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Art into science/science into art

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Abstract

Hybrid artist-scientists are now fairly common. It wasn't always thus. Certainly music has a relatively long history of cross-fertilization with science, not least because of its obvious mathematical qualities, but also because of the medium-term relationship between music and technology. In formal music studies though, the medium of music was generally considered indivisible from itself, even as mathematical models were used to justify certain theories. Film also has a similar, if somewhat less precisely formalized history, as evidenced by the long history of montage film and visual music. Other fine arts have had less clear relationships with science. This can no longer be said to be the case. Artists are collaborating with biologists, computer scientists, geographers and researchers from other far-flung disciplines. Similarly scientists are learning the value that artists can bring to a project in terms of creativity and "ways of seeing" (Berger, 1972, 1). On-going discipline-centric resistance based on adherence to traditional barriers between the (subjective) arts and the (objective) sciences continues to be prevalent; however, it is fair to say that the gulf between art and science that has widened since the Enlightenment has now been widely challenged by a body of scholars, artists and scientists.

This special issue explores the concerns of the emergent transdisciplinary research that seeks to re-unite the arts and sciences into a new hybrid form. There exists a long philosophical history describing the differences, distinctions and (very occasionally) the similarities between the arts and the sciences. This history has been well documented in the scholarly and philosophical literature from Aristotle to Foucault. Similarly there is a history of artists (and especially novelists) speculating on science in their writing and

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artworks. This history is equally well represented from Mary Shelley to Neal Stephenson. Neither of these histories lie within the scope of this volume. Instead, this volume concentrates on contemporary examples of new hybrids that ride the boundaries between scientific methodology and artistic practice. As such we concentrate more specifically on the work being done by art-science hybrids at the present moment.

Pre-history

While there are points in Western history where art and science were quite intimately entwined (such as the Renaissance), the pre-history of a contemporary transdisciplinary hybrid art-science can be traced back to the 19th Century, with inventions such as Rimmington's colour organ (van Campen, 2007, p. 1). Throughout the early Modernist Era and into the mid-20th Century there were numerous attempts to apply scientific thinking to the arts; however, the general trend toward the use of scientific method within artistic practice (and vice-versa) was more firmly established in the late Modernist Era where technologies began to allow precise intersections of art concept with scientific research.

One of the first researchers to formally describe a strange conceptual reality made possible by the then-new science and technology innovations of the 1960s was Ivan Sutherland. He describes new display technologies as having overtly fantastic artistic implications:

> The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. (Sutherland, 1965, p. 256)

Sutherland was the first to try to achieve a part of this vision through the creation of a head-mounted display he called the "Sword of Damocles" (Packer & Jordan, 2001, p. 253). This device was a clear precursor to virtual reality and by extension to present-day augmented reality. Sutherland was a computer scientist by training, but his language is that of the artist and the tools he proposed set off a chain of artistic interactions with technology that continue to this day. For a detailed description of Sutherland's invention (including a video demonstrating its use) ArtMuseum provides an excellent on-line

version excerpted from Randall Packer and Ken Jordan's *Multimedia: From Wagner to Virtual Reality*.

Another key figure in this evolution of art and technology research is computer-scientist and inventor Myron Krueger. Krueger famously developed computer systems and camera-based capture devices to create "Responsive Environments." These systems allowed a person's shadow to be captured, reduced to a single colour outline and then transported into the computer world where he or she would then interact with computer-based creatures and objects. Krueger wrote that "man-machine interaction is usually limited to a seated man poking at a machine with his fingers...I was dissatisfied with such a restricted dialogue and embarked on research exploring more interesting ways for men and machines to relate" (Krueger, 1977, pp. 105-6). Krueger developed many responsive environment technologies that evolved and eventually led to his most well-known work, *Videoplace*.

Figure 1: Myron Krueger, "Videoplace", Golden Nica Prix Ars Electronica 1990 "Interactive Art." Photo © Myron W. Krueger, Katrin Hinrichsen.

Krueger is significant for our discussion and for this Art-Science Hybrids collection as he was a trained computer scientist - he earned a Ph.D. in computer science at the University of Wisconsin-Madison in 1974 – and yet he turned his research into the area of interactive art. In fact he arguably single-handedly established interactive art as a form. There is no doubt his training and skill as a computer scientist gave him an advantage over trained artists in the development of interactive systems for his projects. Remarkably, he built these systems in the early 1970s, before personal computers and well before any camera- or motion-based tracking systems were conceived. Krueger also explicitly identified that although his environments were primarily aesthetic in nature they had "applications in education, psychology and psychotherapy" (Krueger, 1977, p. 106). He expands on this:

> We are incredibly attuned to the idea that the sole purpose of our technology is to solve problems. It also creates concepts and philosophy. We must more fully explore these aspects of our inventions…. The design of such intimate technology is an aesthetic issue as much as an engineering one. (Krueger, 1977, p. 120)

Krueger laid the groundwork for art-science hybrids and particularly for the development of the new forms of interactive art, interaction design and artificial reality. This clip of *Videoplace* serves as an excellent introduction to the technological research and aesthetic concerns of the piece.

In the forty years since Sutherland and Krueger began their pioneering work there has been an exponentially increasing uptake in art-science collaborations. At present there are so many examples of these hybrid forms that covering all the significant projects could fill an entire volume in itself. For the sake of this short introduction I will concentrate of two specific examples that cover different approaches to art-science hybridization.

Science into art

One of the most notable interactive artists of the early 21st Century is Rafael Lozano-Hemmer: He refers to himself as an "electronic artist" who "develops interactive installations that are at the intersection of architecture and performance art" (Lozano-Hemmer, 2013). Lozano-Hemmer's work covers a wide range of disciplines including art, architecture, archaeology, and computer science. His primary medium is large-scale public installation, usually

located at iconic sites, with an element of large-group interaction embedded into the environment. One of his most intriguing projects – *Solar Equation* (2010) – serves as an outstanding example of an art project that uses a public exhibition to disseminate knowledge about science.

> "Solar Equation" is a large-scale public art installation that consists of a faithful simulation of the Sun, 100 million times smaller than the real thing. Commissioned by the Light in Winter Festival in Melbourne, the piece features the world's largest spherical balloon, custom-manufactured for the project, which is tethered over Federation Square and animated using five projectors. The solar animation on the balloon is generated by live mathematical equations that simulate the turbulence, flares and sunspots that can be seen on the surface of the Sun. This produces a constantly changing display that never repeats itself, giving viewers a glimpse of the majestic phenomena that are observable at the solar surface and that only relatively recent advances in astronomy have discovered. The project uses the latest SOHO and SDO solar observatory imaging available from NASA, overlaid with live animations derived from Navier-Stokes, reaction diffusion, perlin, particle systems and fractal flame equations. (Lozano-Hemmer, 2010)

Figure 2: Rafael Lozano-Hemmer, "Solar Equation, Relational Architecture 16", 2010. Used by permission

Solar Equation is fascinating both because of its grandiose scope as an art project and its interest in generating precise scientific data for the audience to view in relative real-time. In addition, the project adds another layer of interactive complexity as users are allowed to caress the surface of the sun using a touch-screen interface developed for the piece. This puts scientific data very much in the hands of the public and demystifies much of the complex science behind the study of the sun. This is one of the best examples of an art project that demonstrates the results of science in a manner that a conventional science display would never be able to achieve.

Art into science

If *Solar Equation* serves as an excellent example of the use of art to disseminate scientific research, then the work of the SymbioticA lab in Perth, Australia represents an equally compelling example of how artistic ideas can be inserted into a scientific context.

> SymbioticA is the first research laboratory of its kind, enabling artists and researchers to engage in wet biology practices in a biological science department. SymbioticA encourages better understanding and articulation of cultural ideas around scientific knowledge and informed critique of the ethical and cultural issues of life manipulation. The Centre offers a new means of artistic inquiry where artists actively use the tools and technologies of science, not just to comment about them but also to explore their possibilities. (Symbiotica: The University of Western Australia)

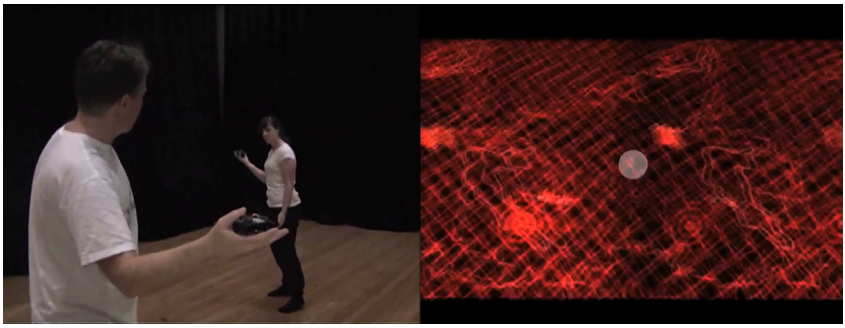
SymbioticA is intriguing due to its uncommon mix of art and biology. While the history of interactive art is rife with collaborations between artists and computer scientists, it is somewhat more rare to see life scientists and artists collaborate on mutual projects. Even though there certainly are isolated precedents for this type of hybrid, including Eduardo Kac's large body of work, in general this type of collaboration is a relatively new phenomenon with massive potential. New biological research on DNA collection, gene splicing and transgenics present enormously complex ethical issues and SymbioticA gives artists the chance to work in these areas and to provide a critical voice while developing projects in a biology-based environment. An illuminating example of the type of work done at SymbioticA is their project Silent Barrage (2009) which is a genuine transdisciplinary collaboration between

biological science, robotics, engineering, and interactive art. The project is quite prescient for this volume as the outcome "is both artistically meaningful and scientifically valid" (Ben-Ary, 2010).

The new hybrids

A genuine art-science hybridization requires that artists and scientists develop skills and understanding of the "other" discipline in more than superficial ways. The projects discussed above demonstrate that this new transdisciplinary work can be both aesthetically appealing and have scientific merit. Certainly there is continued resistance to this hybridization from "discipline-centric" researchers. It should also be mentioned that a lazy transdisciplinarity based on an attraction to the fad of working in interdisciplinary teams is a pitfall to be avoided. True transdisciplinarity requires a depth of knowledge in both areas and this takes time to achieve. University departments are particularly guilty of encouraging interdisciplinary research but then providing no support for it or deriding the outcomes as "not art" or "not science." The new hybrid is unafraid of being labeled "not art" or "not science." He or she understands the rigour that is brought by science and the societal value brought by art. Regardless of accepted label, the work done by these new hybrids is exciting, forward-looking and presents challenges to the unity of the University discipline.

Figure 3 - Steve Gibson and Stefan Müller Arisona, Virtual VJ, 2011-12. Performed by Olivia Hayes and Steve Gibson. Video shot by David Green and edited by Steve Gibson. This transdisciplinary project is hybrid of live audio, live video, kinetic interaction and computer-based motion-tracking. The work for this project is supported by fifteen years of motion-tracking research by Steve Gibson and ten years of work in live visuals research by Stefan Müller Arisona. For video documentation please see http://www.telebody.ws/VirtualDJ/virtualvj/virtualvj.html



The papers in this volume represent a number of different approaches to the mixing and merging of art and science. My co-editor Stefan Müller-Arisona contributes an introductory paper entitled *Iterative Emergence of Art/Science Hybrids*, co-written by his Corebounce colleagues Pascal Mueller, Simon Schubiger and Matthias Specht. The paper discusses three projects that Stefan worked on collaboratively and illustrates how he transitioned from a science perspective to a hybrid practice that merges the work of artists, scientists and engineers. He broadly discusses how technological developments made during these projects were driven by the demands of the artistic ideas he was seeking to realize. Stefan also interviews now-legendary Canadian digital transmedialist George Legrady and his questions get to the core of the joys and issues of working in the science and art domains in tandem.

F. Scott Taylor's paper *Of Social Autism And Hypervisual Digital Artscience* uses contemporary medical research on conditions such as ADD and Autism to provide a compelling analysis of the work of artists who have these conditions. He also extends that analysis to provide a critical discussion of digitally-based "hypervisual" practices which he argues replicate the experience of these various conditions. He ultimately argues for a more humanistic approach to technologically-based "artscience," which he posits should be built on more analog concepts and a return to verbal skills.

Adam Tindale's paper *Theoretical Aesthetics* argues that culture is essential for an understanding and practice of science. Conversely, he also argues that scientific methodology can be applied in an art context in order to provide a more measurable way of determining aesthetic value. Borrowing from Experimental Philosophy he argues for a new discipline that unites the scientific method and cultural values into *Theoretical Aesthetics*.

Paul Goodfellow's paper *Mapping Art to Systems Thinking* makes use of his background as both a geographer and an artist. He offers a form of art practice based on both geographic tools such as GIS and GPS, and conceptual ideas such as Guy Debord's notion of Psychogeography. These are then explored in relation to his own works, which involve walking through a city, recording video of various locales and processing that video in very systematic ways in order to produce abstracted versions of a cityscape.

Farvash Razavi, Nandi Nobell and Mikael Lindström's paper *The Superhero and the DJ* presents a direct discussion of the application of new design practices in an old industry: the forestry industry. The paper traces how experimental prototypes made by two young designers were turned into responsible and renewable products that found new outlets in the market. Léon McCarthy's paper *Sustainable Ecologies Presented Through Audio-Visual*

Performance also revolves around responsible practices, but instead of situating those concerns in the development of new products, McCarthy argues for an engaged audio-visual performance medium which focuses on ecological concerns in a meaningful way for audiences. McCarthy also discusses how he directly engages the audience in his performances through the use of audience input during the performance and audience reflection after the performance is finished.

Marius Carboni's *The Digitization of Music and the Accessibility of the Artist* provides a thorough overview of the issues facing musicians in the internet age, and discusses how various music groups and organizations have employed new models of distribution and dissemination. Covering such projects as The YouTube Orchestra and Atau Tanaka's Malleable Mobile Music, Carboni's paper also presents an exciting introduction to new musical forms that have responded and adapted to mobile and networked technologies. Jason Lim's provocative paper discusses the idea of live robotic programming. He borrows the technique of live replay of recorded algorithmic processes from electronic music and proposes that this could also be applied to the programming of factory floor robots.

Finally we are very happy to have two opinion pieces in this volume. The first is from Matthias Berger from the Future Cities Lab at the Singapore ETH-Centre. Berger discusses how better to utilize artistic skills within science. Postulating that the convention is more likely to be science presented in an art context (in a Natural History Museum for example), he argues for a more engaged use of artistic processes, artistic activism and the artistic mindset within the sciences. Well-known New Media writer Sue Thomas contributes a piece on the Next Nature Network, a transdisciplinary website that explores "the changing relation between people, nature and technology" (Thomas, 2014). Thomas gives a critical overview of the transdisciplinary art-science projects presented on this site and praises its unique and innovative presentation of art-science hybrids.

Each of the papers and pieces in this volume attest to the growing importance of art-science collaborations involving various disciplines, perspectives and aims. We are pleased to have such a variety of voices and to be able to present a glimpse into the future of the new transdisciplinary "artscience."

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