Computer Graphics and Animation as Agents of Personal Evolution in the Arts

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ABSTRACT

The author addresses a number of issues related to the potential of computer graphics and animation systems to enhance or reenforce the process of artistic creativity and evolution. Various constraints imposed by computer graphics systems are explored and the major psychological characteristics of creative thinking are described. Issues are raised regarding the impact on these characteristics by the properties and process inherent in computer graphics and animation systems and their potential as agents for personal evolution in the arts.

Many claims have been made, particularly in the visual arts, regarding the effects of computer graphics and animation technologies on the creative process. Unfortunately, there has been very little empirical research either to substantiate or to refute these claims. Many artists and writers have articulated the apparent, positive effects of using computer systems to explore their ideas [1]. A few have taken a somewhat neutral position (i.e. there is little or no effect on creative productivity) [2], but there is very little documentation to be found regarding the negative aspects of making images with these new technologies [3].

The picture is further distorted by the relative infancy of these media. Relatively few writers or researchers have articulated the aesthetic issues that characterize images produced with computer systems. Those who have attempted to deal with these issues have concentrated primarily on comparisons with traditional media, with the articulation of novel properties and characteristics, with classification or with aesthetic experience. Even less material has been published from a psychological perspective. Almost no empirical research has been forthcoming.

The purpose of this paper is to attempt to clarify some of these issues and, in particular, to raise questions regarding the potential of graphics technologies for accelerating or improving the creative process and hence the evolution of the artist and the visual arts. 'Computer art' is characterized as either mimetic, derivative, innovative or emergent, and these terms are explained.

THE CHARACTERISTICS OF 'COMPUTER ART'

Until the last few years, these technologies have been available to only a few artists because of their high cost. With the increased democratization of the technology, artists are currently able to access software with 'high-end' functionality at relatively low cost on microcomputer systems. A survey of the aesthetic characteristics of work produced with computer systems will, for the most part, reveal that most of it can be classified into one of four categories [4].

The *mimetic* category consists of replications of works of art originally produced in other media, e.g. paint, silkscreen, film photography, etc. This is probably the most common result of initial experimentation with the technology. By attempting to replicate, emulate or imitate established and traditional artwork, the artist is able to determine the characteristics, limitations and appropriate methodologies for the new tools. The artwork should be seen as a function of this experimentation, not as new or novel. The attempt to emulate traditional methods will always fall short of its goal.

Derivative computer artwork has the properties and characteristics of traditional art forms (typically work produced in an existing style or school) and meets established or traditional stylistic and aesthetic criteria. As the artist begins to master the techniques, there is often a period during which he or she makes variations by applying the technology to variations of known conceptual and artistic situations. It is perhaps to be expected that an artist will try to extend his or her working methods and stylistic preferences to new technology or to work in an established stylistic framework.

The *innovative* class of computer artwork demonstrates novel techniques, content or imagery through alterations or changes to the existing computer graphics paradigm. Most often these are the result of the development of new algorithms, but they also may be manifest as novel forms of imagery, for example, in the work of the better-known artists in this field.

The result of this approach is that the work, however monumental in its technical achievement, usually falls short of that which it tries to emulate. If it does come close, and it may be excellent in its own right, it is generally no better than the original. On the other hand, evolution is often achieved by incremental progress, and innovation serves to push development towards major change.

Emergent artwork is characterized by the use of the 'unique' properties of the media. It is this last category that has proved so difficult to deal with, for we have few analytical perspectives (particularly aesthetic ones) by which to categorize and critique the work that results from the application of techniques unparalleled in traditional art forms.

What are the unique properties of computer graphics and animation? To summarize other writers on this topic: there appears to be a general consensus that the uniqueness of

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the media may be characterized by interactivity (direct, immediate feedback), simulation (virtual three-dimensional space) and intelligence (the capacity of the technology to incorporate rules and constraints in order to incorporate decision-making strategies).

These four categories may be used to classify artwork, but care should be taken not to apply them in a way that may invalidate the integrity of, for example, mimetic or derivative work, providing the purpose for their production is appropriate to the situation, e.g. during education and training, as an extension of traditional work or as exploration. The problem is that much work has been produced without any emotion, without any purpose (other than exploration of technique), without novelty, without meaning and without an appeal to a broad cultural context or indeed to human issues [5].

The Constraints of Computer Graphics Technology

With the introduction of any new medium, artists first must master the techniques of the medium and apply them to the solution of existing problems. This is often done by duplicating and imitating, stylistically and technically, traditional works of art. Indeed the very design of the technology is mimetic. The designers attempt to duplicate traditional working methods rather than to invent entirely new tools. This has even been extended to the development of a system designed to duplicate drawing with charcoal!

It is clear that the technology itself also imposes constraints on the aesthetic and stylistic characteristics of artwork produced in this manner. First among this list are the *hardware constraints*, and the most important of these are the characteristics of the hard-copy devices that are available, such as displays, film camera systems, printers, plotters, video technology and the like. These devices provide a very limited range of physical media with which to work, unless a process is developed to extend them or to interface them with other technologies, e.g. photography, ceramics or silkscreen.

In addition, to perhaps an even greater degree, there are *software constraints*, not only the particular characteristics of the system's primitive shapes, text, colors and attributes, but also the working methodologies. Every system is designed by a group of people who, through the combination of hardware selection and software development, leave their characteristic signature, and this signature often leaves its mark on the work of art.

In addition to the above, there are also *physical constraints*. At least for a significant part of the image-making process, the artist's body remains in a relatively static position, which limits the range of expressive gestures and movements available. The artist must maintain a high level of concentration on a bright, luminous monitor and must keep his or her eyes focussed in a narrow range.

In making the transition from traditional to digital media, it is important not to ignore the *emotional and intellectual effects* of working with computer systems. For the most part, artists report significant frustration while learning to use new and complex technologies, especially because the image-making methodologies required contrast sharply with those that they have used in the past and that form the basis of their working methods. The frustrations of not being able to express line, form and shape with the articulation that is available with paint and pencil probably have caused many an artist to reject the computer as a working tool. Breaking away from habitual techniques and replacing them with new ones often requires a painful transition. Many artists are disturbed by a medium that is so apparently logical in nature.

The Creative Act as Personal Evolution

Creativity may be defined as the transformational act of a human in the process of evolution [6]. Creative behavior occurs when there is a transformation or emergence of new ideas or artifacts resulting from a series of interconnected events. It is also the process by which the artist transforms him- or herself. In fact, it may be claimed that artwork is 'merely' a by-product of the process of personal evolution or restructuring. Rather than an end in itself, it is an indicator of the changes that have taken place during the reinvention of the self.

In a previous paper [7], I have suggested that there is a natural evolutionary process involved in the evolution of artistic constructs and skills, and that the hierarchical stages of personal development parallel the mimetic, derivative, innovative and emergent characteristics of artwork described above. These claims are made on the basis of empirical research using the Repertory Grid Technique.

First the artist must develop *skill*, becoming familiar with the materials and their characteristics. The artist builds a repertory of expressive techniques. These techniques are then *applied* to the solution of (usually familiar) visual problems. This step is followed by *novelty and innovation* as these techniques are combined with others or articulated by modification. Finally we may see the emergence of original elements, ideas or concepts. This emergence appears most often to be associated with moral concerns and constructs such as honesty and integrity.

For evolution to take place, for the emergence of the new, boundaries must be broken. For boundaries to be broken, there must be a degree of chaos or fluctuation in an open system. Artists often create chaos purposely in order to break out of their localized, conventional paradigm. Seldom do computer graphics systems have controlled randomness or chaos as a part of their design methodology (although it may often seem that way!).

The Characteristics of Creative Process

In 1926, Wallas [8] formalized the stages of creative process as preparation, incubation and illumination; these terms still are used today. In general, traditional approaches to the development of descriptions and explanations of creative behavior have been limited to reductionist analysis rather than holistic synthesis.

The traditional approaches to research in the field of creativity have generally been limited to

1) descriptions of the various phases or stages of creative process,

Table 1. Comparison of the stages of creative behavior.

Taylor	King
Expressive	
Technical	Mimetic
Inventive	Derivative
Innovative	Innovative
Emergent	Emergent

2) psychological and behavioral characteristics of creative individuals,

3) observations regarding the nature of creative artifacts, i.e. style and aesthetic issues, and

4) the effects of the physical and psychological environment on the outcome of creative behaviors.

There have been many attempts to model the creative process from each of these perspectives. I have proposed a single structural model of creative process [9] that subsumes these traditional approaches by using general systems theory (specifically Catastrophe Theory) as a modelling device. This model has been applied to a variety of problems in computer graphics and computer graphics education.

Creativity is a fundamental part of artistic activity, yet it remains a paradox at the forefront of contemporary inquiry into the nature of human thought. Creative behavior is a synthesis of intuitive as well as intellectual thought, and intuition is not readily open to reductionist analysis. It is characterized by a process in which associations are made among 'remote' facts, concepts or insights in ways that, at least on the surface, appear unpredictable and not always of the individual's volition. While creativity is teleological or goal-oriented, there is often an infinite variety of ways in which the final objective may be reached.

From a variety of different perspectives, psychologists have identified a number of characteristics of creative behavior, both in terms of individual personality characteristics and in terms of process. The most important of these are summarized below, and their relationship to working methodologies in computer graphics and animation is discussed.

The process of divergent thinking (the ability to process ideas from different perspectives and contrasting frameworks) is a key characteristic of the creative process as well as an important part of the creative endeavor. During the formative stages of creative exploration the artist explores both the external world and the inner self in a psychological framework of *openness*. This exploration requires a number of critical capabilities, in particular the *ability to tolerate ambiguity and chaos, sensitivity to problems* and *a high degree of spontaneity*. The creative individual must develop a mental and physical environment that facilitates this activity. For maximum creative productivity, ideas must be produced with *fluency, flexibility* and *originality*.

In *Perspectives in Creativity* [10], Taylor describes a slightly more elaborate set of 'creative dis-positions' that characterize psychological processes similar to those I have described. These he describes as expressive, technical, inventive, innovative and emergent creativity. Table 1 illustrates these ideas.

THE COMPUTER AS AN EVOLUTIONARY AGENT

The degree to which a computer graphics or animation system helps or hinders creative activity is of critical importance. At all stages of the creative process and during the evolution of ideas, we need the computer system to improve, supplement and enhance our articulation and manipulation of ideas rather than to cause mental, emotional or physical blocks to creative productivity.

From the start, we are working with a physical system that restricts access to physical and environmental stimuli. Because of this screen-centered activity, our mental faculties 'lock out', to a remarkable degree, our immediate surroundings. We are less likely to see or experience the environment that surrounds us. We are removed from the impact of other visual artifacts, tactile and auditory sensations and interaction with other people. The technology restricts our divergent thinking during the initial stages of idea development although it should be doing the opposite.

This process is intensified by the *interactivity* of the technology. We are seduced by its responsiveness. We lose a sense of time and place. Interactivity with an 'external' context coupled with the system's interactivity would appear to restrict the creative individual's opportunity to explore or to interrelate divergent concepts and images. In addition, computer graphics systems have significant expressive constraints. The tools available do not facilitate expressive gestures or tactile contact with the image. Hardware and software constraints may also have a negative influence.

On the other hand, the immediacy and interactivity of these systems provide a psychological framework much closer in some ways to that experienced by an artist during intense concentration during a production process. Computer graphics (and to some degree, computer animation) systems provide the artist with extended capabilities for improvement of both the fluency and the flexibility of image generation. They facilitate the rapid exploration of changes in image characteristics in both paint- and object-oriented systems, which are unparalleled in speed, flexibility and fluency by any other media. It is also possible to create, change and manipulate objects and process in ways that cannot be achieved by any other means. The artist can combine, rearrange and manipulate images from a wide variety of sources with great dexterity.

During the convergent stages of creative process (i.e. implementation) a similar situation exists. All of the individual's mental capabilities must be focussed on the process of synthesizing or 'distilling' ideas and concepts that have emerged (usually from the process of incubation and illumination). Again, current computer technologies appear in many ways to restrict the creative process at this point. The ease of production of many variations on a visual theme or pattern can serve to confuse the artist and make selection difficult. The artist also may become seduced into taking many of these variations seriously and may even be incapable of deciding what is important from such overproduction. On the other hand, variety, flexibility and ease of manipulation assist the associative processes, making it easier to combine remote visual ideas and concepts.

From these perspectives, the positive aspects of using digital systems are clear. Added to the above is the continued development of new modes of interactivity, representation and manipulation. Many of these new techniques come from advances in

computer animation and allied technologies such as CD-ROM as well as developments in hard-copy technology. We also can expect to see the development of a wider range of both input and output technologies. As hardware increases in speed and storage capability, accessibility to large databases of imagery, viewable as multiple images on screen, should improve significantly the initial stages of creative exploration. Fast, high-capacity fibre-optic communications links will greatly assist the cultural and crosscultural exchange of both imagery and data.

At the educational level, major advances in artistic and design training could be made. Unfortunately, there is virtually no *systematic, empirical experimentation* available that could form the basis of applying these technologies to the evolution of either technical or conceptual skills. There is an urgent need for such work, if only to arrest the haphazard, poorly conceived tendency in many art schools to submit to the first high-pressure salesperson who sets foot in the door. We need an international task force to design and develop appropriate approaches to these problems and to share concrete experiences and perspectives; otherwise the negative effects of technological change may overcome the positive. This should be done not to standardize but to provide opportunities for divergent approaches and innovative exchange.

As far as the individual artist is concerned, while personal statements about the effects of computer graphics and animation systems of personal creative change are useful, there has been no systematic effort to document and to articulate the issues surrounding the transition process, the effects of these systems on creative behavior or the evolution of technique and ideas. Computer graphics and animation can affect creative activity positively at every stage, by improving the initial, divergent stages of exploration, by providing the means for accelerating the manipulation and articulation of ideas and by providing innovative frameworks for the synthesis of original imagery and concepts.

References

1. Cynthia Goodman, *Digital Visions: Computers and Art* (New York: Abrams, 1987); A. Michael Noll, "Computers and the Arts: A Retrospective View", in *ACM SIGGRAPH 1982 Art Show Catalogue* (Boston, MA: 1982); Frank Dietrich, "Five Aspects of a Theory of Computer Art", in *Panel Notes: Aesthetics of Computer Graphics. ACM SIGGRAPH* (San Francisco: 1985).

2. John Pearson, "The Computer: Liberator or Jailer of Creative Spirit", in *Proceedings NCGA 1988* (Anaheim, CA: 1988).

3. Jack Burnham, "The Panacea that Failed", in *The Myths of Information,* Kathleen Woodward, ed. (Madison, WI: Coda Press, 1980) pp. 200–215; Kenneth Knowlton, "Why It Isn't Art Yet", in *ACM SIGGRAPH 1986 Art Show Catalogue* (Dallas, TX: 1986); Gene Youngblood, "A Medium Matures: The Myth of Computer Art", in *ACM SIGGRAPH 1983 Art Show Catalogue* (Detroit, MI: 1983).

4. Robin G. King, "Aesthetic Experience, Creativity and Computer Art", in *Proceedings NCGA 1988* (Anaheim, CA: 1988).

5. King [4].

6. Robin G. King, "A General Systems Model of the Creative Process", in *Proceedings of the 25th Annual Meeting of the Society for General Systems Research with the American Association for the Advancement of Science, Toronto, Canada, January 2–5, 1980* (Toronto: Society for General Systems Research, 1980).

7. King [4].

8. G. Wallas, *The Art of Thought* (New York: Harcourt, 1926).

9. King [6].

10. Irving A. Taylor, "An Emerging View of Creative Actions", in *Perspectives in Creativity,* Irving A. Taylor and J.W. Getzels, eds. (Chicago: Aldine, 1975) pp. 295–325.