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An Embryonic Scan of the Aesthetic Parameters of Technological Means

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Abstract

As the computer has an increasing impact on our daily existence through altering and enhancing the ways in which we do things, it is having no less an effect on the creation of contemporary art. For an increasing number of artists, the computer has become the means and/or site for making art. It is in the midst of this shift, involving the artistic utility and appropriation of technological processes, that questions arise of critique and aesthetic approach appropriate to this new work. Questions that, perhaps, portend a new route of inquiry.

Introduction

Aesthetics, embedded within axiological concerns of value, examines what is aesthetically valuable along with the attributable features that contribute to that value. Value, then, emerges out of the articulated specificities of the object of evaluation. Accordingly, it is the intention of this aesthetic inquiry to specify the nature and qualities of artworks created through the use of contemporary technological means. This inquiry begins by collecting and sorting some of the contemporary and historical ideas specific, and perhaps, foundational to such an investi-gation. The present day artistic utilization of computational means, following a long lineage of artistic *appropriation* and *redefinition* of technological utility, charts an inescapable dialogue between the artists, the means and the epistemological world in which they exist.

This text is to be considered by the reader as a demonstration of very broad strokes scanning the parameters relevant to such an investigation. It is concerned with computer technology and with the nature of creative expression, with the philosophy of language and with computational linguistics, with artworks created through the use of technological means and with the development of a contemporary framework to comprehend and critique these works.

Admittedly, this research exists at an embryonic stage of development, but one that is a prerequisite for its future growth and coherence. There are areas that have undoubtedly been omitted from this query and which might be critical to its maturation. As warranted, they will be included in prospective revisions of this material. Still, the centrality of the concerns raised here is pivotal not only towards an understanding of this inquiry but towards an appreciation of the very nature of contemporary cultural existence.

Notions of Technology

How then are we to define technology? Is it a fixed notion or one that is fluid and renewable? For clarity, we will employ a contemporary interpretation that defines technology as the utilization of scientific knowledge for practical purposes in a specific field. The particular field on which we will later focus is that of art-making which employs technological means in its process. Technology, then, is to be considered both fluid and updatable while temporally and culturally rooted in its contextual specificity. This in no way is to ignore the universal implications of its origin, usage or future applications, but rather to embed technology and its manifestations within a complex set of occurrences both obvious and concealed. The development of technology, itself a creative act, exists as a conversation between a historical setting, contemporary means, creators, users and observers.

According to Terry Winograd and Fernando Flores:

> All new technologies develop within a background of a tacit understanding of human nature and human work. The use of technology in turn leads to fundamental changes in what we do, and ultimately in what it is to be human. We encounter the deep questions of design when we recognize that in designing tools we are designing ways of being.[1]

Tools/Meta-Tools

Lewis Mumford noted in his 1967 treatise "Technics and Human Development" that there is nothing that particularly distinguishes *Homo sapiens* from many insects, birds and mammals in the making of tools. He further stated, "The consequences of this perception should be plain: namely, that there was nothing uniquely human in tool-making until it was modified by linguistic symbols, aesthetic designs, and socially transmitted knowledge."[2] Although this might be a point of debate, Mumford crystallized this statement with an ontological distinction between the kinds of *tools* that humans develop, build and employ in the course of, and, one hopes, in the service of, life.

Initially contradicting Mumford, Raymond Kurzweil in his book, *The Age of the Intelligent Machine*, describes the Industrial Revolution as the *first* Industrial Revolution "... characterized by machines that extended, multiplied, and leveraged our *physical* capabilities"[3] accomplishing tasks superior to our physical abilities. Later, however, he is in complete agreement with Mumford in what he defines as "the *second* industrial revolution, the one that is now in progress, [that] is based on machines that extend, multiply, and leverage our *mental* abilities."[4] The implications, effects and reactions of these two *industrial revolutions* are incomparable, in Kurzweil's opinion. Perhaps, this speaks to and illuminates a new and unique breed of technophobic resistance. "Though we have always regarded our species as relatively mediocre in physical capacity, this has not been our view with regard to our mental capacity. The very name we have given ourselves, *Homo sapiens*, defines us as the *thinking* people."[5]

The division suggested between these two *revolutions* apparently supports a clean and disturbing bifurcation between body and mind. Useful as a generalized model, but dangerous in its overemphasis on the mind/body unrelate-ness — as if one could exist without the other! Keeping this warning in mind (*and body*), we will proceed, nonetheless, with a watchful *eye*, towards a development of a thesis based, at least in part, on this premise.

In reference to Mumford's earlier distinction, let us define a tool as an implement or instrument that has a *physicality* and is implemented in the creation of a *physical* object or artifact through a *physical* process. Either by hand or by mechanical means, this process utilizes the *physicality* of the tool, while invoking *physical* force and gesture.

For our purposes then, a meta-tool is a tool that uses linguistic symbols and sequential logic as a means of operation. Further, it requires *thinking* about the nature of the tool and about *thinking* itself. Thus, while referencing the mind and to some degree, replicating its very functioning, the meta-tool combines the essence of a tool and the *thinking* about the tool. The combination, then, exponential in its import, and as exemplified in the computer, clearly distinguishes it historically from previously known and used tools. The *meta-tool* is of a higher logical type, transforming and trans-cending the notion of being a tool while also simulating the functioning of a tool; it subsumes and accomplishes the non-physical functioning of a tool by way of its higher order of processing. Additionally, the contemporary computer, with its interactive and layered language structure, is designed as a *multi-purpose* system and not as a single purpose machine capable of only one function. It, therefore, can perform numerous tasks particular to a variety of different tools.

Through the Looking Glass: Human Consciousness/Computer Architecture

In his explication of "An Empirical Theory of the Mind,"[6] Daniel Dennett cites the computer as an illustration in support of the development of his hypothesis in clarifying the nature of human consciousness. He begins his argument with the mathematician, Alan Turing and the creation of the Turing Machine: the first theoretical model of an information-processing machine and which continues to form the basis of contemporary computational theory. Dennett imagined Turing in his process of discovery, trying to solve a mathematical problem and most important, isolating *discrete steps* that make up the *sequence* of his mental acts. These steps could then be transported to a computer system and formulated into an orderly progression of steps utilized in the completion of the original problem. Turing further proposed that the program and the data could both be stored on a tape. Immensely simple in its design and yet so amazingly powerful, Turing concluded that his machine could model *any* machine and solve *any* computable problem. Furthermore, he asserted, if a problem could not be solved by a Turing Machine it couldn't be solved by a human being either.

The mathematician John von Neumann modified Turing's basic ideas and created the abstract architecture for the first realizable digital computer. The von Neumann Machine, as it is called, stores a program in the computer which has a single processing unit and is capable of accessing the program and the data from the same memory. The power of process, then, of storing and further recalling and reproducing what has occurred, is a direct lineage of human mental functioning.

The ability to describe, separate, recombine and further implement procedural operations and data, along with storage and retrieval, has had innumerable effects on the world in which we live and compute. However, these theories, designs and constructions so far mentioned are specific to a *single* processing unit. That is, a *series* of discrete operational instructions *serially* processed — one after the other. Both Dennett and von Neumann quite rightly realized the limitations of the single processing unit computer and brain analogy, and both describe the brain as a *massively parallel* processing system incomparable in its complexity and speed to that of the computer. Nonetheless, one cannot deny the comparison between the two without a complete appreciation for the shared utility of sequential symbolic logic and direct address memory storage and retrieval.

In their 1988 epilogue to *Perceptrons*, Marvin Minsky and Seymour Papert further developed this theory: "Most probably, we think, the human brain is, in the main, composed of large numbers of relatively small distributed systems, arranged by embryology into a complex society that is controlled in part (but only in part) by serial, symbolic systems."[7] "Present-day computers represent an intermediate degree of complexity; they now have millions of parts, and people already are building billion-part computers for research in Artificial Intelligence."[8] Although, Minsky further states in his book, *The Society of the Mind*, that these organized *sets* or systems within the brain are not necessarily aware of their neighbor's functioning; the analogy still persists and is useful in understanding the origin of the computer and the implementation of language.

Natural and Artificial Language

An understanding of language is needed to exact the structures of our mental processes and the sequential symbolic logic that they employ. Multiple theories co-exist as to the development and position language holds within our mental and psychological lives. Most definitions of language include the notion of communication to convey thought and self-expression. Generally, we think of language as a human-to-human enterprise including speech, signs or written symbols that are governed by sets of grammatical rules, syntax and conventions.

Natural language is considered the language between people used in ordinary communication. "Language acquisition is one of the few cognitive skills that is, near enough, both common and peculiar to humans. Some theorists have been led by this to see language as *the* most central characteristic of the human animal."[9] Lewis Mumford credits the evolution of language as a preeminent advancement of human development from mere tool-making. The linguist, Noam Chomsky, constructs a theory that advances the notion that our language faculty is, perhaps, rooted in our very biology and occupies a place in the *deep structure* of our physical being.

In his recent investigation of how language works, Steven Pinker cites two principles as primary in understanding what he calls the "language instinct." The first, explicated by the linguist Ferdinand de Saussure, is "the arbitrariness of the sign."[10] That is, the conventional linking between a word with its meaning. The second principle, for which Pinker credits Wilhelm Von Humboldt, is that language "makes *infinite* use of *finite* media ... [That is, that] we use a code to translate between orders of words and combinations of thought. That code, or set of rules is called *generative grammar* ... In a discrete combinatorial system like language, there can be an unlimited number of completely distinct combinations with an infinite range of properties."[11)]

Another feature articulated by the psychologist Daniel Robinson that can be appended to these last two principles and that also distinguishes language from "non-human forms of communication is not that it *can* be but that it *must* be taught... When we say that it must be taught, we are only acknowledging that language contains both sounds and rules that enable each member of the society to communicate with every other member. If he is not taught these sounds and rules, his communication will be *vocal* but not *linguistic*; he may be able to *signify* but not to *symbolize*."[12)]

The role and utility of symbolic logic in a sequential format is essential to comprehending the development of the computer and its subsequent usage. The analogy between brain functioning, symbolic logic, grammatical constructions and the computer is unavoidable. The philosopher, Justin Leiber, sums up of the role of language in constructing our mental lives — "Looking at ourselves from the computer viewpoint, we cannot avoid seeing that natural language is our most important programming language."[13)]

The use of languages within the contemporary computer is multi-tiered, and as demonstrated in Figure 1, operates within a hierarchical structure of functionality. These languages are operative in a descending order, that is, from top down. On the first top level, is the high level programming language, such as C++, or Pascal or Fortran. It is the most similar to an English mode of writing. As a system of notation for describing computational process to a computer, the programmer must be able to create and modify his/her programs as well as being able to read programs written by other programmers. The programmer, utilizing a language that is common and intelligible to other programmers, writes a program in this high level language which the computer processes and translates through the use of the compiler. The compiler, then, translates the high level language into another, secondary language called assembly language. This secondary language plays an intermediary role by breaking down the high level language into a set of partially numerical instructions which then is translated by the assembler into a third language called machine language. Machine language is a set of program instructions directly controlling the hardware of the computer system giving instructions in the form in which the CPU or central processing unit will execute them. This is the binary level of 0s and 1s that actually control the computer circuits to be either *on* or *off*. These levels of language implementation of procedural logic demonstrate the ability of the computer to manipulate symbols. "It is essential to realize that a computer is not a mere 'number cruncher', ... Computers do not crunch numbers; they manipulate symbols... It follows that the superficial form of a symbol says nothing definite about the nature of what it symbolizes... The terms 'computer' and 'computation' are themselves unfortunate, in view of their misleading arithmetical connotations. The definition of artificial intelligence previously cited — '... the study of intelligence as computation...' — does not imply that intelligence is really counting. Intelligence may be defined as the ability creatively to manipulate symbols, or process information, given the requirements of the task in hand."[14)]

Digital Dialogues

In their chapter entitled "Digital Design," Foley et al. point out that "the concept of a

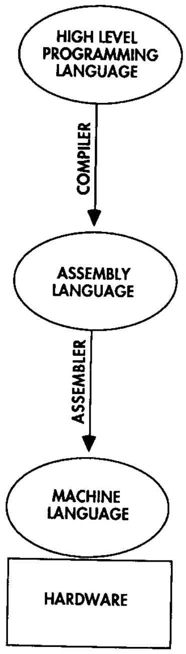

Fig. 1 Levels of Computer Languages
Schematic diagram of layers of computer programming languages and how they are translated and interact with each other.

user-computer dialogue is central to interactive [computer graphics] system design, and there are helpful analogies between user-computer and person-person dialogues. After all, people have developed effective ways of communicating, and it makes sense to learn what we can from these years of experience."[15)]

Regardless of the format that these *digital dialogues* take, either as a program with a text based *menu-structured* interface, or one that uses icons and/or text, etc., the interaction between the user and the program/computer is still intrinsically language-based. This *dialogue*, then, that uses linguistic and symbolic representations, and that makes communication with the computer possible, radically transforms our communication modes from that which was possible with previous instruments. Thus, the computer as *meta-tool* I is central to this *dialogue*.

In his chapter "Computers and Pure Reason," Theodore Roszak cites Seymour Papert's Logo computer curriculum as part of a radically new vision of education and as having the "capacity to teach 'procedural thinking' [to children]... He believes children should be taught to 'think like a computer' because he believes computers have somewhat the capacity to think like human beings and so can help children learn that mental skill."[16)] Roszak concludes that the computer draws upon a category of ideas fashioned from the mind and the logical structures that it employs. Thus, this completes a full circle of dialogue between human and computer and computer to human, one in which a kind of mirroring of human processes is reflected and subsequently used as a learning tool.

As knowledge and communication transform into non-physical systems, one wonders about the effect this will have on our future imaginings, ideas and thinking. "We are living at a time when the means of knowledge are all in the state of transition — indeed, when the major transformations under way within our economies are emerging from the changes which are influencing the means of knowledge... It has become increasingly difficult of late to say what is meant by the term 'information society.'"[17)] Perhaps, because the roots of language, both natural and artificial, are embedded in our technological means; it will permit, through application, Von Humboldt's phrase and Pinker's second principle of language, *finite means* used to create *infinite form*. This would, then, further the development and proliferation of non-material instruments.

Relevance to the Art Praxis: The Historical Tradition

For thousands of years, artistic invention has consistently employed contemporary technology to support a variety of forms of creative expression, from the chemical developments of paints and fabrication of brushes, to sculptural substances and forming processes. But not until the 19th century, however, is there evidence of such a commingling of science and technology with art and the art praxis. "This development led gradually to what in the late 20th century we may call technological or electronic art . . . Although, technological art is a relatively new art form, its coherence and continuity, as well as its aesthetic, sociological and cultural value, can be established. It is an international phenomenon, and its origins can be traced back to antiquity."[18] The roots of technological art, are noticed in Futurism, Dadaism, Constructivism and the Bauhaus of the 1910s and 20s through to Industrial Art and the light, kinetic and early electronic environments of the 1950s and 60s, as well as in photography, film, early cybernetic art, and video with its image processing capabilities.

The first evidence of *computer art* dates back to the early 1950s. And throughout the span of its almost fifty year history, art was being made using the computer in either hospitable or inhospitable surroundings, but art was being made. Research laboratories and offices were transformed into artist's studios, *if even only for the night*. Through multiple generations, transformations and configurations of systems, artists and scientists alike have continually persisted in utilizing the computer for creative expression. While these technologically based art works cover a wide spectrum of intention, usage and output, their impact has not gone unnoticed. Jasia Reichardt, an organizer of the historic 1968 exhibition of computer art, "Cybernetic Serendipity" for the Institute of Contemporary Arts in London, documents in her book, *The Computer in Art*, this impact by describing computer art has having "a unique significance both socially and artistically"[19] and as one of the most important links between art and technology.

Appropriation of the Meta-Tool

Although artists who seek out new forms and emergent technologies for creative expression are continually challenged by either system software or language learning-curves and updates, they are equally rewarded for their efforts. Using uncharted, contemporary means, the artist is allowed more latitude for invention and creativity.

The implementation of the computer as a functional system for making art, allows a dialogue to exist between the artist and the *meta-tool* that extends the conversation an artist might have with him or herself during the course of the creative process. Working with technological means to make art is not just like working with a new medium or tool but is a unique convergence of pre-existing technologies interwoven into newer ones. There is, as is evident in any contemporary computer painting program, a conflation of older techniques with newer ones — formed through simulation and direct use. Thus, previously used skills, perhaps developed from working in other modalities, are conflated with and applicable to newer and more appropriate skills needed for working with a computer. In his 1969 article, "Computer Sculpture: Six Levels of Cybernetics," the sculptor Robert Mallary articulates the benefits of using a computer for "high-speed visual thinking."[20]

Redefining the Means

The diversity of artistic manifestations created with the use of technological means is quite apparent in an overview of the work produced thus far. Although methods and procedures may range from artist to artist, from using menu structures to developing artistic algorithms; the importance and uniqueness of digital technology in current art-making practices is demonstrated in the variety of work that has been produced. Infusing technology with their own visions, computer artists have recontextualized and transformed the means of art-making. And through its use, the universality of the computer, then, becomes specific and individual, personal, and uniquely capable of an artistic *signature*.

Aesthetic Inquiry: Art and Aesthetic Technics

"'The work of art,' says André Breton, 'is valuable only in so far as it is vibrated by the reflexes of the future.'"[21] If this is the sole basis on which to judge a work of art, one could full-heartedly say that computer art is, therefore, *valuable* and then my job would be done. But unfortunately, and although I agree with Breton, this can only be a part of an overall critique. An aesthetic inquiry must start with, and be grounded in, the specificity of the artwork itself.

A study of David Ecker and Eugene Kaelin's model, as demonstrated in Figure 2, provides a clear and inspirational visualization. Their graphic clearly articulates the "orders or levels of discourse that may be associated with any knowledge claims concerning the existence or interpretation of aesthetic objects."[22] That is, it made possible, with a quick visual reference, an understanding of a series of discrete, logical steps, interrelated in a bipolar hierarchy, and a relational checklist necessary to locate and trail any aesthetic claim. In describing an "explicit structure of knowledge", their model grounds aesthetic inquiry on top of the art object or event and follows up the levels

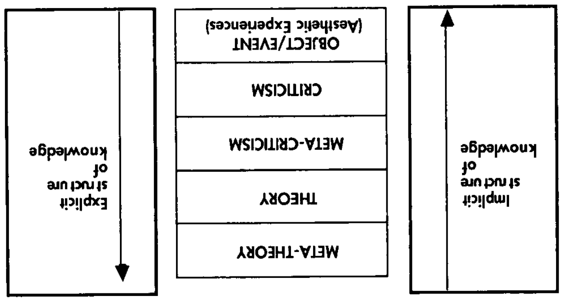

Fig. 2 Ecker and Kaelin's "levels of discourse that may be associated with any knowledge claims concerning the existence or interpretation of aesthetic objects."[23]

accordingly. The inverse is true for an "implicit structure of knowledge."

Meta-Tool/Meta-Medium Model

In borrowing Ecker and Kaelin's structure and commitment to the specificity of the artwork, a model was devised that attempts to describe the functional structure and levels of mediation that an artist encounters when working with technology. Although this model defines the artistic experience and creation in relation to the tool and meta-tool that the artist uses, it does so in order to come closer to an appropriate aesthetic critique of these artworks.

The schematic diagram, as pictured in Figure 3, charts the levels of interaction and creative engagement necessary in the computer art-making experience between the artist, object/event, tool, meta-tool, medium and meta-medium. Starting from the bottom tier and moving up, art can be realized at any level.

Object/Event: This first level of interaction is with the artist and idea; this is a conceptual and design stage. Art realized at this level has no physical form (i. e., some conceptual art has a non-material existence).

Tool: Art made through the use of a *tool*, usually developed into a physical artifact, is realized at level two. The artist interacts with the tool as a functional device to make art. The computer artist interacts with a variety of *tools*: input devices, keyboard, tablet and pen, or microphone for voice control, etc. But, uniquely, in computer art, the *tool* only further facilitates communication with the *meta-tool*.

Meta-Tool: Through the use of language and symbolic logic, art created at this level utilizes a digital dialogue between the artist and the computer. This processing level distinguishes the computer art-making experience by its conversational and interactive ability to permit a *digital dialogue* between *artist* and *meta-tool*. Through the use of a tablet and pen, an artist can draw, input type, etc. with the computer; the skilled hands are still of use. However, working with the computer has allowed the artist, who cannot draw or who thinks that she or he cannot draw, to still be capable of making images.

Medium: Like a tool, a *medium* displays a physicality. The monitor through which the artist views artwork, is itself a medium. Further, the computer artist, having created artwork through the meta-tool, may choose to make a physical representation of the work by outputting the image file to another *medium*. In computer art, we often see artwork output to a variety of media, such as sculptures, hard copy and photographs, slides, film or videotape.

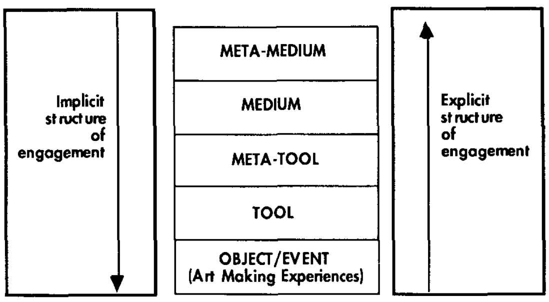

Fig. 3 Schematic diagram of ineraction and creative engagement in the computer artmaking experience.

Meta-Medium: The *meta-medium* uses linguistic symbols and sequential logic. Similar to the distinction made between a tool and meta-tool, it is through the *meta-medium* that a digital dialogue continues, from the artist at the first level through to the *meta-medium* at the fifth level. As a *meta-medium*, the computer extends into a network while still being capable of simulating a variety of other media, thus the appropriation of the term multimedia. If artists choose to put art work on the internet, they are conversing via the *meta-medium* and their work, then, exists in a non-physical state of *logic* and *language*.

This *meta-tool/meta-medium* model, designed specifically for technologically based art works, will, one hopes, be useful in distinguishing contemporary technological means from other art-making tools and media. The extended use of language makes possible unprecedented dialogues between the artist, meta-tool and meta-medium. This uniquely differentiates the computer art process from all other forms of art-making.

The Aura, the Object, and the Ethers

Walter Benjamin began his 1936 article, "The Work of Art in the Age of Mechanical Reproduction," with a particularly relevant quote by Paul Valéry, "In all arts there is a physical component which can no longer be considered or treated as it used to be, which cannot remain unaffected by our modern knowledge and power. For the last twenty years neither matter nor space nor time has been what it was from time immemorial. We must expect great innovations to transform the entire technique of the arts, thereby affecting artistic invention itself and perhaps even bringing about an amazing change in our very notion of art."[24)]

Benjamin articulated, for years to come, the mechanical reality of image reproduction.

He feared "a decay of the aura,"[25] or "the unique phenomenon of a distance, however close it [an art object] may be"[26] as well as a Fascist takeover of these very mechanical means. But, Benjamin lived and died within a context that completely created and supported this second fear. And in fact, with mechanical means, there would surely be a difference between the original and the copy. But his notion of the "aura" has always seemed disturbingly *idolatrous*. With contemporary digital storage, an image is saved in a file and format that can be replicated exactly without any loss whatsoever. Therefore, there are no copies, there are only originals. Or rather, they are, what I call, *parallel multiples*. That is, through the *production* of a computer art image, multiple images can be produced at the same time, with the same quality. This is one of the unique *benefits* of making art with technological means. Additionally, artwork can be saved at various stages of development and produced as separate images. Why constrain the output capabilities of this massively powerful and unique *meta-medium* to past limitations in other media?

Douglas Davis, in his article, "The Work of Art in the Age of Digital Reproduction (An Evolving Thesis: 1991-1995)" responds to Benjamin. "There is no clear conceptual distinction now between original and reproduction in virtually any medium based in film, electronics, or telecommunications."[27] Douglas Davis rightful points out the interchangability of the original and copy, as well as a loss of meaning in the original/copy debate. My only argument with this article, though, begins with the title. I think it would be better titled as, "The Work of Art in the Age of Digital Production." This title would then reaffirm the irrelevance of the original/copy issue within contemporary technological means and emphasize the advantage and possibility of *parallel multiples*.

A more appropriate and meaningful issue concerning current digital image processes previously put forth, is the noticeable shift from physical manifestations to symbolic logic and language structures. In his article, "Transparent Technology: The Swan Song of Electronics," Tim Binkley seems to agree with the non-physical thesis argued above, but diverges from the premise proposed here as to the exact modality of non-materiality this process takes. I argue language, he argues mathematics. Binkley writes, "Electronics is not the personification of digital technology, but only an interpreter accompanying us on our first journeys into unknown and virtual territory. Analog media are physical, digital systems are conceptual, and electronics is just the first technology that connected the two systematically. After introducing us to computable universes, it is now enlisting other guides to take us there. Technology will become increasingly transparent as we develop the interrelationships between mimesis and mathematics first heralded by electronic computers."[28] By extension, it is quite possible that the majority of future artwork using technological means will also be presented in non-material forms.

Conclusions

In *Understanding Media: The Extension of Man*, Marshall McLuhan describes what he meant by the term, ". . . the medium is the message. This is merely to say that the personal and social consequences of any medium — that is, of any extension of ourselves — result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology."[29]

Accordingly, the artistic consequences of computer technology should be included. Already monumental in its impact, it will increasingly impress upon the art world the need to develop aesthetic theories specific to this work. The use and influence of digital technology on artists and art institutions, the internet and the worldwide web, are significantly readjusting contexts and aesthetics, practical consequences and new developments. As we incorporate these means into our creative processes, we are going through a transition from *mass media* to *individual meta-media*.

The questions that arise when utilizing technological means for the creation of art are innumerable and challenge us to develop new aesthetic values and concepts specific to its constitution. From the language structures to the digital dialogues interactively offered through the use of the *meta-tool* and *meta-medium*, to the very existence and historical development of this technology, it inspires self reflection and a deep appreciation for its continual reconfiguration and growth.

Gene Youngblood wrote, "The visual computer enters our lives at a time when we face an unprecedented challenge of creativity: we must create on the same scale as we destroy. Every individual and every society has always faced this responsibility. But the scale of actual and potential destruction today, of both physical and cultural ecology, exceeds our ability to imagine a response. We find ourselves in a crisis of imagination and creativity, a crisis of consciousness and desire."[30)]

There is a body of computer artworks that represent such 'imagined responses' — responses in which artists have appropriated technology and infused it with their own vision. A noble and consistent cause, this conflation of art and science is embedded within its own history while holding great significance for the future of our art-making praxis.

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