),
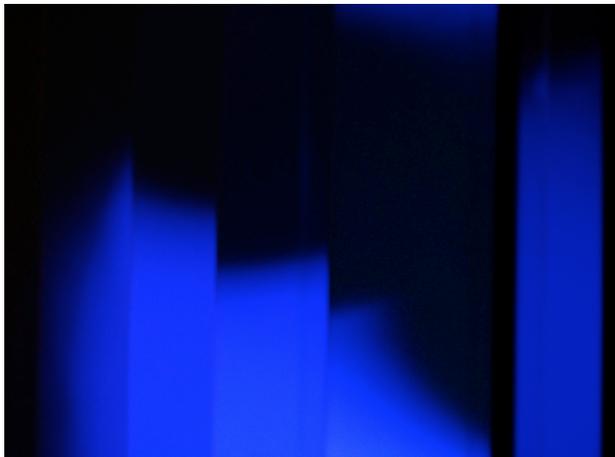

Fugitive Moments II (Blue)
Seen directly
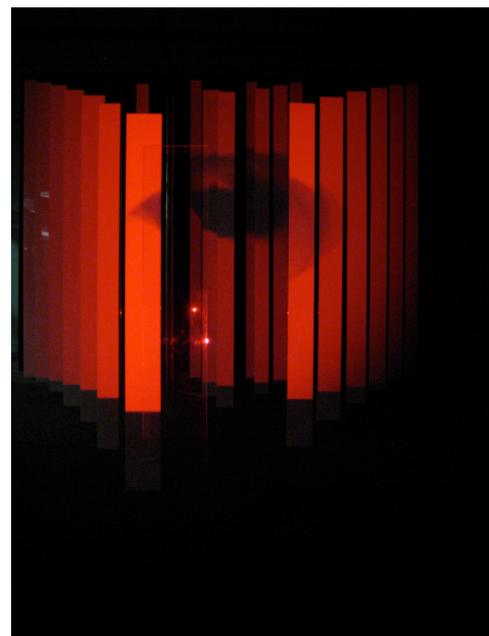
Fugitive Moments II (Red)
from the front.

but when viewed from slightly to one side, or from the side or back became a three-dimensional structure.
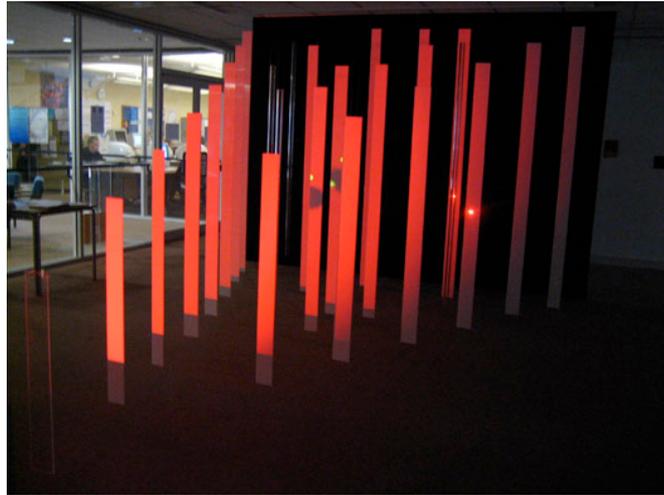
Fugitive Moments II (Red/Green): Seen from the side

The qualities of the semi-opaque Perspex material, which allowed the colour image to be seen from both the front and the back of the strips, enabled the image to viewed from all directions, giving the installation a fully three- dimensional quality.
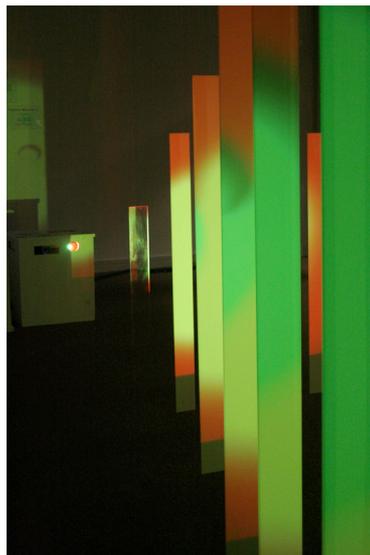
Fugitive Moments II, red/Green: Seen from the back

In this installation the viewers were given the option of creating their own colour systems. The computer running the programme was placed at the front of the installation. Full instructions for the operation of the system were placed next to the computer. Many viewers availed themselves of this opportunity. The 'work' thus changed its qualities with the different colour systems that emerged from the viewers use. (The systems produced by viewers were usually much faster moving and multicoloured.)

Fugitive Moments II Multicoloured

The two-colour systems I had produced were regularly returned to provide a different sense of colour and motion during the course of the day.
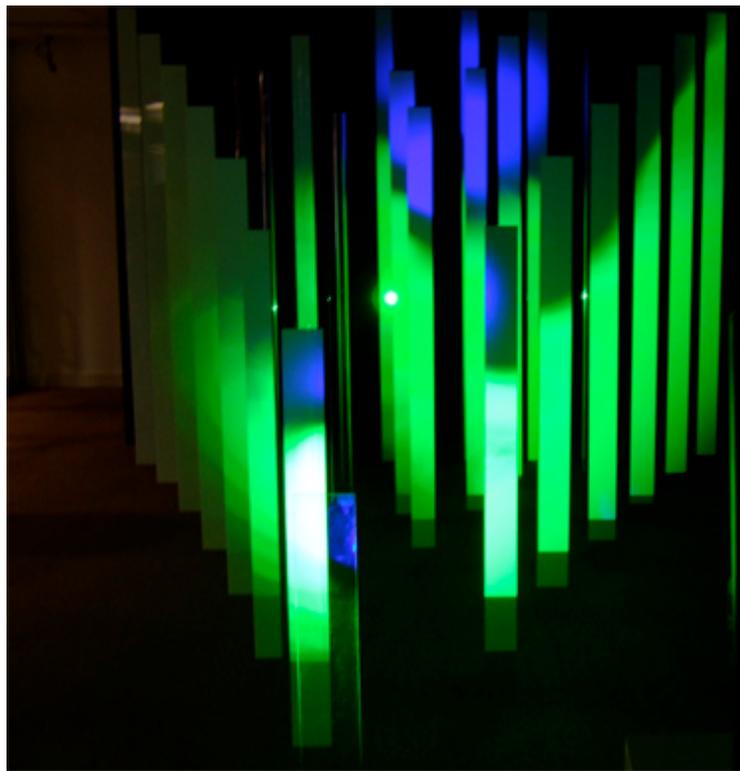
Fugitive Moments II, Blue/Green

Organizing, publicising and mounting the exhibition and building the installation environments also comprised part of this final stage of the research project. This I took full responsibility for.

Conclusions
The project we had undertaken was, we discovered, highly ambitious. Indeed, much of it came under the designation 'speculative research', particularly the desire to embed sensors in smart clothing, and to place them on parts of the body not normally used with biometric measures. Discussions with experts in this field (e.g. The Bristol Wearable Computing Project at Bristol University) made it clear that the sites for measuring SCR and HR were chosen for sound physiological reasons, and that to resite the sensors, whilst potentially not impossible, lay in the realms of speculative research in the field, and thus would require considerable sums of money, and a great deal of time, to research. These we did not have.

Further discussions with experts in interactive textiles (e.g researchers at Concordia University, Montreal, and computer scientist Wei Yei, formerly of the University of Texas) made it clear that these too were in very early stages of development, and that any research into this needed the full support of computer scientists and engineers who had regular access to high end equipment, and who were specialists in this field. Again, these were not available to us on this project. For these reasons it is, perhaps, not surprising that this part of the proposal was not realized in this research period.

However, the multi-leveled art-programme that has emerged from this research has considerable potential for development in an artistic context. Although the results of the biometric experiments were inconclusive in *EvoCritter* (Lotto will be continuing with this aspect of the research with a postdoctoral colleague in 2007), from my perspective the artistic results that emerged from the two-year research period gave rise to many ideas as to how I could work with ALife or evolutionary systems within my artistic framework.

Working with Lotto and his colleagues gave me much food for thought, and new ways of thinking about the systems underpinning generative work. It also made me even more aware of the complexities involved in the integration of fine-tuned artistic ideas with technologies such as those I had envisaged for this project.

The *artistic exhibition* that emerged from this project, although still 'in progress', was from my perspective a success. It received very good responses from its audience, many of whom visited the exhibition several times. Audience responses included the following:

> *"Beautiful organicity, and intimate time of the transformations … fluid, timeless, full, strange, worrying, alive... I will go back to see it again, because it's the kind of thing that you need to see it more than once." (dance artist)*

Theoretically, as this piece has pursued the notion that viewing movement affects the physiology in some way, the 'hard science' readings I undertook at the start of the project, a necessary precursor to undertaking the practical scientific research, increased my knowledge of a number of scientific concepts with which I had previously only had passing acquaintance (see bibliography for an example of papers I consulted during the research project). I also became familiar with concepts which were relatively new to science that resonated with the intuitions I have been working with for many years in my career in dance and choreography. For example, support for dancers' and choreographers' intuitions concerning the way movement is understood was found in a body of experiments that have been taking place by Vittoria Gallese and his colleagues in Department of Neurosciences at the University of Parma. They have discovered a set of neurons (mirror neurons) which become active in very similar ways when the subject is either viewing or enacting a particular movement. This has proved to be a fertile area of debate amongst my colleagues in the arts, and has provided scientific support for many of the areas of study now being undertaken by my peers in choreographic and/or dance-initiated interactive installations. I have included my considerations of this scientific research in relation to my work as a whole in papers and presentations given at symposia and conferences (e.g. *Transnet* conference, Simon Fraser University, Vancouver, Canada, 2005; Research Seminar, Department of Digital Arts, Doncaster College, 2005; Research Seminar University of Chichester, 2006; Queensland University of Technology, Brisbane, 2006).

As far as the results of this project are concerned with respect to the aims of the *People's Award*, I have found the time I spent at *lottolab* extremely valuable. I became familiar with different ways of working, and attempted to accommodate my own strategies into those used in a science lab (that is, I attended the lab two days a week, Lotto quite rightly wanting a collaborating artist to be a physical presence in the lab, rather than a name only). For the two years of the project I did most of the work involving computers in the lab, although I sustained my practice of reading papers and books relating to the project primarily at home. This was in opposition to my own working practices as an artist which tend to take place at any time of the day or night, a practice made possible by the set-up I have in my own home (two computers set up for working on artistic projects, and a library of books, papers and documents that relate to current research projects). Although I found it difficult to change my working patterns I sustained this two-day a week pattern in the lab until the final stage of the project when I worked at home with the computer on the colour-systems and designed and built the installation environments. Although I found that my existing working processes were more suited to both my established artistic and research practices it was a valuable experience to attempt new ways of working for an extended period of time.

Additionally, through being in a situation that did not resonate with my own processes, I have had to pay close attention to and examine the nature of my working practices as an artist-scholar. In doing so I gained many insights into the rationales underpinning my practices that have until now remained implicit. Towards the end of the project unresolved issues arising from engagement in cross-disciplinary collaborative

projects also raised their heads. Amongst these were notions concerning the allocation of roles and of authorship in complex collaborative projects in which the collaboration is not hierarchical. In my previous artistic projects implicit assumptions have been made by collaborators as to the primary (frequently joint), secondary and implicated authorship (and thus ownership) within the context of the collaborative projects. Inherent in this lies implications concerning the sharing of roles at various stages in the research process, whilst maintaining the specificity of one's own expertise. Towards the end of this project, it became apparent that different implicit understandings regarding allocation of roles, authorship and ownership underlay our respective approaches to the project. The levels to which these various modes of contribution applied, and an examination of the way in which roles and expertises became blurred at certain phases of the project, needed to be made explicit if a shared understanding of the detail of the collaborative processes was to be achieved. Addressing these issues explicitly gave me much food for thought, and may yet lead to a paper (not specific to this project but emerging from it) which will discuss different ways in which the network of roles and contributions made by multiple collaborators in cross-disciplinary projects intertwine and give texture and depth to the results of any multi-faceted collaborative process.

During the course of this collaboration I have thus benefited from the rethinking of my working processes that were needed in order to maintain this new way of working, and from the overt conceptualization of the collaborative processes I have been working with over the years. The goals of the People's Award have therefore been met through my participation in a long-term collaboration with the members of *lottolab*. My understanding of scientific issues and working processes has greatly increased, and my experience of working in this context has, I believe, giving me a good grounding in pursuing further cross-disciplinary projects with scientists.

It has also given me insights as to what need to be rethought in future cross disciplinary collaborations between science- and art-based disciplines. For example, continuity of the computer scientists working on the project would have been of benefit. In common with other science-art collaborations, in this project two independent sets of postgraduate computer scientists worked on the underlying ALife programmes over the two years. For me this necessitated the establishment of productive working relationships with two different sets of people, who had different ways of thinking and working. This was achieved relatively easily but, as it took time to explain the ideas to someone new, to some extent it delayed the progression of the project. Although the results were more than satisfactory, I cannot help but feel that had we worked with one programmer or team of programmers across the full two years some of the issues we encountered might have been resolved. In future collaborations, if it is possible, I would try to establish a situation up in such a way that the consistency of all the collaborative relationships goes across the whole project.

In spite of this small issue, this research period has been a productive time, both in terms of process and product, and for a first collaboration between the primary researchers, who also needed to get to know each other and their ways of working, it has been successful. I anticipate that the experience will affect my future work, and lead me to further investigations in this field.

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