The Artist and the Scientific Research Environment

Daniel J. Sandin, Tom DeFanti, Lou Kauffman and Yvonne Spielmann

ABSTRACT

The authors reflect on the experiences of collaboration between artists and scientists at the Electronic Visualization Laboratory at the University of Illinois at Chicago. They outline the measures that enable both media artists and computer scientists to benefit from the collaborations. In particular, if long-term collaborations are to be successful, the collaborators must garner rewards not only in the field of the collaboration but also in their own respective academic or professional fields.

There is a long tradition of artists working in the laboratory. Most famously in the 1960s, Bell Laboratories began an informal artist-in-residence program. In 1963 Ken Knowlton developed the Beflix (Bell Flicks) animation system, which was used to produce dozens of computer-animated films with artists such as Stan VanDerBeek and Lillian Schwartz. At the same time, Billy Klüver worked with artists Robert Rauschenberg, Robert Whitman, Fred Waldhauer and others to found the group Experiments in Art and Technology (E.A.T.), of which Sandin was a member.

In the 1970s, Xerox PARC—which, of course, gave rise to the modern windows, icons, mouse and pointers (WIMP) interface, which we all still use—had a significant program for collaboration with artists, which contributed to the research success of that operation. In the 1980s, the National Center for Supercomputing Applications, with Larry Smarr as director and Donna Cox as one of the artists and scientific visualization experts, focused on scientific visualization and the concept of Renaissance Teams. They put the best scientists and media artists together to produce work that was both beautiful and of great communication value for the scientists. Currently, Advanced Telecommunications Research Institute International (ATR) in Kyoto, Japan, systematically brings in artists to work with scientists as part of an effort to envision the new computer interfaces that we will use in our ATMs and laptop computers.

We discuss in greater detail the experience of working at the Electronic Visualization Laboratory (EVL), which has been sponsoring systematic collaborations between artists and scientists for over 33 years. A further area of concentration is Dan Sandin's collaborations with Lou Kauffman over the last 20 years. EVL is a joint laboratory of the computer science and art-and-design departments at University of Illinois at Chicago (UIC). It has three directors. Tom DeFanti, who is a computer-science professor, and Dan Sandin, an art professor, started the program in 1973, and Jason Leigh has since joined them

Daniel J. Sandin (artist), Electronic Visualization Laboratory (M/C 154), University of Illinois at Chicago, 851 S. Morgan Street, Room 1120 SEO, Chicago IL 60607-7053, U.S.A. E-mail: <dan@uic.edu>. Web: <www.evl.uic.edu>; <www.evl.uic.edu/dan>.

Tom DeFanti (researcher), Department of Computer Science, University of Illinois at Chicago, 851 S. Morgan Street, Room 1120 SEO, Chicago, IL 60607-7053, U.S.A. E-mail: <tom@uic.edu>.

Lou Kauffman (researcher), Department of Mathematics, Statistics, and Computer Science, 322 Science & Engineering Offices (M/C 249), 851 S. Morgan Street, Room 533 SEO, Chicago, IL 60607-7045, U.S.A. E-mail: <kauffman@uic.edu>.

Yvonne Spielmann (researcher), Institute of Media Research, Braunschweig University of Art, Johannes-Selenka-Platz 1, 38118 Braunschweig, Germany. E-mail: <y.spielmann@hbk-bs.de>.

Based on a paper presented at "Hybridity: Arts, Sciences and Cultural Effects," a special section of the 93rd Annual Conference of the College Art Association, Atlanta, GA, 16–19 February 2005.

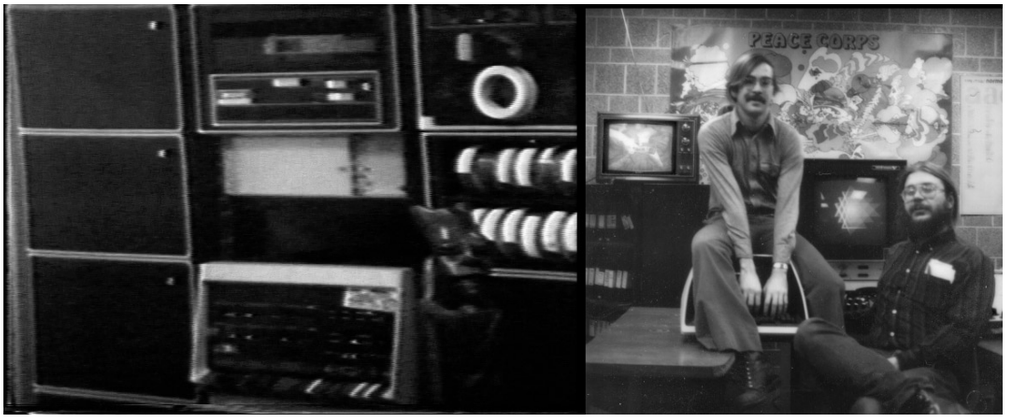

Fig. 1. A PDP 1145 computer used to power the GRASS system (far left). Tom DeFanti (left) and Dan Sandin (right) in front of GRASS display.

as a director. EVL has 12 associated faculty, 9 staff and over 50 graduate students, of which 1/3 are in art and 2/3 in computer science. It is the oldest ongoing program offering an MFA that entails a formal collaboration between art and computer science.

EVL works by delivering art intelligence to scientists and science or technology to artists. It systematically teaches artists the technology and somewhat less systematically teaches computer scientists the art. Teaching the artist the technology is extremely important, because among other things it creates a shared language for working with the scientist and also gives the artist the ability to do things that have not been done before, not just on the content front but also on the technology front. The experience of artists is central to the success of EVL.

In 1969 Sandin was invited to UIC's art department to bring computers to its art curriculum. Even now some art departments are still debating the place of computers in their art curricula. One reason for the invitation was UIC's historical relationship to the Bauhaus. (The art department had begun as the third-generation Bauhaus. The first generation, of course, was in Germany; the second generation was either the media studies area at the Massachusetts Institute of Technology or, as is more commonly held, the Institute of Design at Chicago at the Illinois Institute of Technology.) Some of the graduates of the Institute of Design started the art program at UIC. They believed that the Bauhaus had made its point by combining craft art tradition with industrial production to create the field of industrial design. Their idea was to combine cybernetics with industrial design to produce a new, cybernetic, computer-based design. This synthesis was successful, but nobody imagined it would take 35 years.

In 1973 DeFanti came to UIC with the Graphic Symbiosis System (GRASS) language (Fig. 1). EVL began as a short-order computer and video media house for education and research. The university supported the work by supplying state-of-the-art computer graphics equipment. We presented a series of live, interactive, computer-based art performances in 1975, 1976 and 1978 called the EVE events (Color Plate A No. 1).

Artists have several roles within EVL; for example, they organize projects, help visualize data and create media. The fact that artists are good at organizing projects goes against some stereotypes of artists and technologists. Artists are good at organizing projects partially because of their experience with exhibitions. Engineers are educated in a different way: They believe that once one gets the overall concept and the basic ideas right, one should move on to the next thing. Artists' experience with exhibitions and with the deadlines and quality criteria that exhibitions impose is extremely helpful at EVL. Shows and demonstrations are necessary for obtaining funding from funding agencies and communicating the results of research.

The artists at EVL are supported by science. They get paid research assistantships just as the science students do and get the toys to do their own work. Their work is often inspired by scientist-colleagues in terms of media capabilities and science content. The scientists in turn learn how to better communicate visually. EVL makes the scientists look good to their colleagues and funding sources, because the artists understand rehearsal, showtime and presentation as part of their art traditions. EVL delivers visualization technology and techniques to science. We are paid by the National Science Foundation to deliver visualization technology and, more and more often, network technology.

We would like to discuss the long-term collaboration between mathematician Kauffman and artist Sandin to concretely describe some important aspects of art-science collaborations. Below is a partial list of the products of this collaboration.

The first event in this long collaboration was the creation of a 2D image, a 4-×-4-ft array of "Julia set images," which was shown at the SIGGRAPH art show in 1985. In 1986 Kauffman published a paper entitled "On Crossing the Boundary of the Mandelbrot Set," presented at a mathematical conference [1]. This pattern of exhibiting in the art world and publishing in the academic world is central to the success of the collaboration.

One point to add here is that in long-term collaboration the various professional collaborators must reap benefits as measured within their own disciplines, in addition to the benefits of learning how other people do things and how to share knowledge across disciplines. In 1989 John Hart published "Distance Estimation to the Quaternions," a paper about new algorithms for visualizing quaternion Julia sets [2]. In 1990 an animation utilizing this work, *Volume of Julia Sets* (Color Plate A No. 2), was shown at the SIGGRAPH electronic theater. Hart received an M.A. and Ph.D. based on these visualization algorithms. Kauffman used them to conceive new theorems and achieve good visualizations, and Sandin derived from them a new set of images with which to work.

At Supercomputing 95, many supercomputers were dedicated to ray-tracing Julia sets, which was largely the beginning of our work with having supercomputers all over the world networked together to produce visualizations.

In 1996 Yumei Dang and Kauffman completed the mathematical proof showing Hart's 1989 "distance estimation conjecture" to be correct [3]. Dang received a Ph.D. in mathematics for this work.

In 1998 *A Diamond of Quaternion Julia Sets,* a mathematical animation installation, was commissioned for NTT's 50th birthday party. In 2002 Kauffman, Sandin and Dang published a book and CD-ROM in the World Scientific Book Series, *On Knots and Everything,* edited by Kauffman. The reason we give this list is to illustrate how all these different research products helped to bestow credentials upon the individual collaborators. There were many other projects involving 4D visualizations and knots. We continue to work on new animations of quaternion Julia sets (Color Plate A No. 3).

There are many reasons why people think artists should work with scientists. One of the most common of these is that the artists need it because they are poor. This is a kind of philanthropic impulse on the part of the scientists. A second thought is that it is good for scientists to associate with artists. A third suggestion is that artists bring creativity to the scientists. All of these reasons may be true, but there are problems. Philanthropy has its limits. Socializing is good but is too diffuse a goal to be a good argument for the expenditure of resources. The idea of artists bringing creativity to scientists is insulting to the engineers and the scientists, who think they are already creative.

In our view, media artists should be supported by sciences because media artists share visualization technology with science; artists are trained in this technology; artists are trained in a range of visual studies; artists know about presentation; and artists are good project organizers. Finally, artists create new media, new ways of working with media. These are the reasons why artists should be supported within the research environment.

Artists can benefit from working with scientists. On the whole, science is better supported than art, at least in the U.S.A. It is an interesting and useful place to connect with society and get paid for it.

Science is a great source of imagery for art; in Sandin's work it is the main source. Science is also a very powerful transformative force in society, and so it is appropriate as art content.

Science and engineering can benefit from art. Interactive computer art is speculative research into the human-computer interface. The dominant current computer interface is based on buttons, mice, menus and icons. Although extremely successful, this interface can be limited and clumsy. Many interactive art installations involve camera-based, proximity-based and gesture-based interfaces. Many researchers in the computer science field and in the business world think that our interfaces with computers have to advance beyond mice, and several organizations are employing artists to further this research.

ATR, for example, systematically invites artists to develop their interactive art applications and collaborations with scientists so the scientists can learn and experience these new interfaces.

Perhaps the MFA will become the MBA of the future.

References

1. Ivan Handler, Louis H. Kauffman and Dan Sandin, "On Crossing the Boundary of the Mandelbrot Set," in Martin C. Tangora, *Computers in Geometry and Topology (Lecture Notes in Pure and Applied Mathematics)* (New York: Dekker, 1989) pp. 151–177.

2. See <www.evl.uic.edu/hypercomplex/html/book/rtqjs.pdf>.

3. See <www.evl.uic.edu/hypercomplex/html/book/book.pdf>.

Dan Sandin is founder and director of the Electronic Visualization Laboratory at the University of Illinois at Chicago. He was one of the early developers of video technology and in 1972 developed the Image Processor, one of the first analog computers for processing video images.