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## metacreative engines: artificial life and the edge of art

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We are quite accustomed to thinking about new media as transforming art practice; they provide new tools, new forms, new creative potential, new aesthetics; they bring new networks of cultural value, and new cultural spaces (such as the Web). By definition, they join the process of creation to the endless stream of newness that pours forth from the factories of western technoculture. Within this constant and ongoing transformation, the role of the artist can in a sense be taken for granted; we know from the histories of cybernetic art, of video and computer art, that artists will use whatever they can, however they can; the creative urge will propel new applications of new technologies. New media art contains a strong streak of experimentalism, of playfulness and exploration; it often begins asking simply (of some process or artefact), "what can I do with this?"

Creativity, in this simple, macroscopic view, is a motivating force, an engine. However the nature of this engine cannot be taken for granted, nor can it be held apart from the other transformations involved in new media art. Just as new media alter the creative process, they entail transformations in the concepts of creation and creativity.

This paper considers a very particular instance of this transformation. It occurs within one of new media art's fertile crossover zones, where it meets scientific practice in the field of artificial life. In artificial life the computer is used to model, simulate, or some argue instantiate, the characteristic processes of living things; from the folding of DNA proteins and the complex dynamics of embryogenesis, to the operation of ecosystems and the mechanisms of evolution. Some of the techniques and the thinking of artificial life (or a-life) have found their way into new media art practice over the past decade; artists including Christa Sommerer and Laurent Mignonneau<sup>1</sup>, and British group Technosphere<sup>2</sup> have created interactive artificial ecosystems; others such as Simon Penny<sup>3</sup> and Canadian duo Bill Vorn and Louis-Phillipe Demers<sup>4</sup> apply a-life approaches to interactive robotic sculpture. The artists discussed here share a third approach; they use a computational process modelled on Darwinian evolution to create aesthetic objects — digital images or virtual forms. Within the work of these artists, creation and creativity are reconfigured: these terms are linked with both the sweeping drive of evolution, and the effortless permutational capacity of the computer; their conventional relationship to the individual will of the artist is altered. Finally, work in this field is concerned with a particular amplification of creativity: its extension into metacreativity, the *creation of creation*.

### > breeders

In Karl Sims' *Genetic Images* installation from 1993, a prominently displayed CM-2 parallel supercomputer sits beside an arc of sixteen video screens displaying colourful, abstract images. Every thirty seconds or so the images are replaced with another, slightly different set. In fact, each new set consists of one or more images from the previous set, and others that resemble them in different ways and to varying degrees. Pressure-mats on the floor in front of each screen allow visitors to "select" one or more images that will form the basis of the following set of variations. Over several cycles of selection and variation, the images

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<sup>1</sup> see Sommerer & Mignonneau homepage, available: <http://www.mic.atr.co.jp/~christa/>, 12 October 1998.

<sup>2</sup> see Technosphere homepage, available: <http://www.technosphere.org.uk/>, 12 September 1998.

<sup>3</sup> see Simon Penny homepage, available: <http://www-art.cfa.cmu.edu/Penny>, 23 March 1999.

<sup>4</sup> see Bill Vorn & Louis-Phillipe Demers homepage, available: <http://www.comm.uqam.ca/~vorn/chaos.html>, 9 July 1998.

become more complex; initially simple, planar figures, they become more detailed; colours change, new compositional elements spontaneously appear. The “selectors” steer these changes, choosing the most appealing variants in each cycle, amplifying particular elements or features. There is no apparent endpoint to this evolution; wave after wave of images appears, visitors arrive and leave, and the images themselves continue to change.

What’s going on here? In technical fact the process is mathematical. Each image is generated according to a complex mathematical expression: when an image is selected for variation, its equation is randomly altered fifteen times to produce a new set of equations, and a new set of images; when two or more images are selected, the new set is made by splicing the original equations together at random points. Metaphorically however, this is an image-breeder: its process is founded on analogies with genetics and evolution. Here the image’s equation is analogous to the genotype or genetic code, the code which gives rise to the image, which here is the organism or phenotype. In *Genetic Images* an image’s equation might be altered randomly as it “reproduces”, just as in biology random mistakes in the replication of genetic material produce mutations. When two or more images in a set are selected, their equations are spliced together in a process analogous to sexual reproduction: the following generation of “children” contain various mixtures of the “parent” images’ equations.

According to Darwinian orthodoxy, living things are the cumulative results of long cycles of selection and variation; here Sims presents “computer-simulated evolution”<sup>5</sup>, a process where images are “evolved” according to human aesthetic selection. Many generations of this process produce quite remarkable cumulative results: complex, abstract images with mathematical “genes” so complicated that, in Sims’ words, they “would be quite difficult for any human to design or even understand.”<sup>6</sup> Working individually with the process used in *Genetic Images*, Sims has bred images over thousands of generations which give an indication of the kind of graphic richness and variety the process is capable of. One looks like a tangle of chromed string, another is a bright, liquid-amoebic colour field, yet another resembles a lurid op-art totem mask (from a sequence where Sims selected for the most face-like images).<sup>7</sup> Some images read as flat coloured planes, others imply depth through complex edge-effects and figure-and-ground relations.

*Genetic Images* sets out the basic breeder structure very clearly; a mutable digital genotype codes for a phenotypic form which “evolves” through successive cycles of selection and mutation. In the work of other artists this structure is identical, although the details of its implementation change slightly. Sims wasn’t the first artist to use artificial evolution; William Latham, together with programmer Stephen Todd, developed software for evolving three-dimensional forms in the late 80s.<sup>8</sup> Latham’s 1988 exhibition “The Evolution of Form” consisted of large digital prints of these evolved forms; his later work has included computer-animated video. In Latham’s breeder, as in Sims’, an artificial genetic code is mutated in order to produce variations in the resulting form. The strongly biomorphic forms in Latham’s work are a product of a code which is not so much mathematical as descriptive or procedural; it consists of coded instructions for particular morphological elements: horns, tentacles, fans, and so on. Latham’s work explores the sculptural repertoire lurking within the combinations and recombinations of this formal grammar.

In the years following publication of the details of Sims’ and Latham’s work, a number of other image- and form-breeders have appeared in a variety of contexts. Projects following Latham’s use of procedural constructive geometry include Andrew Rowbottom’s *FORM*

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<sup>5</sup> Karl Sims, “Genetic Images” in Karl Gerbel and Peter Weibel (eds.) *Ars Electronica 93: Genetische Kunst - Künstliches Leben* (Linz: Ars Electronica, 1993), 401.

<sup>6</sup> *Ibid.*, 404.

<sup>7</sup> Karl Sims, “Artificial Evolution for Computer Graphics” in *Computer Graphics* vol. 25 no. 4 (July 1991): 325, 327; “Interactive Evolution” in *Ars Electronica 93*, 121; “Genetic Images” 402, 403.

<sup>8</sup> see Stephen Todd and William Latham, *Evolutionary Art and Computers*(London: Academic Press, 1992).

software<sup>9</sup> and *Cybertation* and *Dancer DNA* by UK multimedia collective The Zen Room.<sup>10</sup> Others including American artist Steven Rooke, veteran “algorist” Kenneth Musgrave<sup>11</sup>, Dutch a-life researcher Peter Kleiweg<sup>12</sup>, and American computer scientist John Mount, have followed Sims’ image-based approach. Mount’s “International Interactive Genetic Art” project virtualises Sims’ *Genetic Images* installation, allowing web users to act collectively as aesthetic selectors by evaluating the images displayed.<sup>13</sup> Jeffrey Ventrella programmed a similar project for a website spin-off of Kevin Kelly’s book *Out of Control*, hosted by Absolut Vodka. Ventrella’s “Absolut Kelly” breeder was designed to produce variants on Absolut’s characteristic “bottle” ads - the bottle-shape is hard-coded into the system’s “genes”<sup>14</sup>.

### > breeding, creation and metacreation

These systems are bizarre hybrids: evolutionary theory implemented in a computer simulation which breeds aesthetic objects. They can be understood as formal, computational systems or as working models of particular theories within evolutionary biology. Here however, they are examined for their concern with aesthetic novelty and creation: it is this concern, or rather desire, that is dominant in artists’ accounts of their work with these systems.

“I use evolution for two reasons. One, to breed things I would never have thought of, nor would have found any other way. And, two, to create things in great detail that I might have thought of, but would never have time to draw.”<sup>15</sup> This quote from Karl Sims indicates first of all that the artificial evolutionary process is used creatively, to make things. Secondly, it indicates that the usefulness of the process, for Sims at least, is linked to its ability to somehow exceed the artist’s own capacity. William Latham echoes this sense: “The machine gave me freedom to explore forms which previously had not been accessible to me, as they had been beyond my imagination.”<sup>16</sup> Somehow these breeders allow for a kind of creative transcendence, a movement *beyond imagination*.

These quotes also contain clues as to how this occurs. Sims uses a mixture of terminology to discuss the process: he “creates”, but also “breeds” things he would not otherwise have “found”; Latham “explores” otherwise “inaccessible” forms. Sims seems to suggest that his images are “found” as much as made; similarly Latham gains access to his forms through artificial evolution — as if they already existed in some “out there”. In fact this “out there” is a central figure in the discourse around these systems. William Latham calls it “form space”: it is a virtual space that contains every possible form that the artificial genome can code for.<sup>17</sup> As a simple way to introduce this figure, imagine a system that instead of abstract images or virtual forms draws stick-figure trees. The procedure drawing the trees has two simple variables - here analogous to genes: one controls the length of the branches, and the other controls the angle between the branches. Different combinations of these values will produce different tree-forms. We can visualise the whole range of trees this process can make in a two-dimensional space: Figure 1 shows such a space, with branch angle increasing from left to right and branch length from bottom to top.

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<sup>9</sup> Andrew Rowbottom, “Organic, Genetic and Evolutionary Art.” Available: <http://www.netlink.co.uk/users/snaffle/form/evolutio.html>, 10 August 1998.  
<http://www.netlink.co.uk/users/snaffle/form/evolutio.html>

<sup>10</sup> The Zen Room, “A Global Multimedia and Internet Creative Cooperative - The Zen Room Limited.” Available: <http://www.zenroom.demon.co.uk/>, 24 August 1998.

<sup>11</sup> Ken Musgrave, “Genetic Programming, Genetic Art.” Available: <http://www.seas.gwu.edu/faculty/musgrave/mutatis.html>, 10 August 1998.

<sup>12</sup> Peter Kleiweg homepage, available: <http://odur.let.rug.nl/~kleiweg/>, October 15 1998.

<sup>13</sup> John Mount, “John Mount’s International Interactive Genetic Art II.” Available: <http://www.geneticart.org/cgi-bin/mjwgenformII>, 25 August 1998.

<sup>14</sup> Jeffrey Ventrella, “Absolut EvolArt.” Available: <http://www.absolutvodka.com/kelly/evoltech.html>

<sup>15</sup> quoted in Kevin Kelly, *Out of Control: The New Biology of Machines* (London: Fourth Estate, 1994) 353.

<sup>16</sup> quoted in Kevin Kelly, op. cit.

<sup>17</sup> Todd and Latham, *Evolutionary Art and Computers*, 75.

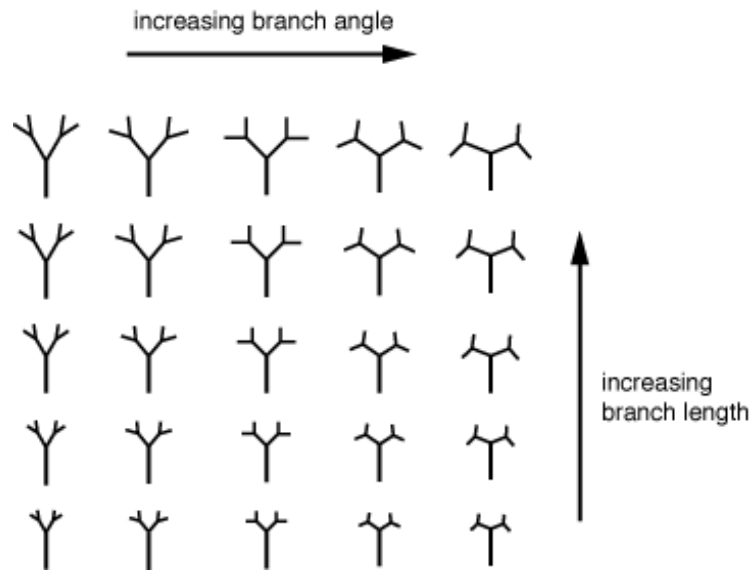


Figure 1: A simple, two-dimensional genetic space

The range of possible trees in this example is relatively unexciting, but such a space need not be confined to two dimensions; if the trees used another variable, for instance one controlling the “trunk” length, the genetic space would become three-dimensional: an imaginary cube. Add another variable, perhaps controlling the number of branches per division, and the space of possible trees becomes four-dimensional. The genetic space has as many dimensions as there are variables in the artificial genome: as the artificial genome becomes longer, and the form it determines more complex, the form space it defines becomes larger.

For Sims and Latham, the apparently creative process of breeding can also be thought of as a kind of navigation within this multi-dimensional space, an uncovering of images and forms already present. Latham uses such terms as “exploration”, “searching” and “steering”<sup>18</sup> in describing the breeding process. The expansive sense of potential that these systems convey is linked to this spatial figure: it is a kind of aesthetic reservoir, Latham’s inconceivable “beyond”.

So are these objects found, made, “bred”? In a stereotypical model of visual creativity, the artistic will exerts itself, shaping its medium, expressing itself. These systems require a more complex model: here the categories of artist and medium are ambiguous; artistic will seems to be exceeded more than expressed. Latham and Todd provide a structure that helps articulate the forms of artistic agency operating within these systems. They propose that within “evolutionism” (their coinage) the role of the artist is twofold, involving “the creation of generative systems and structures” on one level, and “the selection of specific forms and animations” on the other.<sup>19</sup> This twofold role becomes linked to another analogy: “The artist first creates the systems of the virtual world ... then becomes a gardener within this world he has created.”<sup>20</sup> The authors frequently refer to these roles simply as “artist creator” and “artist gardener”.

<sup>18</sup> Ibid., 98.

<sup>19</sup> Ibid., 209.

<sup>20</sup> Ibid., 12.

Kevin Kelly makes the implicit explicit when he concludes an article on Sims announcing "The artist becomes a god, creating an Eden in which surprising things will grow."<sup>21</sup> Richard Dawkins, whose Biomorph software was the first graphical breeder, speaks of "the exaltation I felt ... exploring a land which I had supposedly made."<sup>22</sup> This "artist creator", the designer of the "generative systems and structures" of the breeder, becomes the creator of an entire "land" or "garden". This is a creative act that mirrors Christian theology, as Kelly implies; a single (male) agent brings a whole, bountiful, seemingly boundless world into being. Moreover, given the generative intent of these systems, it can be thought of as a *metacreative* act: it creates creation, defining a creative process, and a field of aesthetic potential.

The "artist creator" is not alone, however: in Latham's binary structure of artistic roles, the god-like metacreator is joined by the "artist gardener". It is the gardener who explores the space of potential these systems define, who in Latham's analogy tends and cultivates its strange crops; it is the gardener, in fact, who experiences the garden's aesthetic rewards, who seeks out its most appealing areas. There is a close complementarity in these creative roles: the metacreator engineers the formal structures, the evolutionary logics, the specifics of an artificial evolutionary process, creating a zone of aesthetic potential. However the metacreator is far from omniscient: the system's potential remains abstract, invisible, and unpredictable. Only through the work of the "gardener", through generation after generation of selection and variation, can the space be explored, and for the gardener, the garden is full of surprises.

Of course the gardener or breeder role is no more conventionally "creative" than that of the metacreator. For the artist gardener, the link between creative will and aesthetic result is indirect, mediated by the system's pre-existing genetic language. The process demonstrates a kind of composite agency: the aesthetic choices of the gardener, the underlying structures formed by the metacreator, and the spontaneous mutations of an artificial genetics interact equally. Within this composite, it is remarkable to observe the subjective reactions of those involved in the breeding process. Steven Rooke is an American image-breeder who uses a system based on Sims' *Genetic Images*. He writes,

I can't stop. There is something compelling about this process. It feels as though the images are trying to break out of their hyperspace into the physical world. Sometimes I'll be two or three days into a run — dozens of generations with one or two hundred individuals in the population — when Wham! there's something familiar staring back at me from out of the computer screen, demanding to be made real.<sup>23</sup>

The reaction of the normally staid Richard Dawkins is even more striking: "I cannot conceal from you my feeling of exultation as I first watched these exquisite creatures emerging before my eyes. ... I couldn't eat, and that night 'my' insects swarmed behind my eyelids as I tried to sleep."<sup>24</sup>

The structure of the process itself might provide an explanation for these reactions. In Sims' discussion of *Genetic Images* he explains how the variation occurring in image-breeding differs from the creative alterations involved in more conventional image-making. Here, creative variation is "succinctly executed by the computer" in the form of a random mutation.<sup>25</sup> It is this computational mutation which is the key to an understanding of the kind of creative agency at work in these breeders — one which operates through preference and selection rather than active construction. The passive position of the artist/user is particularly

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<sup>21</sup> Kevin Kelly, "Genetic Images" in *Wired* 2.09. Available: <http://www.wired.com/wired/2.09/features/sims.html>, 26 August 1998.

<sup>22</sup> Richard Dawkins, *The Blind Watchmaker* (Harlow: Longman Scientific and Technical, 1987) 60.

<sup>23</sup> Steven Rooke, "Biographical Information." Available: <http://www.concentric.net/~srooke/biog.html>, 7 August 1998.

<sup>24</sup> Richard Dawkins, *The Blind Watchmaker*, 60.

<sup>25</sup> Karl Sims, "Genetic Images", 405.

important: as Sims says the computer tirelessly, "succinctly" varies the aesthetic object, and can do so quickly, easily and endlessly. Propelled at speed through generation after generation, the artist enjoys an exhilarating excess of choice, as new objects/creatures appear and are left behind. With the effortlessness of "mutation" comes an accelerated loop of change and selection which can continue indefinitely; one can transform the object endlessly, following the slightest whim of preference, the tiniest margin of desire. The "creative" process is extended, in fact, into an endless deferral of its object. An analogy can be drawn with the psychology of shopping, an activity which in affluent cultures offers not so much necessary material objects as sheer desire, the endless promise of more. Similarly the psychology of breeding aesthetic objects is caught up with the process more than the object, a process driven by a spiral of variation, desire and selection without apparent limits. The strong spatial metaphors which surround these systems, and the unknowable extent of the potential which the metacreator sets up, reinforce this sense of limitlessness, of exploration and boundless novelty.

### > limits to metacreation

This expansiveness begs to be questioned. Once again the hyperbolic Kevin Kelly, writing on Sims' work, provides a sense of the extent of this promise. "Sims constructed a universe ... of all possible pictures. ... this total universe contains all shades of rose, ... the Mona Lisa, and all Mona Lisa parodies ... the blueprints of the Pentagon".<sup>26</sup> In fact Sims' system has never generated a *Mona Lisa*, or even a *Mona Lisa* parody. The strange, abstract colour-fields that Sims' breeder tends to make reflect its underlying mathematical grammar, its collection of trigonometric and logarithmic functions and its repertoire of image arithmetic. Images such as those of Steven Rooke, while they add certain fractal elements to the repertoire, share in this inescapably algorithmic aesthetic. It is interesting to note here that in technical fact it is difficult to define limits to the capacity of systems such as those of Sims and Rooke. Unlike more structured breeders such as Latham's, these use an artificial genome with a theoretically unlimited size. This means that any mutation of an image can actually increase the amount of information in the genome, and hence the dimensionality of the genetic space (or form space) that it occupies; with such an open genetic structure, the space of images that such a system can access might be as vast as Kelly implies.

In the domain of art practice, the distinctive aesthetic of the artefacts evolved within these systems becomes not so much a limit as a mark of individual style. The sculptural aesthetic of Latham's evolved forms is a product of the specific morphological grammar (of spirals, tentacles and horns) which his artificial genome encodes. This grammar at once limits the variety of its results, and imparts them with a distinctive, familial quality. Nonetheless, there remains a sense within the field of limits being pushed, of ever-greater spaces of potential opening up. Steven Rooke is working on an image-breeder which uses a more complex genetic structure, one which like a biological genome operates not as a static line of code, but as a dynamic, temporal structure. Rather than simply being selected from the flow of evolution as static individuals, these images will actually change, like a developing embryo, with time. Rooke anticipates that such a system will be "capable of much richer evolution."<sup>27</sup> Rooke illustrates the way a desire for aesthetic richness and expansive potential drives a process of metaevolution — the evolution of evolutionary systems.

Rooke's developments also illustrate another kind of limit for artificial aesthetic evolution. It seems that as the formal models involved become more complex, more dynamic, and more aesthetically "rich", they also become more similar to the biological structures they imitate. As aesthetic evolution becomes more powerful, and its evolved artefacts become more complex, they may also become more life-like. At some (mythical) point, the artwork attains a kind of autonomy, a kind of life: the human artistic process will have finally exceeded itself and made something else, something fundamentally a-human (or posthuman). At this point (if

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<sup>26</sup> Kevin Kelly, *Out of Control*, 341.

<sup>27</sup> Steven Rooke, (srooke@concentric.net) "re: brief followups." Email to Mitchell Whitelaw (mitchellw@spin.net.au). 12 Aug 1998

not before) the evolved aesthetic object slips beyond the frame of "art" entirely: if it meets our current benchmarks for life and can replicate, adapt, evolve, and serve its own interests, there is no reason why it should stay mutely on the gallery wall, or on the artist's website, for the edification of humans. It may have been bred to please a human aesthetic, but if it is sufficiently dynamic and adaptable, it may go its own way.

As unlikely as this development may seem, as a limit or an endpoint it is projected even within current breeders. Metacreation involves the definition of an evolutionary domain within a controlled, computational space, but what it wants above all is surprise, novelty, to be exceeded. It shifts creative agency away from the active individual will, towards a more passive collaboration with formal and computational structures. It does so, perversely, as a way to amplify creativity, to extend creative capacity, to move "beyond [human] imagination". In the process, it moves towards a point where the created object peels away from human intent, becoming alien, unintelligible. The images evolved within Sims' and Rooke's systems already have this quality: their evolved equations are so dense as to be incomprehensible; their intricate algorithmic surfaces signify not so much the artist's hand or intention as the image's own formal structure and its generative process. The only footholds for conventional forms of meaning here come from the evolutionary and spatial metaphors around the process itself: Rooke gives his images titles such as *In the Beginning* and *Through Caverns Measureless*.<sup>28</sup> In the landscape-like aesthetic that Rooke pursues, the images themselves mirror the abstract form-space or "hyperspace" which they inhabit.

Finally the aesthetic object dissolves within the process and its subjective desiring-loop; pure potential becomes an end in itself, as if at this formal endpoint for human creativity, all that is left is the desire for more. Metacreation folds back on itself.

The extreme rhetoric and the somewhat bizarre implications of these systems suggest that they are extreme examples of the reconfigurations of creative agency occurring within new media arts. However it can be argued that the underlying drive of these breeders, for an extended or amplified creativity through a coupling of human agency with a computational or automatic process, is at work throughout new media art. The seeds of the same desire for generative excess are clear in other algorithmic and combinatorial approaches to both visual and aural media. They are more subtly evident wherever a computational process facilitates some kind of synthesis, gives us something "extra", or something unexpected. These systems illustrate a kind of limit case for these moments, showing what happens when creation becomes abstracted into metacreation, and the pursuit of a kind of absolute creativity.

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<sup>28</sup> Steven Rooke , "Online Portfolio." Available: <http://www.concentric.net/~srooke/portfolio.html>, 7 August 1998.

