

# Breeding Aesthetic Objects: Art and Artificial Evolution

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## Abstract

This paper presents an account of the work of visual artists applying artificial evolutionary techniques, addressing the implications of these techniques for artistic practice. It examines the forms of artistic or creative agency found within the field, the nature of the evolved aesthetic object, and the possible limits to this work.

## 1 Introduction

Computer science investigates, theorises and formalises the operation of the paradigmatic technology of our time. It also pursues the applications of that technology; the ways in which it is used, and might be used. The products of computer science make their way in the world, and are applied and mis-applied according to dynamics of individual whim and collective desire; the Web is one work of computer science which has made a dramatic impact on (Western) society at large, thanks to the collective interest which it has attracted. A standard for online information delivery has given rise to an entire culture, or sub-culture — one which will continue to influence successive waves of technological and cultural development.

An important premise of this paper, then, is that the objects of computer science are actively involved in the wider dynamics of Western technological culture. Here, a very particular instance of this involvement is considered: the application of techniques of artificial evolution in the creation of works of art. Upon close examination this small, somewhat obscure intersection of artificial evolution with art-making raises a variety of interesting issues. Within this intersection we can observe implementations of artificial evolution with peculiar properties; systems which reflect the creative aims and aesthetic imaginations of the artists who use and design them. We can also observe the more abstract structures that surround and inform these systems — the notions of evolution, creativity and the aesthetic object, the biological metaphors, the ideas of creative agency — as well as the aims and desires which propel them. From the perspective of a student of art and culture, we can ask, what kind of creation is this? How does an evolved aesthetic object operate as an artwork? In what sense is the “breeder” of such an object an artist?

An analysis such as this is more usually found in a humanities context, under the label of “cultural studies” or “new media theory.” It is presented here as a kind of field report: artificial evolution has moved beyond the disciplinary boundaries of computer science, and become involved in the melee of cultural and artistic practice;

what follows is an attempt to return an account of its cultural and artistic implementations (and implications) to the scholarly community most closely involved with the invention and development of the technique.

## 2 Breeding Aesthetic Objects

### 2.1 An Overview of the Field

The historical lineage of artificial aesthetic evolution begins with Richard Dawkins, who devised “Biomorph Land”, a program in which the user can guide the “evolution” of generations of graphical stick-figures. Dawkins describes his experiments in “Biomorph Land” in his popular work on Darwinian evolution, *The Blind Watchmaker* (1987, p51-74). While the evolution of the Biomorphs is based solely on their graphical appeal, this breeder is well outside the context of art practice. Within *The Blind Watchmaker* it is used to support Dawkins’ argument for the power of cumulative selection, as a digital demonstration of the capacity of the evolutionary process.

Nonetheless, Dawkins’ Biomorphs were to help inspire a succession of artists to take up artificial evolution. During the late eighties and early nineties William Latham, in collaboration with programmer Stephen Todd, created software for synthesising, mutating and evolving three-dimensional forms — in the artist’s words “ghosts of sculptures” — which he exhibited internationally as cibachrome prints and video animations (Todd and Latham, 1992). His first major exhibition of evolved work, “The Conquest of Form” (1988-89), organised by the Arnolfini gallery in Bristol, toured UK and German galleries and museums including the Natural History Museum in London and the Deutsches Museum in Munich. Despite gaining wide critical attention, Latham has declared himself “dissatisfied” with the art scene and is no longer active within it (Computer Artworks, 1998). After a second touring exhibition in 1991-92, and the publication of a book on his work with Todd (1992), he co-founded software and animation company Computer Artworks in order to develop his work “in a popular form for the mass market.” (Computer Artworks, 1998)

Inspired in turn by the work of both Dawkins and Latham, American animator, artist and a-life researcher Karl Sims developed software for the evolution of two-dimensional images around 1991. Sims presented *Genetic Images*, an artwork using this software, in 1993 at Austrian electronic art festival Ars Electronica, and in an installation at the Paris Centre Georges Pompidou the same year. Running in real time, Sims' work allowed museum visitors to act as a collective "selector" for generation after generation of evolved images. The images themselves showed that graphic objects of remarkable complexity, and some of remarkable beauty, could be generated using evolutionary techniques — see for example Sims (1991, 1993a).

The work of Sims and Latham continues to be influential; the years following publication of their work have seen a number of artists and computer scientists pursue the approaches their work sets out. Projects following Latham's use of procedural/iterative constructive geometry include Australian artist Nik Gaffney's *Mutagen*, a form-breeder which allows both user-driven and autonomous evolution (Gaffney, 1998). Also in this category are Andrew Rowbottom's *FORM* software (Rowbottom, 1998) and *Cybertation* and *Dancer DNA* by UK multimedia collective The Zen Room (The Zen Room, 1998). Others including American artist Stephen Rooke, veteran "algorist" Kenneth Musgrave (Musgrave, 1998), Dutch a-life researcher Peter Kleiweg (Kleiweg, 1998), 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 (Mount, 1998).

## 2.2 A Case Study - Stephen Rooke

These breeders can be treated, as they are above, as technical objects with particular characteristics, and art objects (or art processes) with names and dates. They can be readily identified, described in this way. However as suggested earlier, there are more detailed structures to be considered, and more interesting interplays of the technical and the creative. In an account of the work of one contemporary artist working with artificial evolution, some of this detail is made apparent.

In 1991, equipped with a graphics workstation, an interest in ecology and a background in geology and graphics programming, Stephen Rooke set out to create a graphical ecosystem simulation. Quickly realising the enormity of the task, he turned instead to the artificial evolution of images. Rooke describes himself as an image-breeder "in a tradition inspired by evolutionary art pioneer Karl Sims." (Rooke, 1998a) Like Sims, Rooke uses a "genome" constructed from a grammar of mathematical functions which are evaluated to produce an image; variation is induced in successive generations

through random variation ("mutation") or the combination of two existing genomes (sexual reproduction). The only significant technical differences between the system used in Sims' *Genetic Images* and Rooke's work are in Rooke's larger grammar of mathematical functions, including some which generate fractals.

This grammar is clear in Rooke's images: many of them resemble fantastic landscapes, with the familiar swirls and filigrees of Julia and Mandelbrot fractals sweeping into the distance. They are brightly coloured and extremely detailed, layered with complex, intersecting structures receding into infinity. Their names are just as expansive: "In the Beginning", "Primordial Yearnings", "Through Caverns Measureless", "The Rapture of the Deep". (Rooke, 1998b) While Sims seemed interested in communicating a sense of evolutionary process with the open interactivity of *Genetic Images*, Rooke's practice is solitary, focused on the resulting image. The personal nature of Rooke's approach distinguishes him within this field; rather than a calm aesthetic exploration, Rooke's search is a passionate process, strongly linked to a mystical or metaphysical vision:

Images evolve that look like places I see in my dreams, sometimes complex landscapes I can fly through, sometimes evocative forms that seem familiar, just beyond the edge of recognition. ... I have seen these shapes and places before, in dreams, in altered states, in rocks, landforms, forests, arthropod shells, galaxies, in microscopes. (Rooke, 1998c)

Rooke frequently describes his process in terms of familiarity and its own urgent momentum:

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.

Here Rooke also indicates the scale of the evolutionary process and something of his own role as patient selector, who in the quote above is rewarded — struck — by an image.

Rooke's background in geology is evident in the language he uses to describe the image-evolution. Rather than start from primordial "scratch" for each image, Rooke begins with "digital amber" — genomes already evolved to a certain degree of complexity. He likens this genetic honing-down to the evolutionary "shakeout" that reduced biological diversity after the proliferation of the Cambrian period. Metaphorically, Rooke is locating his work within a progressive

evolutionary flow: rather than the fast, cheap diversity of an initial evolutionary boom, he is interested in the long haul, the slow evolution of higher orders of complexity. As the quote above indicates, the scale of this evolutionary process, the number of “generations” an image embodies, has its own appeal.

This evolutionary language illustrates one of the two dominant metaphors involved in Rooke’s work. The other involves a space — or rather, a number of spaces. The notion of parameter space is often used in discussing the products of artificial evolution; given an artificial genome with a certain number (n) of variables, the potential results can be imagined as occupying an n-dimensional space. This spatial metaphor is used throughout the lineage of artificial aesthetic evolution — notably in Dawkins (1987) and Todd and Latham (1992). In Rooke, the static, finite notion of parameter space becomes a more expansive “image hyperspace”. This change is technical as well as metaphorical: in the open, algorithmic genetic structure Rooke uses there is no fixed number of variables; a mutation can add or remove variables and alter the dimensionality of the genome’s parameter space. In Rooke’s writing however, “image hyperspace” becomes far more than a mathematical figure. He links it to Terence McKenna’s notion of an “invisible landscape”, an inner, imaginary space. In a discussion of a sensor-driven interface that would allow a more intuitive process of image selection, Rooke suggests that “Something like this should lead eventually to ... a much more fluid, interactive, richer way to pull images out of [people’s heads | image hyperspace].” (Rooke, 1998d)

### 3 Breeding and Creation

#### 3.1 Creative Agency and the Breeding Process

Rooke’s work begins to raise some interesting questions regarding the evolutionary process, the role of the artist and the relation of the two. What kind of creative agency, or creative will, is at work in these breeders?

In the work of artists such as Rooke and Latham, creative agency seems initially to operate in a fairly conventional way. Artificial aesthetic evolution is the “process”, and the aesthetic result, in the form of a digital print or video tape, is the “product”. However further investigation reveals a more complex relation of process, agency and “artist” status, here and in other breeders.

Todd and Latham (1992, p209) discuss the way their “evolutionism” “changes the role of the artist in creating an art work.” Here that role is twofold, involving “the creation of generative systems and structures” on one level, and “the selection of specific forms and animations” on the other. While the authors

anticipate that these roles might be performed by different people, such that the artist’s role becomes “less clear”, they vigorously distance themselves from any such confusion. Latham reactively stakes a claim for ownership of “evolutionism”, and a kind of conventional artistic status. Todd and Latham (1992, p12) also introduce an analogy for this twofold artistic role which suggests another important side to the constructions of agency operating in these systems. “The artist first creates the systems of the virtual world ... then becomes a gardener within this world he has created.” The authors frequently refer to these roles simply as “artist creator” and “artist gardener”.

This “artist creator” role suggests a kind of amplified creativity at work in artificial evolution: here the artist creates vast “gardens” of aesthetic potential. 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.” (Kelly, 1994a) To one reviewer Latham’s work suggests “anxiety... in the face of a pervasive god-like omnipotent fantasy, provoked by the possession and control of powerful technical equipment.” (Barter, 1992) Latham’s depiction of himself as the “creator” of a virtual world replete with organic form certainly suggests such an “omnipotent fantasy”.

However the shift that Latham describes from “creator” to “gardener” is equally revealing. In formal terms this switch in roles implies a shift in frame of reference: the “systems” that for the creator were explicit constructions become for the gardener implicit, expressed in the particularities of form they allow; the gardener works inside the created world. It seems that the rewards of aesthetic evolution come when the artist gardener breeds something new, interesting, or somehow unexpected. The joy of the “gardener” comes from being surprised in the garden, confronted with the autonomy of the evolved form - but the “creator” at once recognises it as one of “his” own, a manifestation of the structures already set down.

In Sims’ *Genetic Images* the artist’s agency is less actively constructed. Control of that process is relinquished, turned over to the work’s audience: Sims stays in the “creator” role, defining the formal structures underlying an aesthetic space which others explore. The composite or collaborative agency this suggests, the same complex agency that threatens Latham’s sense of his own status, is something Sims explores with more enthusiasm. He describes his installation as “an unusual collaboration between humans and machine” which “permits the creation of results that neither of the two could produce alone.” (Sims, 1993b, p404) Sims actively questions the resemblance between more conventional creativity and artificial evolution, ultimately identifying *Genetic Images* with evolution’s paradoxical designer-free creativity, a creativity of “accident” rather than “good”. He speculates that the work will “challenge yet another aspect of our anthropocentric tendencies” and demonstrate the “power

of the evolutionary process in general—in simulation, as well as in its many forms in the world around us.”

Sims’ appeals to a generalised evolutionary creativity begin to dissolve the role of the individual user or selector — just as in *Genetic Images*, an individual’s sequence of preferences might be absorbed by a longer-term, more collective process of evolution. The importance of the subjective process of “breeding” aesthetic objects cannot be neglected, however. As Stephen Rooke has indicated, the process begins to assume its own momentum: “I can’t stop. There is something compelling about this process...” (1998c). The response of the normally staid Richard Dawkins is even more remarkable: “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.” (1987, p60)

Clearly, this process engages those who use it in a remarkable way; we might speculate as to how this engagement operates. 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. (Sims, 1993b) Here, creative variation is “succinctly executed by the computer” in the form of a random mutation. 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 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: the “creative” process is extended into an endless deferral of its object. An analogy can be made 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. Perhaps the strength of the desiring-loop these works set up explains the responses of Rooke and Dawkins.

### 3.2 The Evolved Aesthetic Object

How then do the peculiarities of this creative process, and the creative agency it involves, influence the way that the products of artificial evolution are interpreted as works of art? As this rush of “accelerated evolution” feeds itself, it risks rendering its aesthetic objects meaningless. In this overflow of image-material, how

can one mutant claim more significance than another? When evolution is this fast, and this easy, how do we evaluate its results?

It is not only the nature of the process that begs these questions: taken at face value, the images produced by Rooke and Sims’ breeders are lurid bits of abstract computer art. The formal-procedural grammar that underpins their images is a-scalar; a single image is an arbitrary, infinitely detailed window in an infinitely large co-ordinate plane. While a rendering of an image at a certain resolution might produce something resembling a kind of decorative abstract painting, it will have neither the materiality or the gestural quality, the mark of human action and agency, of such a painting: like a fractal, it recedes forever within the frame and extends indefinitely outside it. These products of aesthetic selection represent a strange coupling between an a-scalar, a-human generative process and a human aesthetic perception. Kelly (1994a) describes Sims’ images as “mirages... of an alien beauty”; however significantly the “beauty” these artists breed often involves a move away from the inherent strangeness of their generative language and towards more conventional modes of representation. Sims’ face-like example seems to demonstrate an urge to find an image of the human, a mirror, in these vast abstract fields. In one sense Rooke’s account of his move towards more illusionistic, landscape-like images shows a similar desire to find a familiar pictorial language. Images such as *In the Beginning* and *Skaters*, found on Rooke’s website, illustrate the tension between formal generative elements (the distinctive fractal curls, flattened and stretched throughout the images) and representational convention (the horizon line, the sense of illusionistic depth). Rooke’s work also shows very clearly how the metaphors attached to the breeding process inform its products. The increasingly “spatial” nature of Rooke’s images resonates strongly with the other linked spaces he discusses — image-hyperspace, inner imaginary space, and McKenna’s “invisible landscape”. In fact it seems Rooke is trying to depict in his images the very “space” he imagines them to inhabit. As well, his images operate literally as spaces, spaces in themselves. A vast, high-resolution print of the image swallows the viewer up:

I suppose I am known as something of a fanatic about image resolution, or detail. For me, there is never enough. I want to print these images at the largest size, with the finest resolution and quality available. ... Picture seeing a large mural from a hundred feet away. As you walk closer to it, you see increasing detail - right up to the limit of your vision 12 inches away. (1998c)

The same sense is evoked as Rooke projects slides of his works onto a group of dancers: “When people enter the images, sometimes a phenomenon happens where the dancer feels like they’re snapping into and out of the image. (‘am I in the image, or is it in me?’)” (1998e).

Rooke refers to this technique as “slide immersion” (1998d).

It seems that as we try to ascribe significance to the evolved aesthetic object, it returns us to the evolutionary process. The biological and spatial metaphors which frame the work of Rooke and Latham come from the process itself; their artworks are perhaps best interpreted as self-referential explorations — mystical depictions of the imaginary spaces of genetic potential, in the case of Rooke, and slightly grotesque meditations on organic form, in Latham’s work. In one sense Latham is unusual here in that he offers a subtext to his own work that works against the positive, expansive sense of evolutionary potential that characterises the work of other artists. He describes his work as “a parody of genetic engineering” and a comment on “the wanton destruction of the natural world.” (Todd and Latham, 1992, p207-8) Elsewhere he is quoted as arguing that his work “reminds people of things that they’d rather forget” such as “viruses, cancer [and] bodily processes.” (McClellan, 1998) In a strange inversion, Latham uses images of an artificial biology to “remind” us of the real thing.

## 4 Limits

Throughout this field there is a sense of excitement at the potential of aesthetic evolutionary processes. All of the artists discussed here remind us in their writing of the extent of the genetic spaces, and hyperspaces, which their systems explore. Kevin Kelly, writing on Sims’ work, describes his system as accessing “a universe ... of all possible pictures.” (1994b, p340) This universe supposedly contains “all shades of rose ... the Mona Lisa, and all Mona Lisa parodies ... the blueprints of the Pentagon” although of course the evolved images Kelly sees are “amorphous blotches, streaks, and psychedelic swirls of colour.”

Kelly prompts the question, do the image hyperspaces of Sims and Rooke actually contain all possible images? Given the open-ended structure of their genetic code, this may be difficult to determine formally — in any case such a determination is outside the scope of the current investigation. However the images themselves suggest that, so far, a fairly limited portion of this image space has been explored; no Mona Lisa has yet emerged. Rather the images retain a distinctive algorithmic aesthetic; the generative raw materials of their “genomes”, the libraries of functions they employ, combine (and recombine ad infinitum) but the aesthetic quality of the images remains relatively unchanged.

Instead of a boundless genetic space, access to “all possible pictures” (or forms), it seems that these systems set out their own specific aesthetic domains. The structures of the artificial genome, its rules of mutation and reproduction and its means of expression combine to give rise to a particular aesthetic. While this phenomenon makes the expansive evolutionary rhetoric

that appears around these systems less credible, it should not be taken as an artistic failure. Rooke’s work shows how the aesthetic qualities of the evolved algorithmic image interact fruitfully with the artist’s own imagination. The fractal structures in Rooke’s images are related to the sense of landscape which he pursues; the landscape metaphor links in turn to the figures of inner imaginary space and computational image hyperspace. Similarly the infinite detail of the algorithmic image-surface feeds into this mixture of spaces, as each image becomes a boundless space in itself.

The evolved forms of William Latham’s work provide another example of this phenomenon; here the genetic structure has been designed to give rise to particular phenotypic forms: twisting spirals, branching and recursive structures, tentacles and ribs. The evolved results are limited in their variety, but have a distinctive emergent aesthetic; a combined product of the artist’s design of the underlying generative structures, and the aesthetic selection guiding their evolution. The considerable success of Latham’s work shows that a specialised, and in many ways limiting genetic structure can give rise to a highly individual aesthetic.

Nonetheless the sense of potential that the evolutionary process offers remains palpable in this field. Rooke continues to work on a new genetic structure, one based on Sims’ later work on the evolution of behaviour and locomotion (Sims 1994). This directed graph genome is a more dynamic structure, resembling a genetic network; Rooke suspects that it “will be capable of much richer evolution.” Rooke’s plan suggests another interesting limit for aesthetic evolution; in a quest for aesthetic richness and variety, the formal models involved seem to become more complex, more dynamic, and 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 may attain a kind of autonomy, a kind of life: the human artistic process will have finally exceeded itself.

## 5 Conclusion

A computational technique — artificial evolution — becomes an artistic technique. Out of this transition a set of concrete artefacts, artworks and software, emerge. However less concrete structures emerge as well: the concepts, the metaphorical structures and the creative aims and ambitions which surround and inform its application. Through these more abstract structures, we can observe the ways in which artificial evolution intersects with artistic practice, with the conventional categories of “work” and “artist”, with notions of creativity. We can also observe some of the paradoxes at work in the field, the tensions between its expansive rhetoric and its aesthetic results.

Even as it functions, in part, within artistic practice, artificial evolution challenges it on a number of fronts. The role of the artist alters dramatically; the individual creative will is complicated by its engagement with the evolutionary process; the evolved artwork itself functions in an unconventional way. At its limit, it seems to promise an art which moves beyond human will entirely — one which may be impossible to understand as “art” at all.

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