THOUGHTS ON THE INFORMATION ARTS

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EDITED BY ARIE ALTENA, WITH AN INTRODUCTION BY TACO STOLK

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ABSTRACTION AND COMPLEXITY

Lev Manovich

In the article 'Abstraction and Complexity', which will be part of his forthcoming book Info-Aesthetics, *Lev Manovich looks closely at the recent wave of abstract algorithmic art. He focusses on our faulty use of the opposition abstraction/figuration, and the connection between art and the scientific paradigms of abstraction and complexity. He asks if there is 'a common theme that can be deduced from the swirling streams, slowly moving dots, dense pixel fields, mutating and flickering vector conglomerations coming from the contemporary masters of Flash, Shockwave, Java and Processing'*

What kind of images are appropriate for the needs of a global informational networked society—the society which in all of its areas needs to represent more data, more layers, more connections than the preceding industrial society?[1] The complex systems which have become super-complex[2]; the easy availability of real-time information coming from news feeds, networks of sensors, surveillance cameras; more fragmented and limited access to the senses of any subject in a consumer economy, all this puts a new pressure on the kinds of images human culture already developed, and ultimately calls for the development of new kinds. This does not necessary means inventing something completely unprecedented, instead it is apparently quite productive to simply give old images new legs, so to speak, by expanding what they can represent and how they can be used. This is, of course, exactly what computerisation of visual culture has been all about since it begun in the early 1960s. While it made production and distribution of images efficient, more importantly the computerisation made possible for these images to function in various novel ways by 'adding' interactivity, by turning static images into navigable virtual spaces, and by opening images to all kinds of mathematical manipulations which can be encoded in algorithms.

This short essay will not address all these transformations. It will focus on a particular kind of image:

software driven abstraction. In particular I will address this question: shall the global information society include abstract images in its arsenal of representational tools? In other words, if we take an abstraction and wire it to software, do we get anything new and useful beyond what already took place in the first part of the twentieth century, when the new abstract visual language was adopted by graphic design, product design, advertising and all other communication, propaganda and consumer fields?

Let's begin by thinking about abstraction in relation to its opposite. How did computerisation of visual culture affect the great opposition of the twentieth century between abstraction and figuration? In retrospect, we can see that this opposition was one of the defining dimensions of the twentieth century culture since it was used to support so many other oppositions – between 'popular culture' and 'modern art', between 'democracy' and 'totalitarism', and so on. (Disney against Malevich, Pollock against Socialist Realism, MTV versus Family Channel.) Eventually, the political charge of this opposition has largely dissolved as the language of abstraction took over all of modern graphic design while abstract paintings migrated from artists studios to modern art museums as well as corporate offices, logos, hotel rooms, bags, furniture, and so on. And yet in the absence of new and more precise categories we still use figuration/abstraction (or realism/abstraction) as the default basic visual and mental filter though which we process all images which surround us.

In thinking about the effects of computerisation on abstraction and figuration, it is much easier to address the second term than the first. While 'realistic' perspectival images of the world are as common today as they were throughout the twentieth century, photography, film, video, drawing and painting are no longer the only ways to generate them. Since the 1960s, these techniques were joined by a new technique of computer image synthesis. Over the next decades, 3D computer images gradually became more and more widespread, gradually coming to occupy a larger and larger part of the whole visual culture landscape. Today for instance

practically all of computer games rely on real-time 3D computer images – and so are numerous feature films, TV shows, animated features, instructional videos, architectural presentations, medical imaging, and military simulators. And while the production of highly detailed synthetic images is still a time consuming process, as the role of this technique is expanding, various shortcuts and technologies are being developed to make it easier: from numerous ready-to-use 3D models available in online libraries and scanners which capture both colour and shape, to software, which can automatically reconstruct a 3D model of an existing space from a few photographs.

While computerisation has strengthened the part of the opposition occupied by figurative images by providing new techniques to generate these images – and even more importantly, making possible new types of media which rely on them (3D computer animation, interactive virtual spaces) – it simultaneously had blurred the figurative end of the opposition. Continuous developments in old analogue photo and film technologies (new lenses, more sensitive films) combined with the development of software for digital image processing and compositing, eventually completely collapsed the distance which previously separated various techniques for constructing representational images (photography, photo-collage, drawing and painting in various media). Now the techniques specific to all these different media can be easily combined within the metamedium of digital software.[3] One result of this shift from separate representational and inscription media to computer metamedium is the proliferation of hybrid images – images that combine traces and effects of a variety of media. Think of an typical magazine spread, a TV advertisement or a homepage of a commercial website: maybe a figure or a face of person against a white background, some computer elements floating behind or in front, a little Photoshop blur, funky Illustrator typography, and so on. (Of course looking at the Bauhaus graphic design we can already find some hybridity as well as a similar treatment of space combining 2D and 3D elements. Yet because a designer had to deal with the actual media, the boundaries

between elements in different media were sharply defined.)

This leads us to another effect: the liberation of the techniques of a particular medium from its material and tool specificity. Simulated in software, these techniques can now be freely applied to visual, spatial or audio data that have nothing to do with the original medium.[4] In addition to populating the tool pallets of various software applications, these virtualised techniques came to form a separate type of software: filters. You can apply reverb to any sound wave; apply depth of field to a 3D virtual space; apply blur to type.

Simulation of media properties and interfaces in software has not only made possible the development of numerous separate filters but also whole new areas in media culture such as motion graphics. By allowing the designers to move type in 2D and 3D space, and filter it in arbitrary ways, After Effects has affected the Gutenberg universe of text at least as much, if not more, than Photoshop affected photography.

The cumulative result of all these developments – 3D computer graphics, compositing, simulation of all media properties and interfaces in software – is that the images which surround us today are usually very beautiful and often very stylised. The perfect image is no longer something which is expected in particular areas of consumer culture – instead it is an entry requirement. To see this difference you only have to compare an arbitrary television programme from twenty years ago to one of today. All images have been put through the plastic surgery of Photoshop, After Effects, Flame, or similar software packages. At the same time, the mixing of different representational styles which until a few decades ago was only found in modern art (think of Moholy-Nagy's photograms or Rauschenberg's prints from 1960) has become a norm in all areas of visual culture.

As can be seen from this brief and highly compressed account, computerisation has affected the figurative or 'realistic' part of visual culture in a variety of significant ways. But what about the opposite part of the spectrum – pure abstraction? Is there a larger ideological importance to the elegant algorithmically driven abstract images which started to populate more and more web

sites since the late 1990s? An importance comparable to any of the political positions and conceptual paradigms which surrounded the birth of modern abstract art in the beginning of the twentieth century? Is there some common theme that can be deduced from the swirling streams, slowly moving dots, dense pixel fields, mutating and flickering vector conglomerations coming from the contemporary masters of Flash, Shockwave, Java and Processing?

If we compare 2004 with 1914, we will in fact see a similar breadth of abstract styles: a strict northern diet of horizontal and vertical lines in Mondriaan, a more flamboyant orgy of circular forms in Robert Delaunay working in Paris, even more emotional fields of Wassily Kandinsky, the orgy of motion vectors of the Italian futurists. The philosophical presuppositions and historical roots which have led to the final emergence of 'pure' abstraction in the 1910s are multiple and diverse. They derive from a variety of philosophical, political and aesthetic positions: the ideas of synaesthesia (the correspondence of sense impressions), symbolism, theosophy, communism (abstraction as the new visual language for the proletariat in Soviet Russia) et cetera. And yet it is possible and appropriate to point at a single paradigm which both differentiates modernist abstraction from realist painting of the nineteenth century, and simultaneously connects it to modern science. This paradigm is reduction.

In the context of art, the abstraction of Mondriaan, Kandinsky, Delaunay, Kupka, Malevich, Arp and others represents the logical conclusion of a gradual development of the preceding decades. From Manet, impressionism, post-impressionism, symbolism to fauvism and cubism, artists progressively streamlined and abstracted the images of visible reality until all recognisable traces of the world of appearances were taken out. While in general this reduction of visual experience in modern art was a very gradual process which begins already in the early nineteenth century[5], in the beginning of the twentieth century we see the whole development replayed from the beginning to the end within a single decade – such as in the paintings by a tree created by Mondriaan between 1908 and 1914. Mondriaan starts with a detailed realistic image of a tree. By

the time he has finished his remarkable compression operation, only the essence, the idea, the law, the genotype of a tree is left.

This visual reduction that took place in modern art perfectly parallels with the dominant scientific paradigm of the nineteenth and early twentieth century.[6] Physics, chemistry, experimental psychology, and other sciences were all engaged in the deconstruction of the inanimate, the biological and the psychological realms into simple, further indivisible elements, governed by simple and universal laws. Chemistry and physics postulated the levels of molecules and atoms. Biology saw the emergence of the concepts of cell and chromosome. Experimental psychology applied the same reductive logic to the human mind by postulating the existence of indivisible sensorial elements, the combination of which would account for the perceptual or mental experience. For instance, in 1896 E.B. Titchener (a former student of Wilhelm Wundt who brought experimental psychology to the United States) proposed that there are 32,800 visual sensations and 11,600 auditory sensory elements, each just slightly distinct from the others. Titchener summarised his research programme as follows: 'Give me my elements, and let me bring them together under the psychophysical conditions of mentality at large, and I will guarantee to show you the adult mind, as a structure, with no omissions and no superfluity.'[7]

It can be easily seen that the move towards pure abstraction in art during the same period follows exactly the same logic. Similarly to physicists, chemists, biologists, and psychologists, the visual artists have focused on the most basic pictorial elements: pure colours, straight lines, and simple geometric shapes. For instance, Kandinsky in *Point and Line to Plane* advocated 'microscopic' analysis of three basic elements of form (point, line, and plane) claiming that there exist reliable emotional responses to simple visual configurations.[8] Equally telling of Kandinsky's programme are the titles of the articles he published in 1919: *Small Articles about Big Questions. I. About Point*, and *II. About Line*.[9]

Thus the simultaneous deconstruction of visual art into its most basic elements and their simple combinations by a variety of artists in a number of countries in the first two decades of the twentieth century echoes the similar developments in contemporary science. In some cases the connection was much more direct. Some of the key artists who were involved in the birth of abstraction were closely following the research into the elements of visual experience conducted by experimental psychologists. As experimental psychologists split visual experience into separate aspects (colour, form, depth, motion) and subjected these aspects to a systematic investigation, their articles begin to feature simple forms such as squares, circles, and straight lines of different orientations, often in primary colours. Many of the abstract paintings of Mondriaan, Klee, Kandinsky and others look remarkably similar to the visual stimuli already widely used by psychologists in previous decades. Since we have documentation that at least in some cases the artists knew about the psychological research, it is appropriate to suggest that they have directly copied the shapes and compositions from the psychology literature. Thus abstraction was in fact born in psychological laboratories before it ever reached the gallery walls.

Beginning in the 1960s, scientists in different fields gradually realise that classical science which aims to explain the world through simple universally applicable rules (such as the three laws of Newtonian physics) can not account for a variety of physical and biological phenomena. Soon after, artificial intelligence research that tried to reduce human mind to symbols and rules, also ran out of steam. A new paradigm begins to emerge across a number of scientific and technical fields, eventually reaching popular culture as well. It includes a number of distinct areas, approaches, and subjects: chaos theory, complex systems, self-organisation, autopoiesis, emergence, artificial life, the use of the models and metaphors borrowed from evolutionary biology (genetic algorithms, 'memes'), neural networks. While distinct from each other, most of them share certain basic assumptions. They all look at complex dynamic and nonlinear systems and they model the development and/or behaviour of these systems as the interaction of a

population of simple elements. This interaction typically leads to emergent properties: a priori unpredictable global behaviour. In other words, the order that can be observed in such systems emerges spontaneously; it can't be deduced from the properties of elements that make up the system. In somewhat different terms: 'Orderly ensemble properties can and do arise in the absence of blueprints, plans, or discrete organisers; interesting wholes can arise simply from interacting parts; enumeration of parts cannot account for wholes; change does not necessarily indicate the existence of an outside agent or force; interesting wholes can arise from chaos or randomness.'10

According to the scientists working on complexity, the new paradigm is as important as the classical physics of Newton, Laplace, and Descartes, with their assumption of the clockwork universe. But the significance of the new approach is not limited to its potential to describe and explain the phenomena of the natural world that were ignored by classical science. Just as the classical physics and mathematics fitted perfectly the notion of a highly rational and orderly universe controlled by God, the sciences of complexity seem to be appropriate in a world which on all levels – political, social, economic, technical – appears to us to be more interconnected, more dynamic, and more complex than ever before. (As Rem Koolhaas has put it recently, 'globalisation is about connecting everything to everything else'.[11]) So at the end it does not matter if frequent invocations of the ideas of complexity in relation to just about any contemporary phenomenon – from financial markets to social movements – are appropriate or not.[12] What is important is that having realised the limits of linear top-down models and reductionism, we are prepared to embrace a very different approach, one which looks at complexity not as a nuisance which needs to be quickly reduced to simple elements and rules, but instead as the source of life, something which is essential for a healthy existence and evolution of natural, biological, and social systems.

Let us now return to the subject this text is about – contemporary software abstraction and its role in a global information society. I am now finally ready to name the larger

paradigm I see behind the visual diversity of this practice – from stylish animations and backgrounds which populate commercial web sites to the online and offline works which are explicitly presented by their creators as art. This paradigm is complexity. If modernist art followed modern science in reducing the media of art – as well as our sensorial, ontological, and epistemological experiences and models of reality – to basic elements and simple structures, contemporary software abstraction instead recognises the essential complexity of the world. It is therefore not accidental that often software works develop in a way that is directly opposite to the reduction that took place in Mondriaan's paintings, where a figurative image of a tree becomes a composition consisting of a just a few abstract elements. Today we are more likely to encounter animated or interactive works that begin with an empty screen or a few minimal elements that quickly evolve into a complex and constantly changing image. And while the style of these works is often rather minimal – vector graphics and pixel patterns[13] – the images formed by these lines are typically the opposite of the geometric essentialism of Mondriaan, Malevich, and other modernists. The patterns of lines suggest the inherent complexity of the world that is not reducible to some geometric phenotype. The lines curve and form unexpected arabesques rather than traversing the screen in strict horizontals and verticals. The screen as a whole becomes a constantly changing field rather than a static composition.

When I discussed modernist abstraction, I pointed out that its relationship to modern science was two-fold. In general, the reductionist trajectory of modern art that eventually led to a pure geometric abstraction in the 1910s parallels the reductionist approach of contemporary sciences. At the same time, some of the artists actually follow the reductionist research in experimental psychology, adopting the simple visual 'stimuli' used by psychologists in their paintings.

Since designers and artists who pursue software abstraction are our contemporaries and since we share the same knowledge and references, it is easy for us to see the strategy of direct borrowing at work. Indeed,

many designers and artists use the actual algorithms from scientific publications on chaos, artificial life, cellular automata and related subjects. Similarly, the iconography of their works often closely follows the images and animations created by scientists. Some people actually manage to operate simultaneously in the scientific and cultural universes, using the same algorithms and the same images in their scientific publications and art exhibitions. (One example is Karl Sims who in the early 1990s created impressive animations based on artificial life research that were later shown at the Centre Pompidou in Paris.) What is less obvious is that in addition to the extensive cases of direct borrowing, the aesthetics of complexity is also present in the works that do not use any models from complexity research directly. In short, I argue that just as it was the case with modernist abstraction, the abstraction of the information era is connected to contemporary scientific research both directly and indirectly – both through a direct transfer of ideas and techniques and indirectly as being part of the same historically specific imagination.

I decided to test my hypothesis in 2003 at the *Abstraction Now* exhibition in Vienna, by systematically going from piece to piece, one by one, rather than selecting only a few works that would fit my preconceived ideas. My experiment worked better than I expected since almost all pieces in the online component of the show turn out to follow the aesthetics of complexity, invoking complex systems in a natural world even more often and even more literally than I expected.

Golan Levin's *Yellowtail* amplifies the gestures of the user, producing ever-changing organic-looking lines of constantly varying thickness and transparency. The complexity of the lines and their dynamic behaviour make the animation look like a real-time snapshot of some possible biological universe. The works perfectly illustrates how the same element (the abstract line) that in modernist abstraction represented the abstract structure of the world, now evokes instead the world's richness and complexity. In other words, if modernist abstraction assumes that behind sensorial richness of the world there are simple abstract structures that generate all this richness, such separation of levels is absent from software abstractions. What they show us instead is the dynamic interaction of the elements that periodically leads to certain orderly configurations.

Insertsilence by James Paterson and Amit Pitaru works in the same manner: a click by the user immediately increases the complexity of the already animated line cob, making lines multiply, break, mutate, and oscillate until they 'cool down' to from a complex pattern which sometimes contains some figurative references. While the artists' statement makes no allusions to complexity sciences, the animation in fact looks like a perfect illustration of the concept of emergent properties.

Often software works deploy vector graphics to create distinctly biologically looking patterns. However a much more modernist looking rectangular composition can also be reworked to function as an analogue to the complex systems studied by scientists. The pieces by Peter Luining, Return, and James Tindall evoke the compositions created by students at Bauhaus and Vhkutemas (the Russian equivalent of Bauhaus in the 1920s). But again, with a single click of the mouse the compositions immediately come to life, turning into dynamic systems whose behaviour no longer evokes the ideas of order and simplicity. As in many other software pieces which subscribe to the aesthetics of complexity, the behaviour of the system is neither linear nor random. Instead we are witnessing a system which seems to change from state to state, oscillating between order and chaos – again exactly like complex systems found in natural world.

While some of the software pieces in *Abstraction Now* adopt the combinatorial aesthetics common to both early modernist abstraction and 1960s minimalism (in particular, the works by Sol LeWitt), this similarly only makes more apparent that today a very different logic is at work. For instance, instead of systematically displaying all possible variations of a small vocabulary of elements, *Arp code* by Julian Saunderson constantly shifts the composition without ever arriving at any stable configurations. The animation suggests that the modernist concept of 'good form' no longer applies. Instead of right and wrong forms (think for instance of the war between Mondriaan and Theo van Doesburg), we are in the presence of

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a dynamic process of organisation that continuously generates different forms, all equally valid.

If the works described so far were able to refer to complexity mainly through the dynamic behaviour of rather minimal line patterns, another group of works uses algorithmic processes to generate dense and intricate fields which often cover the whole screen. Works by Glen Murphy, Casey Reas, Dextro, Meta and Ed Burton all fit into this category. But just as with the works described so far, these fields are never static, symmetrical or simple, instead they constantly mutate, shift and evolve.

I can go on multiplying examples but the pattern should be quite clear by now. The aesthetics of complexity which dominates the online works selected for *Abstraction Now* is not unique to it; scanning works regularly included in other exhibitions such as at the website of the Whitney Biennial (curated by Miltos Manetas), Ars Electronica 2003, or the Flash Forward festivals, demonstrates that this aesthetic is as central to contemporary software abstraction as the reductionism was to early modernist abstraction.

Let me conclude by returning to the question that I posed in the beginning: the need for new types of representation adequate for the needs of a global information society, characterised by the new levels of complexity (in this case understood in descriptive rather than in theoretical terms.) I suggest that practically all of the developments in computer imaging so far can be understood as the responses to this need. But this still leaves open the question of representing the new social complexity symbolically. While software abstraction usually makes more direct references to the physical and biological than the social, it may be also appropriate to think of many works in this paradigm as such symbolic representations. For they seem to quite accurately and at the same time poetically capture our new image of the world: a world as dynamic networks of relations, oscillating between order and disorder, always vulnerable and ready to change with a single click of the user.

Notes

1. I rely here on the influential analysis of Manuel Castells who characterises the new economy which emerged in the end of the twentieth century as informational, global and networked. See Manuel Castells, *The Rise of the Network Society. The Information Age*, second edition Blackwell, Massachutes, 2000, p. 77.
2. Lars Qvortrup, *Hypercomplex Society*, Peter Lang Publishing, 2003.
3. The notion of computer as metamedium was clearly articulated by the person who, more than anybody, was responsible for making it a reality by directing the development of GUI at Xerox Parc in the 1970s: Alan Kay. See Alan Kay and Adele Golberg, 'Personal Dynamic Media' 1997, in Noah Wardrip-Fruin and Nick Monfort, *The New Media Reader*, MIT Press, Cambridge Mass., 2003, p. 394.
4. In *The Language of New Media* I describe this effect in relation to the cinematic interface, i.e. the camera model which in computer culture has become a general interface to any data which can be represented in 3D virtual space. But this is just a particular case of a more general phenomenon: simulation of any media in software allows for the virtualisation of its interface. Lev Manovich, *The Language of New Media*, MIT Press, Cambridge Mass., 2001.
5. See, for instance, the exhibition *The Origins of Abstraction*, Musée d'Orsay, Paris 2004.
6. For a detailed reading of modern art as the history of reduction which parallels the reductionism of modern science and in particular experimental psychology, see little known but remakable book *Modern Art and Modern Science*. This section is based on the ideas and the evidence presented in this book. Paul Vitz and Arnold Glimcher, *Modern Art and Modern Science: The Parallel Analysis of Vision*, Praeger Publishers, New York, 1984.
7. Quoted in Eliot Hearst, 'One Hundred Years: Themes and Perspectives', in *The first Century of Experimental Psychology*, p. 25.
8. Vassily Kandinsky, *Point and Line to Plane*, Solomon R. Guggenheim Foundation, New York, 1947.
9. Yu. A. Molok, 'Slovar simvolov Pavla florenskogo. Nekotorye marginalii' (Pavel florensky's Dictionary of Symbols. A few margins), *Sovetskoe Iskusstvoznanie* 26, 1990: p. 328.
10. See <http://serendip.brynmawr.edu/complexity/complexity.html>.
11. CONTENT – Rem Koolhaas/OMA/AMO, section on Prada stores, exhibition at Neue Nationalgalerie Berlin, November 2003 – January 2004.
12. For examples of works which apply the ideas of complexity to a range of fields, see Manual de Landa, *A Thousand Years of Non-linear History*, MIT Press, Cambridge Mass, 1997; Howard Rheingold, *Smart Mobs: The Next Social Revolution*, Perseus Publishing, 2002; Steven Johnson, *Emergence: Connected Lives of Ants, Brains, Cities, and Software*, Scribner, New York, 2003.
13. See my article 'Generation Flash' for a discussion of this visual minimalism as a new modernism, available at <http://www.manovich.net>

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ART AS RESEARCH
The Cultural Importance of Scientific Research and Technology Development

Stephen Wilson

In 2002 MIT Press published an almost 1000 page book by Stephen Wilson, artist and professor of conceptual design at San Francisco State University: Information Arts, Intersections of Art, Science, and Technology. *This book is the fruit of twenty years of research in different new fields of art that have evolved in connection with technological and scientific developments like microbiology, genetics, nanotechnology, artificial life, programming, GPS, robotics, radio, virtual reality and the internet.* Information Arts *is an encyclopaedia of the new fields of technological arts. It is also a sign of the heightened importance of what could be called artistic research. According to Wilson contemporary artists engage with science and technology, not to adopt the vocabulary, but to explore and comment on their agenda, content and possibilities. He convincingly argues that the important artistic work in these fields is created when artists work alongside scientists on developing science and technology. Although the paper that we republish here was originally*

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written in 1996 it is still an insightful introduction to the most important questions regarding the relationship between art and scientific research.

The arts are perplexed about what to do in response to the growing importance of scientific and technological research in shaping culture. One response positions artists as consumers of the new tools, using them to create new images, sounds, and video; another response sees artists emphasising the critical functions of art to comment on the developments from the distance; a final approach urges artists to enter into the heart of research as core participants.[1] It is a critical error to conceive of contemporary research as merely a technical enterprise; it has profound practical and philosophical implications for the culture. The shaping of research and development agendas could benefit from the involvement of a wider range of participants including artists.

Scientific and technological research is not as 'objective' as many of its practitioners would like to believe. While some of its practices strive toward objectivity, the whole enterprise is subject to larger political, economical, and social forces. Historians of science and technology have documented the winds that determine what research ends up getting supported, promoted, and accepted and what products win in the marketplace. Thomas Kuhn's *The Structure of Scientific Revolutions*[2] showed how paradigms dominate thought and scientific practice until new paradigms develop. Many possibly significant theories and technologies are ignored.

As research increases in general cultural importance, it becomes more dangerous to accept this triage as inevitable. Valuable lines of inquiry die from lack of support because they are not within favour of particular scientific disciplines. New technologies with fascinating potential are abandoned because they are judged not marketable. Our culture must develop methods to avoid the premature snuffing of valuable lines of inquiry and development. I believe the arts can fill a critical role as an independent zone of research. Everyday life is increasingly dominated by the objects and cultural forms created by technology research. For example, telephones,

computers, entertainment systems, medical equipment, transportation systems, governmental and policing systems, and product distribution technologies shape the ways people in the developed world spend their days, interact with others, and conceptualise the present and the future.

Scientific research reaches beyond narrow academic questions. Astronomers attempt to understand the origins and shape of the universe. Breaking with all prior human history, they can look at the universe using radio wave, ultraviolet, and infrared 'eyes' and see a universe quite different than what has been known. Biologists increasingly unravel mysteries of life and invent methods for manipulating the genetic heart of life. Scientific research has profound practical and philosophical implications.

Throughout the last centuries during which science and technology have been increasing in importance, the arts have failed to develop a viable role. Often they have tried to ignore these developments and treat them as peripheral to the core of culture. Even when artists did attend to these developments, they did so as distant commentators, sniping from the audience, often without deep understanding of the world views and processes of scientific research. I believe there is a much stronger role for the arts in which artists integrate critical commentary with high level knowledge and participation in the science and technology worlds.

For a long time now I have been exploring this approach of artist as researcher. I have incorporated the monitoring of research developments into my artistic discipline. I monitor science and technology journals, participate in online forums, and attend technology trade shows and academic meetings. I engage the developers in discussion about their products. I have been appointed as beta tester and developer for several technology companies and acted as artist in residence in corporate research centers. I have functioned as an inventor and won a patent for a method I developed to integrate interactive electronics with print.

Emerging technologies are my medium. I seek them out before they become widely known. I focus on them to understand where they come from, where they might go,

and what might be their cultural implications. I experiment with them to see if they have unexplored potentials.

These years as a shadow researcher have been illuminating. I have read in the literature of intriguing developments that never saw the light of day. I have seen many inventions and emerging technologies killed because marketing departments judged that no money could be made. I have seen entire Research & Development departments and their years of research blown away by the winds of corporate politics. Government and corporate support for basic research has almost disappeared and the concern with the bottom line has shortened the pay-back horizon to the point that few risks are taken. I have encountered debates in the scientific community that devalue approaches that do not fit the paradigms currently in favour.

I am worried that the invisible hand of the marketplace might not be so wise as many would like to believe. The judgements that make short term sense for stockholders do not make sense for the culture. The peer review referees of scientific journals cannot always see beyond their disciplinary blinders. Many good ideas are orphaned, unheeded in the wilderness. Scientific and technological research are both so critical that we cannot afford the premature elimination of these ideas and efforts that do not find favour through traditional channels.

As I said, the arts can function as an independent zone of research. They could become the place where abandoned, discredited, and unorthodox inquires could be pursued. They might very well value research according to criteria quite different from those of the commercial and scientific worlds. The roles of artists could incorporate other roles such as researcher, inventor, hacker, and entrepreneur. Even within research labs artist participation in research teams could add a perspective that could help drive the research process.[3] Several traditions of the arts uniquely equip them for this function. (1) Artistic traditions of iconoclasm mean that artists are likely to take up lines of inquiry devalued by others. (2) The valuing of social commentary means that artists are likely to integrate widely ranging cultural issues in their

research. (3) Artists are more likely to incorporate criteria such as celebration and wonder than commercial enterprises. (4) The art's interest in communication means that artists could bring the scientific and technological possibilities to a wider public better than peers in other fields. (5) Artistic valuing of creativity and innovation meant that new perspectives might be applied to inquiries.

The history of the personal computer illustrates the need for this independent research function and the role the arts might serve. Early developers such as Apple Computer founders Steve Wozniak and Steve Jobs found little support for their ideas about the personal computer from the companies they worked for. Supervisors signed waivers on the ideas because they could not imagine any market for a desktop computer used by individuals. Similarly, the discipline of computer science was mostly uninterested in software and hardware issues related to these computers. Advances often came from individuals who worked outside traditional academic and business channels. Teenagers became world experts and artists made significant contributions in the development of interface design and image/sound processing.

Similarly demonstrating the value of art-research cross fertilisation, the SIGGRAPH[4] annual meetings have included an art show since their beginnings. These shows have been influential in several ways. Artists have been able to learn about emerging computer graphics research and technologies long before they became products to the extent that they could start experimenting with them. In parallel fashion, researchers have become acquainted with artistic work that pushed the technology in unanticipated directions and offered ideas for new research directions.

If the culture had to rely only on traditional lines of research, we might have had to wait much longer for the developments that have profoundly shaped the last decades. This story potentially could be repeated many times in many other fields of inquiry if alternative venues for research are developed. The arts could well serve this function if artists are prepared to learn the knowledge, language, work styles, self discipline, and information net-

works that are instrumental in their fields of interest.

What must artists do differently than they always have done to prepare to participate in the world of research? They must broaden their definitions of art materials and contexts. They must become curious about scientific and technological research and acquire the skills and knowledge that will allow them to significantly participate in these worlds.[5] They must expand conventional notions of what constitutes an artistic education. The parameters of the science and technology education required is not yet clear. Can artists find the right mix of objective and subjective processes? Can artists learn enough to engage in research at a non-dilettante level? Scientists and technology researchers who have devoted their entire professional lives to educating themselves about topics being investigated might be sceptical.

At the same time artists must keep alive artistic traditions of iconoclasm, critical perspectives, play, and sensual communication with audiences. They must be willing to undertake art explorations that do not neatly fit in historically validated media and offer their work in new contexts.

The viability of this kind of collaboration is so critical to the future of both art and research that it is worth thinking about in more detail. What can researchers contribute to art and what can artists contribute to research? Why can high tech companies gain from artists being involved?

Much of the most well known collaborations between artists and scientists/engineers do not provide good models. For example, the EAT (Experiments in Art and Technology) in the 60's and the LA County Museum collaborations in Art & Technology produced some interesting art but did not profoundly address the role of artists in research. Often the engineers functioned as technical assistants to the artists or the artists dabbled with new technologies.

Better models would provide more mutual benefit. Early examples, include Bell Labs involvement of artists in sound research that was instrumental to telephony, electronic sound, and electronic voice research and electronic music. Also, artist Sonia Sheridan's artist in residency

at the 3M research centre in the 1970s helped influence the development of colour copier technology as well as shaping her development of the Generative Systems programme at the Art Institute of Chicago that influenced so many artists.

Sceptics sometimes wonder what possible contribution artists can make to serious research and development. Artists can augment the research process in several ways. They can define new kinds of research questions, provide unorthodox interpretations of results, point out missed opportunities for development, explore and articulate wide ranging implications of the research, represent potential user perspectives, and help communicate research findings in effective and provocative ways. They can bring centuries of artistic experience to bear on the technological future. They often approach problems in ways quite different than those of scientists and engineers. The critical role of designers and artists in computer human interface research over the last years demonstrates this new model of interdisciplinary research.

Many 'high tech' artists believe they have already addressed the future by becoming computer artists who work with digital image, sound, and interactive media. They have made a critical error. They have misunderstood the real significance of artists' work with computers during the last decade and a half. The new media are interesting, but more important is the fact that artists were experimenting with microcomputers at almost the same time that other kinds of developers and researchers were. Artists were not merely using the results of research conducted by others but were actually participating as researchers themselves.

Many new technologies such as genetic microbiology promise to have similar or even greater impact on life and thought. Artists need to actively patrol the frontiers of scientific and technological research to identify future trends that could benefit from the artist/research inquiry. Knowledge of computers and the internet are valuable assets because they are required tools in most areas of research. Artists who think, however, they are in the vanguard because they work with

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computers may soon find themselves in the backguard. Below I list some areas of scientific inquiry and technological development that I believe may have cultural impact and will be fruitful areas for artistic inquiry. This diverse idiosyncratic list is by no means exhaustive and identification of other areas of interest should be considered an important artistic activity of our era:

New biology,
Extra-sensory phenomena,
Animal consciousness,
Brain physiology,
Medical technology,
Touch, taste,
and smell research,
Biosensors,
Artificial life,
Alternative energy,
Materials science,
Cosmology,
Non visual astronomy,
Space science,
Artificial intelligence,
Robotics,
Gesture recognition,
Speech recognition
and synthesis,
Wearable computing,
Information visualisation,
Groupware,
Inspectable movies,
Virtual Reality,
Ubiquitous computing,
Surveillance
and remote sensing,
Bar codes and RfiDs,
GPS,
Intelligent home.

Research is shaping the future in profound ways beyond the utilitarian confines of the technology produced. Our culture desperately needs wide involvement in the definition of research agendas, the actual investigation processes, and in the exploration of the implications of what is discovered. Artists can contribute significantly to this discourse by developing a new kind of artist/researcher role.

The appropriate contours of this involvement are not yet defined. Much experimentation is required. How can research settings learn to be open enough to benefit from the unorthodox contributions artists might make? How can artists learn to involve themselves in the ways and byways of researchers without losing touch with their artistic roots? (Many of the best young artists I had as students who became involved as researchers ultimately ended up being seduced by the recognition and economic rewards of research that they quit functioning as artists.) Also scientific inquiry and technology development are not identical processes; what kind of involvement in each might artists fashion for themselves?

I am not claiming that artists should act exactly like researchers. If they did, they would be unlikely to make any unique contribution. Contemporary art often includes elements of commentary, irony and critique missing from 'serious' research. Similarly scientists and technologists strive toward objectivity; artists cultivate their idiosyncratic subjectivity as a major feature of what they do. The 'research' that artists created will most likely look different than that produced by traditional researchers. It would work like art always does – provoking and moving audiences through its communicative power and unique perspectives. Still it might simultaneously work as research – using systematic investigative processes to develop new technological possibilities or to discover useful new knowledge or perspectives.

Maybe the segmented categorisation of artist and researcher will itself prove to be a historical anachronism; maybe new kinds of integrated roles will develop. Signs of this happening already appear. Some of the hackers who pioneered microcomputer developments may one day be seen as artists because of their intensity and their culturally revolutionary views and work. Similarly art shows such as Ars Electronica define research ideas as core themes and invite researchers along with artists as key presenters. Research has radically altered our culture and will continue to do so. Art must be an essential part of this process.

Notes

1. For a more detailed analysis see my paper 'Dark & Light Visions', *SIGGRAPH Visual Proceedings*, Art Show Catalogue, ACM, Chicago, 1993.
2. Thomas Kuhn, *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, 1970
3. See my editorial, 'Industrial Research Artist', *Leonardo* 17, no.2—1984.
4. International organisation for computer graphics research.
5. See my article 'Research and Development as Source of Ideas and Inspiration for Artists', *Leonardo* 24, no. 3 1991, for examples of research that could be of interest for artists.

This paper was originally prepared in conjunction with the [a:t] – association for temporary art project in Sweden, 1996. It appears here in a slightly edited version.

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C

COLLECTIVES AND ART, a few remarks

Arie Altena

The world of information arts abounds with the names of collectives, groups and duo's. One can ask the question if this is significant; and if so, what that means for art and our thinking about art and culture.

(A)ction is never the realisation, nor the implementation of a plan, but the exploration of the unintended consequences of a provisional and revisable version of a project.... We have moved from science to research, from objects to projects, from implementation to experimentation. The dream of rational action has become a nightmare now that consensus and certainty is so hard to obtain: everything would be stalled if we had to wait for experts to agree again.[1]

The world of information art is populated by collectives, groups and duos. There are, of course, artists who operate as an individual and who present their work under their own name; but the number of collectives, groups and duos is nevertheless striking. Is the history of modern art a succession of names which refer to individual artists – or a succession of movements which consist of groups of individual artists – the development of the information arts largely rests on the names of collectives.

Actually, it is a trite observation: 'people work together'. Is there actually anything different going on in the contemporary information arts? In any event, we have no difficulty in placing these collectives, groups and duos. The 'names' that make up the arts scene, are now also those of collectives, like JoDi, Driessens and Verstappen, the Yesmen, the Critical Arts Ensemble, the IAAA, or Tomato. They are names which refer to a clear identity. Perhaps we don't need to dig very deeply to explain the existence of all these joint ventures. It may be simply that two or more people can do something together which they could not manage alone.

Artists have always worked together. The great masters ran studios full of apprentices. Warhol had his Factory. Artists not uncommonly have assistants. The difference, however, lies in the name which appears underneath the work. Is it the name of an individual artist or that of a collective? The work of

Warhol's Factory is Warhol's work. The name of the individual refers, to some extent, back to the view of the artist as an autonomous subject with a particular creative vision. This ultimately goes back to the concept of genius and the subject as defined in the eighteenth. These views may have somewhat eroded over time, but a remnant of them still definitely exists. However, I think it would be going too far to link the presence of collectives in the information arts with something like the 'end of the autonomous subject'. What you can conclude though, is that the willingness to show that artworks are the fruit of collaboration, and did not spring from the insight or perception of a single individual, is on the increase. In the information arts, in any event. It centres not on the artist as an autonomous subject, but the subject as part of a collective process, and which is realized in a collective process. That is a difference.[2]

We can also conclude that the traditional image of the artist does not fit well with the information arts. The artist sitting alone in his studio making a work of art which is then shown to the public in a gallery, art space or museum. The image is a cliché, but one which still haunts our imagination. The artists in the information arts work together, are part of a team and mobilize their networks to realize projects. They often stand (to some extent) outside the art world and its institutions. They make use of the publication models provided by music (issuing CDs and DVDs), show their work at festivals or academic conferences, make use of the internet and arrange exhibitions.[3]

The myth of the artist in his studio is being transformed into that of the artist at the hub of a network. What is changing is the importance that is attached to collaboration, the mobilization of the contacts. This is also affecting the content of the artwork: what a work of art does in the world can be considered as the mobilization of connections, it creates contexts for itself, from which the work derives its cultural significance.

In his introduction to Sonic Acts X Taco Stolk states that artists

> pose themselves as directors, mediators or researchers. By doing so, they distribute parts of the creation process over the environment in which

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> the artwork emerges: ranging from computer programmes (algorithmic art) to social communities (neo-conceptual art).
>
> Taco Stolk, **Introduction,** p.56

Here too, there is a reason for the preponderance of collectives. Artists have become directors and researchers. Although not evident from the term, this implies a collective process. Directors are producers, to direct the 'play' you need others. Research is almost always done in teams. Research cannot take place without sharing insight and information.

It is characteristic of the visual arts that the 'collective' can be applied conceptually. It can become a game with the 'collective'. You are the artist, you profile yourself as a business and in so doing you are playing a conceptual game. What does it give you? When is it just a business? When does a name stand for an artistic standpoint, an art-collective, and when does it stand for a production house? Conversely, the name of a label (e.g. a music label) – once nothing more than a (small) business publishing music – can become a brand, or even the sign of an artistic standpoint. The style of the label, the tightly choreographed choice of music that is brought out, the individual artists who, in effect, are members of the group, combined with carefully chosen images, artwork, VJ-recordings or even in-house software: this is what (almost?) elevates the label to a branded form of artistic expression.[4] In collectives the editorial role grows in importance.

So where lies the boundary between a collective that makes art and a business that does cultural productions? Is Tomato not just a business that exploits music and images? You could also ask whether it is useful to want to make such a distinction. A modernist analytical view wants to see that distinction. 'Common sense' says: the boundaries are vague. The way they merge, the 'messiness', is typical of where our culture stands today. There is no clear-cut division. 'This is art, this is not art. This person is an artist and that one is, well, something different, an activist or a designer.' Our culture and our art are a composite, of collective projects and processes.

A partial explanation for the rise of collectives may also be found in the cultural shifts which have taken place

due to the internet and its many tools and protocols for collaboration. It has, in any event, put cooperation on the agenda as one of the central themes of our culture. It has increased people's receptiveness to collaborative processes and protocols for cooperation in the arts. As a result there has also been a gradual shift in focus away from the autonomous artist in his studio to how projects are realized through collective effort. The discourse about cooperation is mostly about political and social issues, and organisation. Key words such as open source, peer-to-peer, collaborative blogging, creative commons, and Wikis initially referred to tools and protocols to create content. It is typical of the artworld's drive towards the new that such key terms are picked up and often idiosyncratically applied in the art world. Whatever you may think, it shows the level of interest in the 'collective'.

I hope that by considering these fairly mundane questions an impression is created of a gradual cultural shift. This cannot conceivably be pinned down to one single aspect, there is no one particular reason for this shift to occur. It is also not the case that everything has switched or agrees with the new perception. It is no more than a process which has been taking place over the last few years.

I would further like to touch on three possible approaches for thinking about the role of the collective in the arts. The first is the history of radical twentieth century art. In the wake of the avant-garde movement of the '60s, collective art was linked to the democratization of the arts and a deconstruction of the idea of 'high art'. This type of art became an invisible part of daily life, or was incorporated in the system of art which it set out to undermine.[5] I don't think that the art produced by collectives, in its current form, is primarily concerned with a similar democratization. These are projects which manifest themselves in different ways, and which do not always want to be seen as art, as such. They are not intent on undermining the art 'system'. Their aim is to create cultural meaning. In this sense, their place is not in the margins of the museum, but the museum stands in the margin of these cultural projects.

The second possible approach is the most fundamental: the ideas of

the French philosopher and sociologist Bruno Latour on science and society. Latour sees social processes as large collective experiments. He considers the modernist vision of science as a tragedy because it dreams of a strict separation of facts and value, and sees human existence preferably as a 'concatenation of incontrovertible causalities' instead of a 'controversial collective'.[6] In the glossary of *Pandora's Hope* (1999), Latour describes what he refers to as the modernist settlement, as follows: '[The modernist settlement] has sealed off into incommensurable problems questions that cannot be solved separately and have to be tackled all at once: the epistemological question of how we can know the outside world, the psychological question of how a mind can maintain a connection with an outside world, the political question of how we can keep order in society, and the moral question of how we can live a good life – to sum up "out there", "in there", "down there" and "up there".[7] That is exactly what we should not do. According to Latour, life is messy. There are no 'matters of facts' which you can investigate, there are only 'states of affairs'. Anyone who thinks like this can be said to be a non-modernist.

Non-modernity is the situation you find yourself in if you don't believe in exact definitions ('this is art, this is not art'), if you accept that science cannot be perfectly separated from politics, that there is not one nature, that it is not up to the experts to make decisions. '(I)f, in the depth of your heart, you are convinced that, whereas yesterday things were a bit confused and entangled, tomorrow facts and values, humans and non-humans, will be even more entangled than yesterday, then you have stopped being modern. You have entered a different world or, more exactly, you have stopped believing that you were in a different world from the rest of humanity.'[8]

You have become an ordinary person. This non-modernist view offers, I think, a better perspective on contemporary art and culture than the modernist view. You are not trying to make a clear distinction or ask yourself whether a particular project is or is not art, you look at what it means, what it says about who we are, where we are, what we are doing, et cetera. It is about whether it provides a meaningful experience.

This brings me to the third and last approach: the aesthetical views of the American philosopher John Dewey, as set out in *Art as Experience* (1934). For Dewey, the experience of art is directly connected with everyday life. As far as he is concerned, this has nothing to do with avant-garde ideas about art. As he sees it, there is no essential difference between the experience of art and the experience of enjoying a game of sports or watching a sunset. Just as: 'Mountain peaks do not float unsupported; they do not even just rest upon the earth. They are the earth in one of its manifest operations,'[9] so art is not essentially different from culture or the experience of daily life. For Dewey art is a meaningful part of any organized society – not something which only exists in a gallery or museum. He postulates 'Theories which isolate art and its appreciation by placing them in a realm of their own, disconnected from other modes of experience, are not inherent in the subject-matter but arise because of specifiable extraneous conditions.' Dewey wants to reconcile 'the continuity of aesthetic experience with normal processes of living'.[10] In this context art becomes something of a collective – which, by the way, doesn't mean that art is not made by individuals.

Both Latour and Dewey offer a context and a background for understanding the nature of collectives. To me, their views are pivotal to an understanding of contemporary cultural production – to use that ugly expression. Because you cannot avoid using labels. It remains a thorny question: what to call it?

Notes

1. Bruno Latour: 'From 'matters of facts' to 'states of affairs'. Which protocol for the new collective experiments?' (forthcoming, in Henning Schmidgen (ed.), *Experimental Cultures*). This quote is about the relationship between science and society, and not about art.
2. In the context of this short article, I will not amplify on this any further.
3. The appearance of collectives is unusual in the visual arts, but in music, dance and film it is the norm. Perhaps we should look to music and film to find the role of the collective in the visual and information arts.
4. An example might be Tomato of John Warwicker.
5. See, for example, the contributions of Gregory Sholete and Charles Green at the conference Freecooperation: <http://www.freecooperation.org>.
6. Latour wrote: 'It is for me one of the most tragic intellectual failures of our age that the best minds, the highest moral authorities we possess, dream only of one thing: 'If only, they say, we could control science, separate it entirely from the realm of human values, keep humanity safely protected from the encroachment of instrumental rationality, then, and only then, would we live a better life'. They want to keep science and technology as distinct as possible from the search for values, meaning and ultimate goals! Is this not a tragedy if, as I have argued, the present trend leads precisely in the opposite direction and that the most urgent concern for us today is to see how to fuse together humans and non-humans in the same hybrid forums and open, as fast as possible, this Parliament of things?'
7. Bruno Latour, 1999, p. 310
8. Bruno Latour, quote from 'From 'matters of facts' to 'states of affairs'. Which protocol for the new collective experiments?'
9. John Dewey, 1934, p. 10
10. John Dewey, 1934, p. 10

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Geert Lovink & Trebor Scholz, Free Cooperation, Publication, PDF <http://www.freecooperation.org>.

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COLOPHON

Unsorted, THOUGHTS ON THE INFORMATION ARTS, *An AtoZ for Sonic ActsX,* edited by Arie Altena, with an introduction by Taco Stolk.

Unsorted, THOUGHTS ON THE INFORMATION ARTS was edited during the preparation of the tenth edition of the Sonic Acts festival, and presented in advance of the festival (23–25 September 2004, Paradiso, Amsterdam). The texts and interviews gathered here can be considered as a partial theoretical context to the theme of Sonic ActsX: the information arts.

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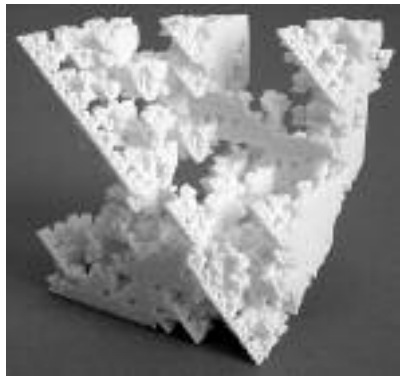
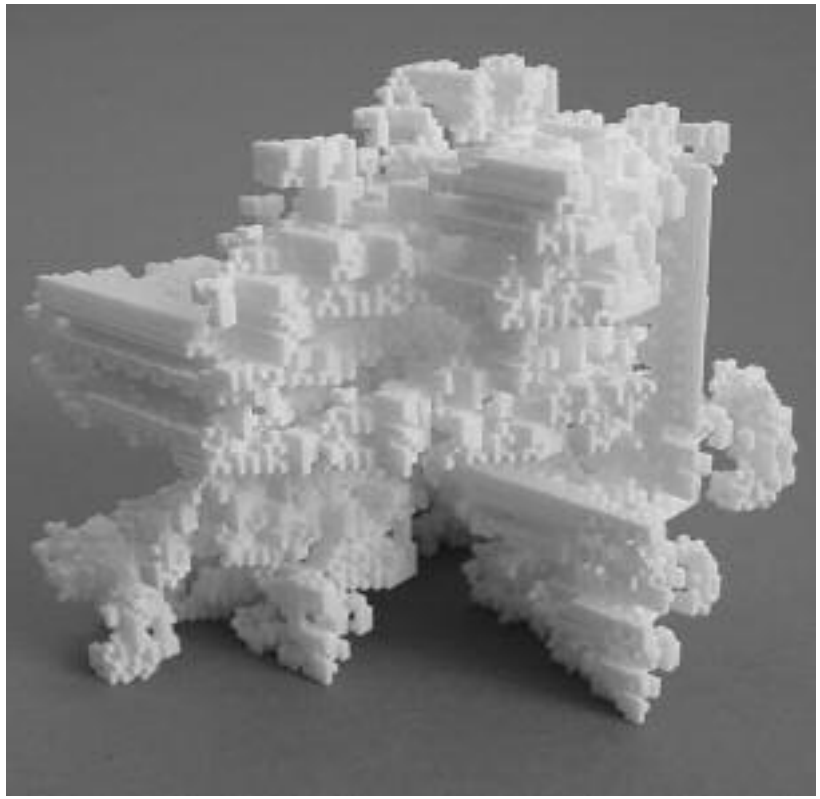
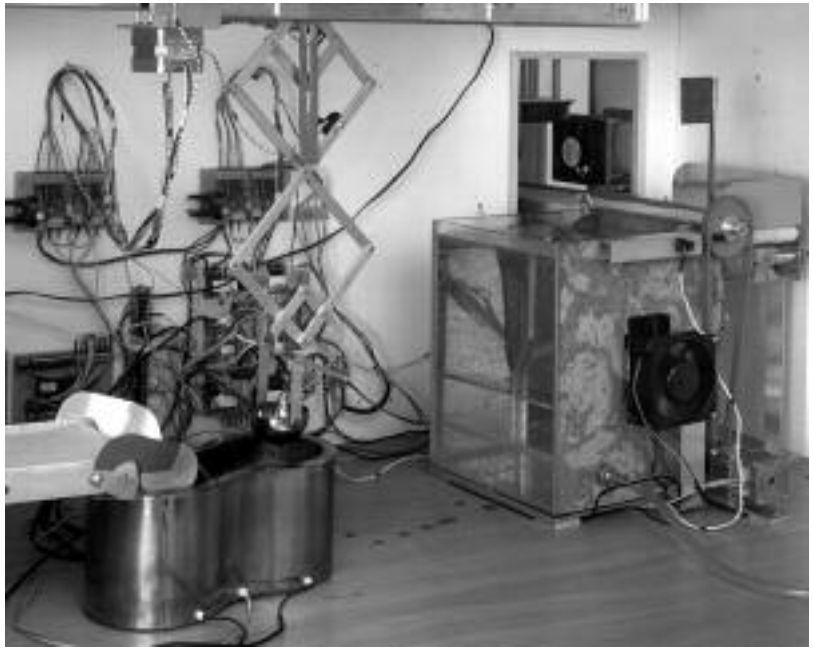
D

DRIESSENS & VERSTAPPEN



Driessens & Verstappen, **Breed ID 294** and **266,** 2000, model generated with **Breed** software, realised with Selected Laser Sintering (SLS), 96 x 96 x 96 mm.





Driessens & Verstappen,
The Factory, 1995,
transformation room,
collection FRAC Lorraine, Metz

Driessens & Verstappen,
The Factory, 1995,
beeswax form, generated in
The Factory, volume 25 ml.

Driessens & Verstappen, **Morphotheque #9,** 1997,
32 elements, plaster with acrylic paint,
collection Anne Marie and Sören Mygind, Copenhagen,
Galerie für Landschaftskunst, Hamburg

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GENERATING ART

Driessens & Verstappen
talk to Arie Altena

Erwin Driessens and Maria Verstappen are two Dutch artists who have been working with algorithmic art since the early nineties. They conceive physical or computer algorithms which create forms. They also had much success with their installation Tickle Salon, *for which they won first prize in 2002 at Life 5.0, an international conference for art and Artificial Life.*

Arie Altena Many of your works involve the automatic generation of forms as a seemingly continuous process. However, you often present finished objects. Is your work mainly about the creation of an algorithm or is it about the end product?
Maria Verstappen We have been concerned with this for a long time now. It actually goes back to the early nineties, when we were still at the Rijksakademie in Amsterdam. We were confronted with the idea that there is a very compelling relationship between the artwork, on the one hand, and the art spaces which present it, plus the journals and magazines which in turn reflect on it, on the other. The art world is a self-perpetuating system. We established at the time that the artwork is essentially a strategic element in ensuring the continuity of institutionalized art. New art has to be shown every month, the production must go on. The magazines give glowing reviews to the galleries and art institutions, which buy large glossy advertising pages in these magazines. The so-called new and interesting therefore seemed to be very closely bound up with mutual commercial interests. We asked ourselves whether it would be possible to automate the production of art, and so meet the continual demand. It was a somewhat nihilistic response to the powerless situation in which we seemed to find ourselves. If you automate art production as a reaction to this, you need to have an end product, because only then will you know if your plan was successful.
Erwin Driessens It also had to do with the fact that at the time you could immediately see who had made a particular work of art.

Everyone had their own style, their own way of doing it. As if every artist had a developed a method of producing art. As if style was a system to be able go on producing art.
AA Is style based on a particular set of rules then?
MV That's what we thought at the time. When we tried to apply our idea it quickly became clear that you won't get far with such a nihilistic view. It turned out to be quite a job to devise a system which could produce something new each time, a system of which even we didn't know what would come out of it – otherwise it wouldn't be new. The challenge in our work, at the time, was to find a way to build a form of emergence into the system, to create a changing output.
AA You took a step back as an artist.
ED We wanted to be both artist and viewer at the same time. To be surprised ourselves by what it produced.
MV Right from the start we developed in two directions. We tried to formalize a way of dealing with the properties of the material, on the one hand. You could say that we devised physical algorithms in which plastic materials independently took on a detailed fixed form. At the same time we were working with the computer and programming. We conceived formal systems, worked with mathematical formulas, with the aim of being able to cultivate images instead of designing them by hand. We turned the computer models into objects later. Here we found ourselves up against the limits of what was programmable at the time. You may think that you can programme anything, but the technology sets the limits. Which in itself results in an individual style.
AA Can you give an example of a physical algorithm?
MV Take beeswax, a material which can easily be shaped: you liquefy it by heating it, it solidifies again as it cools. So you can easily do an experiment in which you pour molten wax into water and scoop it out again. Two liquids in motion, water and beeswax, together make a complex structure which is revealed by the solidified wax. It is a purely physical expression of wax. We made a machine, *The Factory*, which does that. *The Factory* shows a continual cyclical process of solidification and liquefaction and records the individual expressions

of form of the successive lumps of wax on video.

AA What about the computer models? Did you immediately start working with genetic algorithms – computer algorithms which grow and change constantly?

MV We were busy developing things mathematically, of some things you could say, with hindsight, that perhaps it was a generative system, but they weren't genetic algorithms.

ED In the beginning it was just fiddling about. We were mainly trying to find out what the scope of a particular programmed system was. When you're just starting out you think it's fairly straightforward. We tested formulas. We wrote something down and then looked to see what came out of it. The formulas were fairly primitive functions based on circles and lines which we made combinations of. We were still too much involved in the design. Now we are at a stage where we leave even the composition of the formulas to the computer. To reach that level you need to be thoroughly familiar with programming.

AA In the type of generative system which you both make, surely you decide the parameters? What exactly do you determine and how do you create it in such a way that as much as possible is left up to the computer?

ED You try to let the computer work out the details itself. You do not programme an image pixel by pixel. You just write a number of general things, for example: you want a 2D-image which changes with time. You can setup a repertoire of basic functions and a mechanism to link these functions to one another. The computer is then capable of creating short programmes for itself, which then leave their mark on the screen.

MV But we definitely want the images generated to intrigue you as a person. You must want to keep looking. We once wrote a programme in which every pixel on screen changed colour at random. But this simply resulted in noise. If you want to make something that results in a coherent form or style, then there needs to be a feedback mechanism in the software.

ED There has to be growth in it, a genesis.

MV We let go of control over the creation process to give the emergence a chance. We deliberately

allow unpredictability in the process, because we want to be surprised by the results. The more distance there is between our input and the end result, the greater the unpredictability and the surprise element. The greater the distance, the more we like it. We initially made our work with beeswax by hand. We had a bucket of water and a spoon and we tossed the wax into it. The form was still influenced by your physical strength, which is why we made *The Factory*. Another important aspect is that there are limits to any system you set up. These relate to the state of the technology as well as the physical and chemical properties of the material. We did a project last year on changing form which was done by etching away and galvanizing metal. In such a case it is clear from the start what you can do. The results therefore show the possible variations in form within that particular process. That's the case with computer software, too. You make a decision at the beginning which dictates what is and is not possible.

ED Everything we do is bottom-up. We always try to start out with a primordial soup and then see what emerges.

AA One of your works in which the computer essentially takes all the decisions, is *Breed*, in which cells divide and divide again until an optimum form is created. You then create that form, initially a 3D-computer model, as an object. How do you decide where the programme should stop?

MV During the growth of a *Breed* object, in each division every individual cell divides itself into eight new units which may be either solid or hollow. The choice of which it will be is determined by what the immediate vicinity of the building block looks like. A response to every conceivable type of spatial environment has been incorporated into the genetic code of the object. This genetic code gradually mutates through an evolutionary process in such a way that it meets a small number of criteria.

ED We also include end criteria in the programme. The process stops when the form meets the criteria.

MV The underlying principle with *Breed* was that the 3D-computer models could also be presented as an object. This meant that in the final object all the building blocks had to be attached to one another.

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There should not be any loose or floating parts. This was included in the programmed constraints. Nowadays the objects are made under computer control. We built the first models by hand in layers of plywood, so the limit was what you can cut out by hand. The programme therefore makes an internal measurement: can this form be physically made? That is a defining criterion.

ED At the same time, what form it will take is left entirely open.

MV *Breed* mutates the genotype for the form and compares the result of this mutation with the previous generation. If a higher percentage of building blocks are connected to each other – and the phenotypic form can therefore be more easily made than the last one – then the new genotype is used as the basis for another mutation. This goes on until the genotype best meets the set criterion, and produces a phenotype in which all the building blocks are spatially connected to one another. The requirement that the results must be fully interconnected drives the development of the form. It is essentially a fitness criterion. A type of artificial evolution takes place in *Breed*. You programme a criterion and a form evolves which gradually meets that criterion better and better. In *Breed* the algorithms drive voxels (volume elements), these are the building blocks. You can draw an analogy with cells, to us pixels and voxels are cells. We often use terms from biology. You might think that we are comparing virtual processes with organic processes but, in fact, we use these terms in a more abstract manner.

AA Are you training the computer to become an artist?

MV In the case of *Breed*, not to become an artist but more of a structural engineer. The computer knows nothing about the aesthetic qualities of the generated forms. There is no aesthetic selection.

ED Artist is not the word I would use. Creator or maker is better. We are now working on a new project in which you, as the user of the software that develops the generative forms, can choose what you like or think is good.

MV You give an image a score, based on which the system learns what you like.

AA It has been suggested that Artificial Life (AL) art, which could also include *Breed*, goes a step further

than the readymade of Duchamp and the work of Warhol. In the sense that Duchamp and Warhol also stepped back – or appeared to do so – from their own artistic egos. What do you think of that idea?

MV Because of Duchamp, Warhol, and Beuys too, there has been some sort of short-circuit which has cleared the way for AL art, among other things. At least as important is that *IMA Traveller*, for example, one of our works which is based on AL software and in which you navigate through abstract areas of colour, was possible because modernism opened up the abstract domain. No one thinks it odd that *IMA Traveller* is abstract. We don't have to defend it. I think it's interesting that AL art can link up so easily with abstract art. It is also somewhat inherent to algorithmic art. You could say that AL art realizes the potential released by Duchamp, Warhol and Beuys. We use it as an area of exploration. They showed that everything can have an aesthetic quality, we are physically exploring that territory.

AA Do you see yourselves therefore more as researchers, investigating the field of aesthetics, than as artists?

MV We are not in a hurry to pin the label art on our work. Whether it is art or not, I don't know. I prefer to use the word artificial. But because we mainly present our work in an art context, it would seem logical for it to be called art. It sometimes seems to be that if you do research in art you are more likely to be seen as a scientist. But we feel that our work and our aspirations are entirely bound up with the visual and creative process. That's why the visual arts is the ideal realm for us to investigate. We are well aware of the limited role of art. We are so spoiled by the world around us. You are given so many fantastic visual impressions. And you would try to match that with art? A plant, for example, is so detailed, you cannot even get close to it with art. In a number of projects we observe physical phenomena. Through the way in which we record our perceptions, we try to reveal an underlying process. As in *Frankendael*, which comprises 52 photos taken over a whole year from a spot in the Frankendael park in Amsterdam. They have been put on film and time is compressed, which allows you to see certain changes which you would not otherwise be able to see. *Morphoteque 8* and *Morphoteque 9* show

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an abundance of potato and carrot shapes have been collected and recorded, they show the diversity of form within a species. The genetic potential is revealed. A work of art can attempt to evoke that sense of wonder about the physical form of the things around us. Not in relation to the external forms themselves, but in terms of the underlying processes which create them all. We don't want to simulate existing processes, which would soon fall short, but specifically, to make use of the particular qualities that artificial processes offer. In this way you can evolve a new, living world of phenomena.

AA It is a kind of artificial nature?

MV Our point of departure is usually a simple fact, an algorithm which does something locally, but which at a general level can evoke great detail and complexity. That is wonderful. This is also how we reflect on the world around us and our amazement about these things and how they are connected to one another, only grows. You can connect it with the aesthetic of the sublime. In our software packages you could say that we are describing the laws of an artificial nature. In the nineteenth century the sublime was linked to a sense of futility in relation to the unpredictable forces of nature. An important aspect of the sublime is the tension between pleasure and fear. You can now run a programme that shows something of the amazing power of the computer, that has something of the sublime about it. The underlying generative process cannot be directly grasped but we are capable of experiencing it through the machine. You can be overwhelmed by a sense of being out of control, and at the same time enjoy the spectacle. What nineteenth century painting could only portray figuratively, you can let the observer actually experience with AL. You can pick up the ideas from that era again, link them with the principles of abstract art from the last century and the achievements of Duchamp and Beuys. All these threads are being drawn together for us now.

AA *IMA Traveller* is, in that sense, the computational sublime.

MV The AL artist Jon McCormack used that term at a conference in Melbourne. It certainly makes sense.

AA Does this mean that you are essentially aiming at a visual impact

on the viewer?

MV We try to make sure our work is accessible. That is why it is important that it has a direct visual impact, which you also get even if you don't know anything about what's going on in the background. It's only now, at this moment in time, that the purely conceptual approach of the computer arts is coming together with a credible visual language. What you often see in computer art of the past is that it was more of a demonstration than something which you could really experience. We sometimes say ourselves, half jokingly, that we are aiming for a sort of Hollywood quality.

AA You mean a high resolution image in which you can immerse yourself, as it were?

MV That's why we also aim for a real-time experience. The best thing is when the area that you explore, as the observer, is built up in real-time, as in *IMA Traveller.* It did not exist until you found it, you are the first person to see it. It is not a pre-calculated set of images, as in film or video. It requires fast computers and refined software. The pixels must be transmitted at lightening speed. The image should preferably refresh itself sixty times a second.

ED An artwork of this kind really has to be a parallel world. It has to compete as far as possible with the world we know.

MV Well, it should mainly compete with the other media we know. These dictate our perception. I hope that when people see our works they encounter visual images which do not carry a message put there by an artist. You can talk about what is beautiful and ugly with a certain detachment once again once you realize that the things were created by a machine which has no notion of beautiful or ugly. If you like it, that's your personal taste.

AA With *Tickle Salon* and the tickling robot you are really competing with reality. The machines do something which we perceive as very human, stroking and tickling.

MV And they have surpassed human beings when it comes to stroking and tickling. They do it better. The psychology – of the machine doing it instead of a person – gives the machine an advantage. It does not have certain physical limitations, like the limitation of what you can do with an arm. Also,

it is very selfish to want to be stroked. You want to be stroked, which you need someone else for. If it is done with love, that's an extra bonus. Sometimes it is just nice if that element is not there, that you don't have to burden someone else with it. What is amusing is that in art people often look for a clear statement from an artist, but this is not the case with *Tickle Salon*. Clearly, it creates its own context.

AA Have you ever been asked: when are you going to bring it out onto the market as a product? You haven't done that so far. Presumably you don't see yourselves as product developers?

MV We find it very interesting that the question is raised. We would prefer to leave it open for as long as possible. It is sometimes taken amiss that we haven't said anything about it. 'Tell us, is it art or is it a prototype for a consumer product?' We have not made any fundamental decision about that. To us it is what it is. You can see the machine entirely in terms of an invention – a tickling robot – which makes the whole question of art or the market irrelevant. But it looks as though you could sell it in a box. That's important, it's part of the experience. But we certainly don't intend setting up a production line with all the risks that that involves.

ED We are more interested in the question of whether or not something is possible. If it turns out to be possible, then we turn our attention to something else.

AA Do you do a lot of research before developing a project?

MV We do research, but we often begin from scratch. You cannot always use what you discover from research. During the research for the *Tickle Salon* we discovered that GPS software partially does what we needed, but that software is hard to get and not freely available.

ED It is often more difficult to tailor existing software to the things you do. It is often better to develop your own software. When we made *IMA Traveller* we had no notion whatsoever of AL and cellular automata. It was developed in parallel.

MV That's often the way it goes. You look for a connection somewhere and you find out that you are actually already connected.

ED That's also because the strategy we use is truly 'keep it simple'. We are certainly not the only people who do that, and then you soon find yourself developing something which others have also developed. Certain techniques and solutions reveal themselves. But I do read more scientific papers now than I used to.

The Amsterdam based artists duo Erwin Driessens (1963) and Maria Verstappen (1964) have worked together since 1989. They both studied at the Rijskakademie, Amsterdam and the Academy of fine Arts, Maastricht. They develop low and high tech systems (physical algorithms, evolutionary software, robotics) to generate a continually changing output of images, 3-dimensional shapes or movement. They have held numerous joint and solo exhibitions in galleries and museums in The Netherlands, France, Germany and other countries. <http://www./xs4all.nl/~notnot>

HEARING PURE DATA: Aesthetics and Ideals of Data-Sound

Mitchell Whitelaw

Digitalisation turns sounds and images (still and moving) into strings of zero's and ones. Pure data, in fact any data, can therefore become sound or image. The artists dealing with these issues operate between the worlds of experimental electronic music, visual arts, and design. Australian researcher Mitchell Whitelaw dives into the aesthetics of pure data, data bending, and sonification.

The basic resources, for sound artists and producers, are now digital. Production tools have for the past decade been moving from hardware to software; this process has recently reached saturation point, such that the computer has completely internalised – virtualised – the studio: the only vestige of hardware is an audio interface, necessary still to convert between data and audible signal. Creative sound culture is restless; casting around for

new resources, it appropriates and misappropriates whatever it can. Given that the basic platform for sound culture is the personal computer, it's not surprising that it has begun to draw on data as the raw material of that environment.

In some recent sound practices, data is explicit, not implicit, and concrete, not transparent; I refer to such work here as data-sound. This work turns in on that conversion from data to signal, normally taken for granted, which underpins contemporary sound culture. In the process it reveals data as itself an elusive construct, a figure, an idea(l), as much as a commonplace material. Data-sound entails an imagination of data and its milieu – dataspheres or spaces – which is a cultural act in itself. Sound culture, and increasingly culture as a whole, is digital; so the question of how data is, and can be heard, is significant.

Data misappropriation is straightforward: select 'file: open any' or 'import raw' in your sound editor. Select any non-sound file from your hard drive, and press play: most likely a harsh block of noise, maybe flecked with modulating bleeps, squeals and pulses. Select different file sizes and formats, and observe the results. Import, export and file conversions form a web of potential for modifying files; shifting from one application to another, any data can be displayed and edited as text and/or sound and/or image.

This is data bending, both a process and a loose-knit subculture of audio artists working across the interbreeding genres of contemporary electronica[1] (see stAllio! p.). In its most recent form it is a digital relative of 'circuit bending', the exploratory hacking of electronic musical toys and instruments.[2] 'Bending', because the instrument must remain functional – like some neurosurgery, circuit bending must be undertaken without an anaesthetic, while the patient is powered-up and playable. Similarly, data bending is a kind of creative, adaptive modification which both subverts and maintains functionality. It comprises a handful of strategies: the first, 'open any', is described above. All files become audio files: the hard drive becomes a sample library. This transcoding can give rise to particular aesthetic and conceptual projects: audio from

images, audio from text, audio from text, and so on. The transformation is bi-directional, so sound can also be converted back to other formats, and this opens up new modes of manipulation. Open an audio file as text, and begin altering characters: paste in a few tracts of your favourite philosopher, or delete random chunks; reopen as audio. Open audio file as image; apply filters, scribble, save, reopen.

Frequently data bending is used to generate sonic source material, rather than an entire piece: stAllio!'s twelve inch *True Data* consists of edited excerpts from random data files sequenced into noisy, abrasive techno.[3] Smartelectronix, a collective producing audio plugin software, suggests the same approach in their recent competition. Here the data files of Smartelectronix plugins themselves are to be edited and sequenced into 'Pop, hardcore, ambient, noise, electro…' in order to reveal 'the sound of Smartelectronix'.[4]

As a creative strategy, data bending might be explained as simple sound expansion – that tendency, in the musical avant-garde, to constantly seek out new sound materials. A seminal example of sound expansion is Cage's prepared piano. Yet clearly the act of modifying a piano (however gently) is significant in itself, even apart form the expanded sound palette it generates. So too here; data misappropriations, transcodings and manipulations are more than mechanisms for sound expansion, they are cultural acts and statements, and readable as such.

One of the striking features of this work is the notion of data that it constructs. There is a pervasive notion of 'raw' or 'pure' data. stAllio!'s *True Data* hints at this (tracks include 'open as raw'); Smartelectronix seek sounds that embody the core identity of their work: the data structures of their audio software. On the microsound list, Christopher Sorg writes of 'trying to figure out the aesthetics of a pure, sequential data stream.'[5] One of the preferred programming tools for experimental digital audio/visuals is Miller Puckette's *Pd* – 'pure data'.[6] In this last example the software seems to be reminding its users that, despite the structured media artefacts it produces (images, sounds) its internal representations are abstract; purely data. Otherwise this notion of purity

reflects a desire to somehow access data itself. Christopher Sorg, again: 'What I have been particularly interested in is the idea that all data inside the computer are essentially the same, and that it just takes someone to "peel the skin", and peer inside, either with ears or eyes, or whatever senses we care to translate the switching of 1s and 0s into. … To me, the most interesting thing about "data-bending"… is letting the data speak for itself, trying to listen to the data stream with as little interference as possible.'

In part this notion of rawness, and of 'peeling the skin' from digital media, is related to the recent wave of media errors, glitches and clicks that has swept through electronic music. Elsewhere I have described such work in terms of 'inframedia' – the technological underside or substrate of media technologies.[7] From record cracks, to CD-skips, digital glitches and crashing and malfunctioning hardware, this aesthetic points to the physical infrastructure which underpins electronic media. It is a reminder of materiality, a collapsing of representational transparency. Data bending and related practices are an expansion of the 'clicks 'n' cuts' aesthetic: here the momentary error, skip or crack, opens up, and the substrate itself pours through. As in other inframedia aesthetics, the physicality of sound is significant: we feel and sense the data, rather than reading or understanding a message. Data bending is a form of anti-content – especially considering its tendencies to self-referentiality (using audio applications and plugins as sound sources). It makes a (doomed) attempt to resist the production of yet more arbitrary media content, and instead reveal what is 'true' (about itself). This raw data signifies (by a kind of metonymy) the digital in general, as a sphere or space; what Lev Manovich refers to as 'the computer's own cosmogony'.[8] It also signifies the cultural status of this cosmogony. If power and agency subsist, now, in the sphere of the digital, then to hear raw data is to hear some trace of that.

The deliberate misreading of data bending leads us to a basic opposition, and a crucial tool for pursuing an analysis of data-sound practices. Just as data bending is anti-content, it is anti-information. Information is a formatted message;

significant difference, as opposed to randomness; it has a sender and receiver. Information technology relies on a substrate of formatted symbols, and ultimately binary bits: digital data. But information is not data: information is the content of data, its message. So data bending is an attempt to hear the underneath of information, to deny the (intended) message. Information implies communication and subjectivity; while the data itself suggests data as pure (found) object, alien to the subject, unintentional and a-referential.

However this pure object, this separation of data from information, is impossible, and impossible from two sides at once. Semiotically, a message always creeps back in, even if the message is 'listen to me, accessing pure data'. The process and performance of data bending always returns to fill in meaning; once again, sound-expansion is never purely itself. From the other side (the underneath), it is impossible because the data itself are perceptually inaccessible. The data are always and inevitably ordered, organised, formatted – even if they are mis-formatted, they are re-formatted, and in fact any format is yet another trace of subjectivity and intention: it is a cultural artefact, an agreed convention of form. Not other, not alien, but part of us. In the case of reading in a non-sound file (say an application) as sound: the original file contains certain structures and patterns, with instructions and resources stored in various segments of the file, themselves formatted. Read as audio, these original structures are flattened and traversed, as the binary data are re-formatted into a string of (for example) 16-bit integers. What we hear is not the data in itself, but data in one format, smashed through another; and both formats are cultural artefacts. Format punctures any ontological purity we might imagine, but also inevitably conditions the sonic outcomes. The parameters which the data bender chooses to reformat (and transcode), fundamentally shape the sound.

This is not to dismiss data bending as a creative enterprise. That the romance of hearing pure data is impossible, only makes its pursuit more interesting, and certainly doesn't preclude the possibility of compelling art emerging along the

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way. It does suggest an alternative route for data-sound practices, though, which is to work with, rather than against, format and information. If we accept that some process of translation, some mediation between data and sound is inevitable, then the question is, what is translated, and how, and how else could it be done? This question is crucial at a time when the social, economic and cultural valency of the datasphere is growing. As Manovich writes: 'This is the new politics of mapping of computer culture. Who has the power to decide what kind of mapping to use? Which dimensions are selected? What kind of interface is provided for the user? These new questions about data mapping are now as important as more traditional questions about the politics of media representation.'[9]

Mapping data to sound is the preoccupation of a small but active research community working on 'data sonification' and 'auditory display'.[10] In one sense sonification is the converse of data bending: where data bending is arbitrary, abstract and aesthetic, sonification is designed, referential and functional. Where data bending seeks out the data itself, sonification seeks out meaningful, usable information. Artists and researchers Mark Hansen and Ben Rubin refer to 'the use of sound in exploring the information hidden in data'.[11] Hansen, Rubin and a group of other sound artists have taken a sonification approach to data/sound aesthetics.

Listening Post (p.57) is a recent installation work by Hansen and Rubin that shows a highly evolved approach to data/sound mapping, and raises some of the implications of this approach. The work draws its data in real-time from thousands of public online discussions, in chat rooms and online bulletin boards. As its name suggests, the work attempts to 'listen in' to this discourse, to render this textual chatter audible. More specifically, the work seeks to convey the content of those discussions, their scale (the sheer volume of text data) and a sense of their momentary dynamics or 'immediacy'. This is achieved through a sophisticated set of data collection, analysis and sonification processes. In one example that the artists outline, software agents search the text stream, returning posts that

match those retrieved by other agents; the result is a topically grouped accumulation of texts, displayed and intoned by voice synthesisers. This is one of four mappings, or display algorithms, that *Listening Post* cycles through in a ten-minute period. So, aesthetic experience is structured here according to mapping; this provides formal variety, but also communicates the point that data and mapping are functionally distinct — that data might be mapped and re-mapped, and that these mappings render the same data in different ways.

Listening Post takes on the datasphere in its most prominent manifestation – the internet. It emerged from research on the functional sonification of network traffic, a popular application for sonification that offers system administrators an ambient display of data activity that is (for them) highly significant, but normally intangible.[12] While these systems focus on network transactions, *Listening Post* mines the network's content.[13] Another work of software art, Jason Freeman's *N.A.G* (*Network Auralization of Gnutella*) elegantly sonifies both transaction and content. *N.A.G* seems initially to be simply a client application for the Gnutella peer-to-peer file-sharing network. It is a Gnutella client, but a slightly bent one; enter a keyword and *N.A.G* begins not only downloading matching files, but playing back loops and fragments of its find. The aural texture that results shifts as *N.A.G* finds new files, and as the network dynamics (particularly download rates) change. However *N.A.G* works best not as a network sonifier, but a kind of free-associating cultural core sample. *N.A.G* turns the 'false positives' of a keyword search to its advantage, creating a sprawling musical collage of unexpected trash and forgotten favourites. It illustrates a kind of mutant sonification, radically open and uncertain in sonic content and correspondingly in the 'information' it communicates.

These works, and others like them, share a basic dynamic of revelation which draws attention to the dynamics and structures of networked data. Often, as in *N.A.G* or Andi Freeman's (1999) *<head>banger* browser, they intervene in existing protocols and structures with a few simple connective gestures, re-wiring software in a way that

correspondingly re-wires attention and experience. Mapping is a process of linking, joining together; here, as in data bending, the first (and crucial) step is the connection: Manovich's question of what connection, and why, still seems secondary.

Even in *Listening Post*, which makes sophisticated and self-conscious mappings, there is a primary urge for revelation. Hansen and Rubin aim to make a 'meaningful rendering of a massive data stream', and 'distill the content and the structure of this collective communication.' The sense of data as object emerges again here, along with a desire to reveal what is inherent to the data. As well the scale of the dataset is significant in itself, and its vastness is a part of what the artists seek to communicate. Manovich identifies the same phenomenon in visual data-art: 'If Romantic artists thought of certain phenomena and effects as un-representable, as … beyond the limits of human senses and reason, data visualisation artists target the exact opposite: to map such phenomena into a representation whose scale is comparable to the scales of human perception and cognition.'

This is the 'anti-sublime': the condensing and collapsing of the unimaginable vastness of contemporary datasphere, into perceivable objects. It applies exactly to *Listening Post*, and perhaps other works as well. *N.A.G* presents a local, specific, momentary aural sample of the vast and shifting pools of a peer-to-peer file sharing network. Some data bending work seems to have the same, evocative sense of scale; the microsound *RNDTXT* project takes as its dataset a massive 15Mb text file of random text culled from spam email.[14] This mass of text is imperceptible in itself, as text, but a rich subject for visual and sonic data mapping and mashing. UBSB's release traceroute consists of data slabs surreptitiously gathered from a broadband network hub, converted to audio; scale here is bandwidth, rather than network size.[15]

But what of the anti-sublime? Manovich is right to suggest that such works take the unimaginable 'beyond' of data, and make it available to experience. Yet this seems no different to the way that artists have traditionally evoked the sublime. A painting of a stormy sea never

attempts to capture or entirely reproduce that sea or its dynamics, but to evoke an idea and instill a feeling; it makes a finite and specific impression of the vast beyond, and its own limits, its own static smallness, only adds to the pathos. So too, much of this work makes self-consciously limited but evocative impressions of the sublime of data. Perhaps data-sound connects with what Jon McCormack and Alan Dorin call the 'computational sublime': 'the instilling of simultaneous feelings of pleasure and fear in the viewer of a process realized in a computing machine.'[16] This feeling is induced by the accelerated symbolic logic of computation, its ability to outstrip human thought and imagination, to seem 'beyond us' even though, as the saying goes, the computer's only talent is to be stupid, very quickly.

This sublime of data returns us to the notion of data as pure, found object; there is a shared sense of data as other and elsewhere, constituting or inhabiting another realm. This construct is comfortable and familiar, for it has deep cultural roots: cyberspace, virtual reality, the Ars Memoria, Heaven and Hell. All the more reason to seek out ways of unthreading it. Interactivity, another favourite new media construct, may help here. When data-aesthetic practices generate closed systems, or aesthetic objects, they play into this mystification of data; data and map become inextricable; we have little sense of how things could be otherwise. Wittingly or not they present intentionality, in the form of a map, as unintentionality, the data itself. Interactive or open systems allow us to tweak the map or alter parameters, even navigate or manipulate 'the dataset itself' (as in *N.A.G*). They begin to reveal the contingency of any particular mapping and the abyssal plasticity of the dataset, the impossibility of the 'in itself'. Interactive systems leave the question of intention at least partially unanswered, turning it over to the user: what do you want to know, make, find? What, in this dataset, is information, and what is noise?

A final word from Manovich. He makes the point that disciplines such as scientific visualisation (and sonification) are already effective in extracting meaning, and even beauty, from abstract data. 'The more interesting and (…) maybe more important challenge is how to

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represent the personal subjective experience of a person living in a data society.' This is too modest a challenge, I think. We are all already data-subjects, from our GUIs to our ATMs; data-sound and other practices reflect that reality. The challenge now is to transform that subjectivity, to instill in it a pragmatic data-literacy which increases its power. Perhaps the most important lesson from data-sound comes from process, rather than product, for in this domain it is the artists who are prototypical data-subjects. Theirs is not a single subjectivity, but they use diverse strategies and mappings, and these are not complete, rational or determined, but arise through mixtures of whim, convenience, insight and chance. They may show us a way, to hear data for ourselves.

notes
1. For a starting point see the databenders group: <http://launch.groups.yahoo.com/group/databenders/>
2. While the coinage 'data bending' is recent, similar practices have a longer history. Ian Andrews reports industrial acts Throbbing Gristle and Severed Heads using audio from computer data-cassettes in the late 70s and early 80s. Ian Andrew, email to microsound list, 8 6 2004.
3. StAllio!, 'stAllio! – True Data 12".' <http://www.animalswithinanimals.com/stallio/discog/truedata.html>
4. Smartelectronix: <http://www.smartelectronix.com/competition-Rules.php?selected=compRules>.
5. Christopher Sorg, email to microsound list, 7 June 2004.
6. See for example <http://puredata.info/about/>
7. Mitchell Whitelaw, 'Inframedia Audio', *Artlink* 21(3), 2001 p. 49-52.
8. Lev Manovich, *The Language of New Media*, MIT Press, Cambridge, Mass., 2001, p. 46.
9. Lev Manovich, 'The Anti-Sublime Ideal in New Media' , *Chair et Metal / Metal and flesh*, 2002, http://www.chairetmetal.com/cm07/manovich-complet.htm.
10. See ICAD (International Community for Auditory Display), <http://www.icad.org>.
11. Mark Hansen and Ben Rubin, 'Babble Online: Applying Statistics and Design to Sonify the Internet', *Proceedings of the 2001 International Conference on Auditory Display*, <http://www.stat.ucla.edu/~cocteau/papers/pdf/rubin2.pdf>.
12. See for example Peep, <http://peep.sourceforge.net/ intro.html>.
13. *N.A.G*, <http://www.turbulence.org/Works/freeman/index.php>.
14. microsound RNDTXT, <http://microsound.org/rndtxt>.
15. UBSB, traceroute (Ash 4.7 LP).
See <http://www.kcw70.dial.pipex.com/html/releases/ash4.7.html>
16. Jon McCormack and Alan Dorin, 'Art, Emergence, and the Computational Sublime', *Proceedings of Second Iteration, Second International Conference on Generative Systems in the Electronic Arts*, Melbourne, , p. 67-81. <www.csse.monash.edu.au/~jonmc/ resources/art-2it.pdf>.

Mitchell Whitelaw is the author of *Metacreation, Art and Artificial Life*, MIT Press, Cambridge Mass., 2004, a detailed and critical account of the creative practice of a-life art and science. He teaches new media at the University of Canberra.

INTRODUCTION to SonicActsX

Taco Stolk

Art reflects the society which gave birth to it. It is therefore not surprising that many new art forms have emerged in recent years (from computer art to neo-conceptualism and from business art to genomic art) which in form and content are rooted in the information society: the information arts. The numerous varieties within this domain differ from each other in many ways, and it is important to research how they do. On the other hand, it is

challenging to find ways to compare these new art forms. In general, the information arts defy several paradigms on which traditional art forms are based.

An important traditional paradigm is the familiar distinction between art disciplines such as visual arts, music, dance, theatre and literature. Usually, the different works of information art are forced to fit within this classical categorisation model. This, however, provides us with a misleading image of the nature of the new arts. For instance, imagine two works of computer art, generated using largely similar algorithms. The first work has an aural output, the second results in visual forms. Then the first one will be labelled as music while the second will be called visual art. This might seem to be an arbitrary problem, but it becomes relevant when we realise that the infrastructures of, in this case, the musical world and the visual arts world operate in rather separated areas (art education, exhibition and performance spaces, criticism and analysis). Many of the interesting issues of (and between) artworks like these are being missed because they are positioned outside the current categorisation models.

Or take genomic art: 'living artworks' created by artists using genetic modification technologies. Works like these are usually labelled as visual art, while this is in fact irrelevant. A living creature is (whether it could be called a work of art or not) as much a visual 'object' as it is 'performing' sound and motion. It could even be seen as 'literature', since it is the result of a composed string of data (DNA). Here also, the focus on the 'visual' aspect blurs the more intrinsic qualities of the work and the methods of creating it.

Once we conclude that the traditional distinction between visual arts, music, et cetera does not work effectively for the information arts, we have to pose the question if there are any other categorisation models thinkable to provide us with a deeper and wider insight in the field of the newest arts. The discussion about these potential alternatives seems to gain more attention lately. Several recent publications propose new categorisation models – such as *Information Arts. Intersections of Art, Science and Technology* by Stephen Wilson and *The Language of New Media* by Lev Manovich.

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Another important paradigm shift in the information arts concerns the position of the artist – in relation to society as well as to the creative process. Due to the use of technological equipment and conceptual viewpoints, but also by adaptation of organisation models from other social areas (like science, business or politics), the traditional images of the skilled craftsman or the individual artistic genius do not fit information artists very well. They pose themselves as directors, mediators or researchers. By doing so, they distribute parts of the creation process over the environment in which the artwork emerges: ranging from computer programmes (algorithmic art) to social communities (neo-conceptual art). As a result, craftsmanship is being replaced by specific knowledge skills, whether they concern computer programming, marketing techniques or scientific expertise. A by-product of this development is the apparent blur between 'autonomous' art and the social areas in which the artists operate.

This attitude towards the role of the artist can also be seen clearly from how artists organise. In the information arts, collectives are widespread. Sometimes these are ad hoc collaborations, like artists working with scientists or other specialists. In other situations, the collectives have adapted structures like that of companies, political parties or even nation states. This goes even further where institutions like record labels, advertising agencies, or even companies in less creative areas, try to establish themselves as artists. All these various forms of cooperation cause different dynamics in the creative processes, so they result in different types of art.

Too many young artists, these paradigm shifts come naturally. They react creatively on the society in which they live. It can be foreseen that the different aspects of the art world will evolve in directions which fit the new arts. This will however only happen when we develop new insights on the differences and similarities of these arts.

Taco Stolk is a conceptual researcher and editor of Sonic Acts X. Since 1993 he is formulating WLFR, which can be described as the abstraction of an artist. He is head of the ExtraFaculty of the Royal Academy of Arts in The Hague.

LISTENING POST

Mark Hansen & Ben Rubin

Mark Hansen & Ben Rubin, **Listening Post,** 2001—2004, prototype circuit board, 2001. Photo by Wendy Stulberg

Listening Post (p.57) is a recent installation work by Hansen and Rubin that shows a highly evolved approach to data/sound mapping, and raises some of the implications of this approach. The work draws its data in real-time from thousands of public online discussions, in chat rooms and online bulletin boards. As its name suggests, the work attempts to 'listen in' to this discourse, to render this textual chatter audible. More specifically, the work seeks to convey the content of those discussions, their scale (the sheer volume of text data) and a sense of their momentary dynamics or 'immediacy'. This is achieved

Mitchell Whitelaw, **Hearing Pure Data,** p.50.

Mark Hansen & Ben Rubin, **Listening Post,** 2001—2004, electronic component prototype, 2001. Photo by Wendy Stulberg

Ben Rubin: For years, I have thought about ways to hear inaudible phenomena, ways to map the observable world into the sound domain. My starting place was simple curiosity: What do 100,000 people chatting on the Internet sound like? Once Mark and I started listening, at first to statistical representations of web sites, and then to actual language from chat rooms, a kind of music began to emerge. The messages started to form a giant cut-up poem, fragments of discourse juxtaposed to form a strange quilt of communication.

www.earstudio.com/projects/listeningpost.html

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Mark Hansen & Ben Rubin, **Listening Post,** 2001—2004, Whitney Museum of American Art, 2002. Photo by David Allison

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Mark Hansen & Ben Rubin, **Listening Post,** 2001—2004, Whitney Museum of American Art, 2002. Photo by David Allison

ORGANIC AND CONCEPTUAL SYSTEMS

Casey Reas answers
Bert Balcaen's questions

The works of Casey Reas, software, animations and digital prints, have been exhibited on venues, festivals and galleries all over the world. His programmed kinetic systems are amongst the best examples of abstract interactive art that is blooming on the internet and in the new media art world.

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Bert Balcaen What are the main themes in your work?

Casey Reas Systems have been the core of my work for the last twelve years and for the last six years I've been creating dynamic systems in software. I work in two areas: organic systems and conceptual systems. The organic systems are derived from my interest in artificial life and the phenomenon of emergence. The conceptual systems are more formal and explore the nature of software, representation, notation, and process. I'm fascinated with the way temporal and logical processes are encoded and decoded through symbols.

BB How important is science for you?

CR I'm interested in biology (particularly physiology), and psychology, but I'm not very concerned with physics. I'm more interested in metaphysics and engineering. I've been interested in artificial life, artificial intelligence, the principle of emergence, and robotics for many years. This interest motivated me to learn how to write software and build electronics. The related courses I took at MIT further fed these interests and the core of my work in the past few years is derived from ideas explored in these communities. I've recently been reading more art theory and writings on conceptual art. I'm actively bringing together ideas from both directions.

BB What are your criteria for deciding if a work is successful?

CR I have many criteria and I don't apply them to every piece. It's successful if it holds my interest over a period of months, if I want to keep using it or watching it. It's successful if it holds the interest of other people. If they want to spend time with the work – to explore and discover its core. It's successful if it reveals something I haven't previously known. I often think about these issues: (1) Who is in control? Is the system controlling the interaction or is the participant? (2) Is there a balance between action and response? If it always behaves the same way, it becomes boring. If there is no relation between the stimulus and the response, there is no feeling of engagement. (3) Is there a fine level of control? The human body is amazingly dexterous and expressive. Does the interface allow us to use our potential or does it restrict? (4) Does the work engage the entire body? Is there total involvement? Like many people of my generation

I grew up playing video games. They were my first experience using computers and I judge all interaction with computing machines in relation to this early experience.

BB What's the best type of place to present your work?

CR I've been shocked by the difference the venue makes for viewing interactive art. Depending on the setting, people quickly dismiss the work or treat it with a high degree of respect. I've had people physically destroy my pieces by being extremely rough with the interface and I've had wonderful experiences where people take time to explore and understand the work. Some works are very successful at media art festivals where there are large groups of people with short attention spans, while some works fail in this environment and succeed in others. Interactive work is often fragile and most traditional museums don't have the experience or the staff to maintain it. They have enough difficultly maintaining mechanical kinetic art and interactive work can be even more problematic. Museums such at the Ars Electronica Futurelab are excellent for showing work because they have a superb staff. I enjoy showing my work in exhibitions including work in other media. I think this helps take the emphasis away from the technology. Galleries are an excellent place to show work. They are usually not extremely crowded and it's possible to spend time with the work. Because gallery spaces are small, there is no pressure to rush off and see other pieces, which is a tendency in a large museum or media festival.

BB While many other multimedia artists use software packages (such as MAX/MSP) or special programming languages (such as Flash ActionScript), you work with general-purpose languages. What is your reason for this choice?

CR For some people, tools like MAX/MSP and Flash are more complicated than general purpose languages. It depends on they way peoples' brains are wired. The decision to make software with one environment should be made based on the goals of the final work and the process individuals are comfortable with. Because I want to make generative work (typically the only visual element in my software is a line), I don't need many of the form editing controls and image editing tools embedded into software like Flash

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or Director. Because my work is complicated logically, using MAX would be tedious. Another aspect is the 'quality' of the result. To use problematic metaphors, acrylic paint has a different quality than oil and plaster has a different quality than stone. Different software materials also have different 'qualities' and I prefer the quality of C++ using OpenGL. My materials give me more resolution in time and space and this is important. I've been learning about computer programming since 1998 when I was 26. I spent many years working with visual media before thinking about it in relation to writing code. I still hold many prejudices from this time and I think it allows me to not be consumed by the technology. In some ways I'm constrained because I don't have the programming skills of some of my contemporaries, but it also helps me to put the focus of the work on the concept rather than technical innovation. I don't accept programming for what it is, but instead think critically about how it can be improved for making visual and interactive work. Programming languages are developed for making precise calculating programmes and this heritage can be very confining for people wanting to do different things with the technology.

BB Usually, you create custom interfaces for your works. For example, what's the idea behind the discs in *TT*?

CR *TT* is an environment of enigmatic growing forms. It is a software installation projecting images onto disks hovering above the floor and configured to encourage people to move through the space, stopping to look at the different images. I feel strongly that all software should have a method of presentation that is optimum for the concept. I'm very frustrated to show my work on standard computer screens using peripherals like a mouse or keyboard. These are arbitrary physical objects which have no intrinsic relation to my work. My previous projects *Tissue* and *RPM* both also have interfaces built to relate to the software's controls. I'm working to always integrate my software into objects and environments.

BB You made DVD and print versions of your software pieces. How do you decide which medium to use?

CR The concept exists outside of any physical medium and seeing different manifestations in diverse media give a more complete view of

the whole. *MicroImage* is also a good example of exploring a concept through diverse media. The core of all my work is the concept, not the implementation. I work in print to reveal the resolution of the system, I work with animation to have complete control of how the image unfolds over time, and I implement the structure in software so it's possible to interact with it. The software implementation is closest to my actual concept, but the other media provide additional views into the structure. For example, in addition to the software, *MicroImage* is also manifested as prints and animation. There is a series of medium format prints and a triptych of large format prints of 5 x 2.8 meters which was commissioned by the Ars Electronica Center. The quality of the printing decreases tremendously at this size but the scale allows for a different experience of the underlying structure. To augment the software and prints, an eight minute animation was carefully scripted. The animation explores an image density not possible in live software due to the processor's speed not being able to draw as many lines as I want in each frame. For each different medium, I alter the software to enhance the unique qualities.

BB Your visual language is abstract; there isn't any direct representation. However, your recent works all have an organic, living feeling...

CR I love representational and narrative painting and film, but when I make my own work, abstraction comes naturally. I don't think of abstraction as devoid of representation, but there are different levels of abstraction along the path from pure representation to pure abstraction. For example, there are the abstractions of landscape found in the work of Diebenkorn and the abstractions of Rothko which make no reference to our physical environment. In my work I create abstractions of the systems of the natural world, rather than the appearance of the natural world. The fact that people see recognizable forms in my work is symptomatic of how our brains work, but is inconsequential in understanding the work. The works *Tissue* and *MicroImage* are based on writings of neuroanatomist Valentino Braitenberg. Because this software is derived from natural systems, sometimes natural visual patterns appear in the form and motion.

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BB How does the traditional art world relate to media artists like you?
CR There are a few ways to think about it and there are very different communities of 'traditional artists' and 'media artists'. The communities I'm a part of are converging. In the past, there have been cross-over artists and both domains share some heroes including Nam June Paik and John Cage. There were many events and exhibitions in the late 1960's where many pioneers of media art were engaged in the same communities as traditional artists. This diminished and has diffused but contemporary art magazines and newspapers publish reviews of media art exhibitions alongside exhibitions of painting and sculpture. I think I'll see a complete convergence in my lifetime, the same way that video is now entirely integrated into the world of traditional art.
BB Processing is an open project initiated by Ben Fry and yourself...
CR Processing is a programming language and environment built for the electronic arts and visual design communities. It was created to teach fundamentals of computer programming within a visual context and to serve as a software sketchbook. The software exports Java applets which may be posted on the internet and shared with other artists and designers.
BB Where are you in ten years time?
CR My plan is to infiltrate what you refer to as the 'traditional art world' and to remain teaching at UCLA. I'm working hard to create a greater technical literacy so software and electronics become more prevalent within the arts. The idea is to remove technical barriers so the next generation of media artists can innovate the concept and theory of the work, rather than remaining constrained by needless technical barriers. In ten years, Processing should be on version 3.0 and will either be entirely different or hopefully be pushed aside by other languages and environments that it helped spawn.

Bert Balcaen is a reseacher at the Jan van Eyck Akademie, his work can be seen at <http://www.rekalldesign.com>.

Casey Reas is an artist and educator exploring abstract kinetic systems through diverse digital media. He has exhibited and lectured in Europe, Asia, and the United States, was a member of the Aesthetics and Computation Group at MIT and is currently Visiting Assistant Professor in UCLA's Design Media Arts Department. Together with Ben Fry he initiated the development of Processing. <http://processing.org>, <http://dma.ucla.edu>, <http://groupc.net>.