Visual Blends: A Computational System Exploring Digital Creative Spaces

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ABSTRACT

The focus in this paper is the application of evolutionary computing processes in the generation of artworks. I shall ask questions such as, to what extent do artists re-interpret their practice through the context of programming languages, theories of artificial life, or the metaphors they use. Reference will be made to models of creativity, for example, conceptual blending, which may inform our understanding of art systems that evolve over time, exhibit emergent behaviour and how semantic and syntactic issues arise from such processes.

Reference will be made to the development of an autonomous, evolutionary drawing system which combines traditional art studio practice (drawing, painting, montage) with computational computer processes. An important aspect of this research is in defining the high level concepts by which the system carries out artistically significant analogies. The paper will discuss how metaphor, analogy or similarity is relevant to defining relationships between the domains (classification of images) in a computational, emergent system.

Keywords

Art, Evolutionary computing, Semantics, Metaphor.

CONTEXT

In 1966, the Experiments in Art and Technology group was founded in New York by Billy Kluver who stated: "That the goal from the beginning was to provide new materials for artists in the form of technology" [1]. In 1968, an exhibition called 'Cybernetic Serendipity', at the ICA, focused on the ideas and technologies that linked artists and scientists and how the notion of open-ended computer behaviours might lead to unexpected art outcomes generated by machine systems. More recently, books such as "Metacreation: Art and Artificial Life" by Mitchell Whitelaw have focused on ALife (AL) artists. Eduardo Reck Miranda illustrates how he combines the modeling of both physiology and abstract musical ideas: "Alife is a discipline that studies natural living systems by simulating some of their biological aspects."[2] "Information Arts" by Stephen Wilson gives a summary of some of the many types of interdisciplinary creative (computer / art) work from the robotics of Ken Rinaldo, the intersection between the physical body and technology in the performances by Stelarc, to the visual computer generated algorithms of Karl Simms. The research outlines many ways in which a computer can be used to create art from utilizing the bounded components of Photoshop to devising personal metaphors and syntax in an idiosyncratic software design.

An idiosyncratic approach towards computer art making was adopted by the artist Harold Cohen about thirty years ago at a time when pre-existing software interfaces did not exist. He asked questions about his perceptual and cognitive art practice and how it might be computationally modelled. He wove traditional art practice, computer science and the semantics of code with philosophy to produce an '*investigative tool*' called Aaron, using Artificial Intelligence processes. "Artificial intelligence (AI) is a cloth woven from three academic disciplines – psychology (cognitive modelling), philosophy (philosophy of the mind), and computer science – with further strands from linguistics, mathematics, and logic". [3]

Aaron draws and paints and is a knowledge–based program where decisions are represented in rule form based on pre-defined boundaries that model, specifically, representational drawing. Aaron selects which subject to paint from the internal symbolic model that has been provided by Cohen (i.e.: a portrait or a still-life). The system's hierarchical descriptions include direct references to making a two dimensional image with semantics that refer to *PLANNING* the picture and planning involves *LINES* and line refers to *CURVES* and *SECTORS* that signify potential pathways for the line to take. Cohen is using familiar visual language components so that:"The encoding and decoding of messages requires access to the same code-book by the image-maker and the image-reader."[4] Cohen states how he is not making art but, exploring for example the boundaries between lines having meaning or not. He uses the term '*standing-for-ness*' instead of: "words like "symbol", "referent", "metaphor", "sign", and so on: words which abound in art theory and art history. An image, I have said, is something which stands for something else."[4] However, by using a familiar coded representation or model of the world, Cohen is, to a certain extent limiting the boundaries of potential meaning to be explored in his investigation and in the audience mediation.

ALife (AL) differs from the knowledge–based approach because it has rules that do not hold a model of the real world, instead, these systems are based on complex interaction of objects in the system. Jon McCormack states: "Many Alife simulations make the distinction between genotype and phenotype. The genotype is commonly referred to as 'code' that creates the phenotype in an interpretation analogous to the view of DNA as a 'code'. [5]. The phenotype is the visual form that the viewer can see on the screen and it is resolved partly by the code structure that defines it and as a direct result of the dynamic interaction over time with other forms in the artwork. This evolutionary approach enables potential for greater emergent behavior in an open-ended system design that allies creativity with life. But, does this mean that an AL computer / artist collaboration is any less bounded in the '*code-book*' of

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image-making and mediated communication of meaning than a Knowledge-based system such as Aaron?

VISUAL BLENDING OF MEANING

By studying the metaphors used by AI/AL artists I shall discuss the visual ideas that are communicated and in what ways they are bounded in meaning and creative value.

Arthur Koestler, a notable writer on creative processes, quotes Karl Mach who describes an analogy for relaying the idea of being aware of the solution before the problem, similar to Aaron having an image at the outset of the drawing: "The subject who wishes for a tree to be laid across a stream to enable him to cross it, imagines in fact the problem as already solved….he proceeds from the target-situation to the given situation, along a road he will re-trace. [6] The point here is that the search process for solutions to creative problems may be enhanced by using methods that are less bounded by prescriptive rules. Evolutionary computer algorithms may potentially offer artists more flexible search processes and emergent creative behaviour.

The artist and historian John Willats draws on an interesting analogy between language and visual art. Willats refers to modern linguistics and two definitions defined by Fernand de Saussure who stated: "Synchronic linguistics studies the structure or "state" of a language as it exists at a given time within some particular group; while diachronic linguistics studies the changes in language over time." [7] Aaron has information for constructing representational form, adopting a Synchronic approach that represents a particular style. AL is possibly analogous to diachronic principles, because a system evolves over time and therefore adapts to novel developments / interactions.

Cognitive processes are such that: "The solution does not proceed in a single line from target to starting point or vice-versa, but by a branching out of hypotheses – of possible strategies – from one end, or ends, until one or several branches meet. [7] In AL art, the systems typically do not begin with a pictorial model at the outset, so they have a greater emergent potential embedded in their code design. Contemporary languages allow for detailed class interfaces for individual objects. For instance, Java supports the dynamic interaction of objects as containers for ideas or the code structure for a genotype as in AL.

This in theory should facilitate a greater ability for the artist / computer collaboration to be more adaptable to potential combinations of ideas and aims. The artist and writer Paul Brown wrote: "The artistic mind is a 'butterfly' mind that can fly from flower to flower, from source to source, with little respect for logic or scholarship". Therefore: "Theory does not (necessarily) inform creation, although creation, of necessity, informs theory". [8]

Koestler refers to 'stepping stones for thoughts' which are the spaces where the artist compels the audience to exert its imagination. The suggestion here is that creative computational art systems should leave room for interpolation both during the execution of the algorithms and in the perception of the audience. For a system to be about creativity then maybe greater consideration needs to be given to how ideas or metaphor are explored. Lakoff states: "The essence of metaphor is understanding and experiencing one kind of thing in terms of another" [9]

There are many examples where visual metaphors for AL art are grounded in forms derived from molecular structures and biological cells and then united with scientific theories. The theories have developed software models for genetic coding, particle systems, or Embryogeny as in biology which is used in computer science and art for mapping genotypes onto phenotypes. In Biotica, Richard Brown uses biological semantics for his cell structures called 'Bions' which are like particles, with rules regarding their DNA, which are the genotypes expressed in cell-like phenotypes. The inspiration for both the art and science of 'Biotica' included an idea common to AL art which is Autopoiesis systems theory developed in 1970's by Humberto Maturana and Francisco Varela. It explores the notion of how living systems co-exist in a fine balance between the order and chaos modelling of life and cognition. A computer model called Cellular Automata (CA) is based on the Game of Life by Dawkins and manifests itself in the work of Paul Brown's 'Chromos' and Jon McCormack's Eden World projection, both of whom use patterns similar to Islamic tiles as an aesthetic expression of CA. For McCormack it is a lattice work populated by his sonic agents, rock and bio-mass but, the tiles are a means of metaphorically engaging with an alternative aesthetic than the common theme of biological forms in AL: "These minimalist geometric textures suggest abstract landscapes rather than the iconic or literal individual representations that are common in many Artificial Life simulations. "[10]

So, even artists using AL principles perceive limitations in their methods and acknowledge sacrifices in the aesthetic appearance of the visual forms and the potential for emergent meaning from the separation of genotype and phenotype which is not a natural state in nature. But, the design of dynamic interactions in an autonomous assessment process is considered to be a closer parallel to life and possibly the notion of creativity than more determined computer processes. McCormack states that: "What we would like is a system that combines the ability to subjectively evolve towards phenotypes that people find' interesting' without the bottleneck and selection problems inherent in aesthetic evolution".[10] Possibly the processes employed limit visual and metaphorical communication in AL work which are the elements that compel an:

"audience to exert its imagination. " [6]

Conceptual Blending (Fauconnier and Turner, 1990's) offers a model of how 'mental spaces' or concepts are dynamically mixed. Many of the ideas can in principle be linked to Lakoff and Johnson (1980) and their work on metaphor. Together, these writers explore both the cognitive and physical nature of metaphor. They discuss how we associate concepts and how these evolve culturally and physically as in the work of The Neural Theory of Language by Srinivas Narayanan (1997). Lakoff writes about the multiple layering or interaction of concepts which is considered to be necessary for creative thought: "even our deepest and most abiding concepts – time, events, causation, morality, and mind itself – are understood and reasoned about via multiple metaphors. In each case, one conceptual domain (say, time) is reasoned about, as well as talked about, in terms of the conceptual structure of another domain (say, space)". [9]

As an artist, evolutionary computational processes offer the possibility to define idiosyncratic, dynamic layering of concepts in the form of objects within a system. The resulting cause and effect of blended, 'mental spaces' results in emergent visual ideas. Lakoff and Johnson state that new ways of understanding or being

creative / novel / innovative are: “not miraculous; they do not come out of nowhere. They are built using the tools of everyday metaphorical thought, as well as other commonplace conceptual mechanisms.” [9]

When studying for example Synthetic Cubism, there is a synthesis of commonplace and cultural objects and concepts which when united (blended in a generic space) they inferred new meanings / genre in art. The ‘Guitar’ (1912 -13) by Picasso blends painting and sculpture in one space, mixing the two genres and found materials associated with everyday objects and then placing them in the abstract context of art. The juxtaposition of the commonplace and exploring boundaries of established disciplines is part of creative practice but, in this context it resulted in a novel approach. It has contributed to the cultural re-appraisal of the boundaries between two and three dimensional form and process in art. Margaret Boden discusses ‘conceptual spaces’ [11] as generative systems which may contain the rules of chess or at the turn of 20th century, the rules of painting and sculpture. Picasso’s tweaking of these spaces may be considered to have resulted in a ‘transformational’ creative act because he altered the rules for painting. Therefore, the potential for real emergence must depend on the design of systems that enable the cross-fertilization of ideas or concepts as opposed to pre-determined structures that set boundaries for generated forms or image-making.

In an AL piece such as Life Spacies (1997 – 99) by Christa Sommerer and Laurent Mignonneau, a form of ‘*counterfactual blending*’ (Tony Veale: ‘Creativity as Pastiche: A Computational Treatment of Metaphoric Blends with Special Regard to Cinematic Borrowing’) occurs, meaning a re-visiting of a familiar theme but interpreted in a new context without altering the general structure of our perception of living systems. Tony Veale gives the example of Romeo and Juliet revisited in the form of Westside Story. The premise of Life Spacies is the evolution of an ecosystem as analogous to ‘Art as a Living System’ which represents the dynamic of the audience/user and the system interaction. So, to what extent is this theme inferred visually and semantically? Living systems or evolutionary processes are bound in Victorian interpretations of survival of the fittest and more recent visualizations of bacterial growth or film footage of plants sprouting from seed to full form in five filmed seconds. The structures of this theme are not challenged but bounded by the evolution of phenotypes that are directly associated with abstracted organic creatures / plant-like forms. A direct semantic link between nature and code are encapsulated in the work of William Latham that began as the paper based *FormSynth* drawings but, later formed the foundation for *Mutator,* a generative computer system. His interest in biological forms resulted in works whose titles such as “*Mutations”* appropriately conjured the mutation and evolution of forms derived from nature. The Mutator interface allows us to ‘Marry’ forms, to ‘Breed’ them and the code has containers such as ‘LOBSTER’ structures who live out a life cycle of birth, ‘matures’, ‘decay’ and ‘dies’. This is designed on an Interactive Genetic Algorithm basis and therefore retains considerable control over the aesthetic outcome of the work. The difficulty in an autonomous system is controlling the aesthetic assessment process and still facilitating the layering of ideas and diverse visual outcomes.

Casey Reas’s at Ars Electronica 2003 discussed the importance of analogy and versatility of varieties of images being animated in an art work: “You can sort of move to different kind of spaces within time by selecting images in a different way. Computational it’s not very interesting at all but by carefully selecting certain images and cropping them in certain ways I create different rhythms and patterns in time. The code works on any image but I think it is only significant if it is extremely carefully selected.” [12] So, the value of this statement for me is in the idea that code can result in generic application of code semantics to different kinds of image input. The higher level definition for fitness in Reas’s autonomous systems enables the flexibility for adjusting to diverse subject content. He suggests a conceptual design that facilitates the separation of the underlying image input from the visual drawing behaviour in the animation MicroImage’. Therefore, allowing flexibility to accommodate subject/content changes.

A COMPUTATIONAL SYSTEM

The computational system under discussion in this section is autonomous, evolutionary drawing software which combines traditional art studio practice (drawing, painting, montage) with evolutionary computer processes. The computer / art collaboration begins with the physical, studio practice where images are made. The images are input into the Map Conversion Interface of the software as shown in Figure 1. The images are converted to Map objects as illustrated by the image on the right in Figure 1. All these images are held and categorized in the system as the foundation drawings for the animation. The Map Layer (Figure 2 on the right) evolves from one group of drawings to the next, selecting images from the groups and applying fitness criteria to their animation.

However, this evolving Map Layer remains invisible to the audience who see only the Animation Layer as shown in Figure 2 (on the left). The image on the right shows the system selecting and evolving between Map objects which include in this example, the Portrait and abstracted GasNets image categories. The drawing aesthetics are separate from the Map Layer but, they are semantically linked through the system design and syntactical code descriptions.

In order to get closer to the ‘*essence of metaphor’* I have taken a similar approach as suggested in the context of Reas, where the Genetic Algorithm powers the selection of images in the Map Layer and this layer is separated from the expressive drawing behaviours. This enables a generic means of working with diverse image content and drawing expression. Similarly, in traditional studio practice one can hold in the mind for example, two entities, one that relates to the image subject and its associated ideas. The other is what expressive and conceptual decisions you are making in order to communicate that image.

The groups of images are intended to be classified so that they contain a prototype for that group such as portrait but, there are sub-types that may be semantically linked to thumb print images or text conceptually reinforcing the idea of portraiture. The developing rationale for the structure of these ideas has partly been informed by George Lakoff and his work on ‘*categorization’* as a means of comprehending our experiences and ideas. This in turn is supported by using object orientated programming methods which enable groups of objects and events such as drawing behaviours to interact with each other. I employ genetic algorithms to achieve fitness assessments for the animation cycles. The process is influenced by books such as “the Blind Watchmaker” by Richard Dawkins who proposed “biomorphs” that held code which represented the DNA for forms. However,

unlike AL outcomes, I have not absorbed the ideas and externalized them using the visual metaphor of organic forms derived from nature.

In "Evolving Line Drawings", Ellie Baker and Margo Seltzer describe "Drawing Evolver": "a system that mates or mutates drawings selected by the user to create a new generation of drawings. The initial population from which the user makes selections may be generated randomly or input manually. The process of selection and procreation is repeated many times to evolve a drawing." [13]

Their paper references art systems such as those produced by Karl Sims, Latham and Todd. Sims provides a genetic code for defining colour or form. When he runs his computer program, the DNA of the images is altered and takes on a new appearance. The user then decides which are the most successful to include in the next generation. When you run the code and achieve the fitness or the rules/analogies that you stated, then the system is ready to mutate the next generation of bitmaps

From Ellie Baker's model I have taken the principal of including two drawings, or as I specify them, a starting drawing and a target drawing. The images are converted into Map objects in the Map Conversion Layer, which are then mutated in the Map Layer, producing populations to which a fitness measure is applied. The fitness measure may be the direct comparison of the number of black and white pixels in the starting and target drawings. However, when the fitness is reached (i.e. the starting drawing evolves towards the target drawing), I do not then interact with the system in order to select the next generation of drawings or to direct the path or search journey of the animation. The systems mentioned above depend on aesthetic decisions to be made by the user where as this research is developing autonomous ways of making these choices. Therefore, there has to be suitable high level descriptions that result in successful evolutions between image concepts regarding their classification (grouping) and drawing behaviours.

The Animation layer shown in Figure 2 on the left is what the audience actually sees on screen or as a projection. The Map Layer shown in Figure 1 remains invisible, it is there as a topological layer for the lines to map themselves to or propel themselves from. The potential of this design means that I have the ability to build explorative relationships between the drawing Animation Layer and the Map Layer which evolves the images I have input into the system. Should the animation reach 100% fitness for the algorithm, then it would in this scenario take on the form of the face before continuing with the selection process. At about 60 % one can begin to see the face emerging through the drawing as shown in Figure 2. However, similarity assessments are continuously being made based partly on group similarity descriptions. The drawings may break off and select another face to evolve towards or make the similarity decision based on visual drawing expression. A new target image may have similar drawing descriptions or similar visual behaviours which have emerged during the process of animation.

CONCLUSION

The creative interest for me is in the journey that the drawing takes during the animation. But, the challenge is in the descriptions that are defined in order for the animation to successfully reach fitness or break at a particular point. Gombrich presents a drawing in 'Art & Illusion' which shows a '*Rabbit or Duck?*' which is not, fully one or the other, yet our perception allows us to subtly perceive both animals in the same drawing. The visual play of meaning and content in this way is partly what may evolve in my system and I have to semantically tag images, so that they make successful, aesthetic and conceptual transitions.

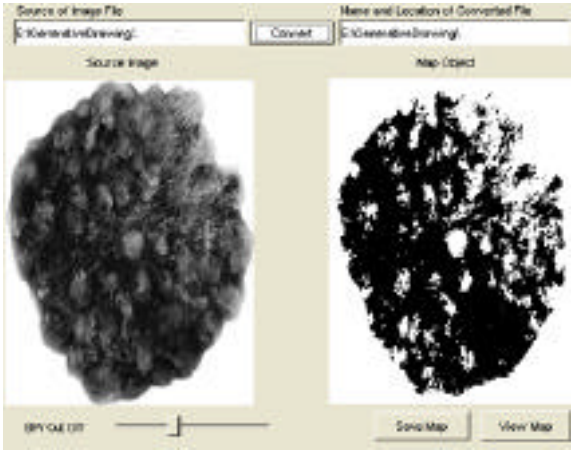

Figure 1. Drawing input and conversion to a Map object in the Map Conversion Interface.

Figure 2. A 60 % evolved Animation Layer screen shot (on the left). The start drawing (as above left in Fig.1) and a portrait image Map object evolving in the Map Layer (on the right).

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