ART RESEARCH JOURNAL | Art Research Journal / Revista de Pesquisa em Arte
ABRACE, ANPAP e ANPPOM em parceria com a UFRN

Evolutionary Immersion, Digital Arts, Science and Technology

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1. Open Science

Open science[1] is a transdisciplinary construction proposed several decades ago that presents hybridization and transformation processes of natural and social sciences. Technologies, and particularly information sciences, may be involved in this perspective in order to explore the fields of artificial life, their relationships or connections with electronic and digital arts, as well as bio-inspired computational processes. Given the advances in these fields, it is necessary to define, in terms of theory and concepts, the aesthetics aimed at studying and exploring intelligent behaviors, intelligent matter, the use of metamaterials in the creative processes and Net images, as well as the multiple and varied sets of knowledge that expand digitally.

We are living in a changing technological environment: one that grows exponentially under a *non-human*[2], permanent transformation that is nonetheless related

1 The Report from the Gulbenkian Commision on the *Reestructuring of the Social Science*s, published in 1996, and under the coordination of Immanuel Wallerstein, issued an invitation concerning the intellectual diversification of the disciplines including, among them, the arts and their related fields, among them, the Science of the Processes, a term coined by Ilya Prigogine (1997, p. 68). SCI (Science Citation Index) is used in the second decade of the 21st century with the purpose of analyzing and ranking the number of scientific publications at the global level. The highest percentage in Latin America is that of Brazil, as an evident sample of scientific-level research and publications in Latin America and in several areas in which arts are included. This information may be complemented at: http://unesdoc.unesco.org/images/0018/001898/189883S.pdf. Accesed on: April 30, 2015.

2 Concerning this topic, Bruno Latour's approach, in which he includes a dimension of nature that involves artificial and biological systems, leads also to present the ecology of artificial ecosystems that are in our surroundings in an increasing manner. Computational devices, cell phones, tablets,

to human biological systems, therefore suggesting different relations with the conditions of nature from the standpoint of artificial life.

According to C. Emmeche (1998), a continuum exists in which the evolutionary process of information electronic technologies experiences constant transformation and the updating of the devices, as well as of software. Consequently, an open possibility emerges towards the qualitative theories of aesthetics and art as artists, scientists, creators and audiences (interactors) understand these modifications with the purpose of incorporating these languages into their work and scientific documents.

The exploration and knowledge of other worlds through artificial life (A.L.), as micro and nano[3] scales, and the display of laser rays sent from the devices to the vast universe arise from the close relationship of scientific investigations, mainly Physics,[4] and from the advances and applications of computational technologies that we have around us. Software interactivity and application with respect to the devices we carry with us enable the possibility of connecting systems. The core aspect of these connections stems from mathematical languages and applications in simulations in which binary systems, algorithmic systems and fractal languages are subsequently read in images and networks whose sense of logic explains the creative processes in the digital and computational arts.

Thus, computational and digital arts require an aesthetic explanation based on the complexity of the ever changing knowledge concerning digital transformations for the creative arts. Also, artists who wish to take advantage of this theoretical and conceptual expansion to integrate the concepts of the social sciences into their work are increasingly challenged to accompany the transformations that will allow them to develop a poetics, or metaphors, that utilize software pro-

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and the diverse and wide array of software, are part of a cognitive and collaborative resources that transform the arts.

3 Research from Ana Barros and Nara Cristina Santos are among the different theoretical examples of current research projects that can be quoted (Nanoarte, 2014, p. 59-70).

4 Michio Kakú (2014, p. 374) explains the following from the perspective of Physics: "Therefore, the problem does not lie in the amount of data sent through laser rays. In principle, they may carry an unlimited amount of data. (…) We may have to use quantic computers which do not compute with silicon transistors but with individual atoms."

gramming's capacity as a technological and knowledge-related resources.

The technological events of the art world and **time horizons** modify the perception, participation and interactivity processes vis-à-vis expository modes as well as how digital and electronic art live on through the permanent updating of the software. It implies, from the perspective of the arts, that digital works require the permanent updating of the computational languages in codes, software, and other aspects for their evolution and updating on the devices.

Physicists call this process **Event Horizon**. The use of digital media and experience through interactive networks by means of technological devices provides interpretation ties in knowledge links. In addition, it is possible to access, in an open manner, the fields of science: e-Science. There are creative works[5] in which eco-computing is understood: where a transdisciplinary framework is built in order to process information and synthetize ecological data from ecosystems, communities, populations, or hybrid fields in which perspectives of traditional ecology are integrated with those of bio-computing, or synthesis biology, in order to create, as well as simulations that are more focused on bio-inspired computing.

We are witnessing the **metamorphosis** of a science that progresses within the context of the knowledge society with the chances of consulting, investigating, using and innovating converging and future fields; especially given the added resources that additional links through key words provide to the sciences and arts. These factors regarding the increase in fields of knowledge and the interrelation and exchange of concepts, reflections and knowledge suggest not only philosophical changes concerning the way in which natural and artificial life processes are thought. It also suggests major narrative shifts in how the changing milieus of what is considered social and cultural within the wide range of biological and exobiological events that take place in or out of the planet are narrated with different written languages, video, algorithms, and fractals.

Along with the philosophy of artificial life and computing-based creation, it is understood that all matter undergoes computing processes through information processes. It is that digital biology (Lahóz-Beltrá, 2004) in which another life form

5 This relationship between ecology and computing has been shown at the exhibits of Guto Nóbrega and Maria Luiza Fragoso at the museum of Brasilia in 2013 and 2014.

is reproduced and whose evolution is carried out through glances, bio-inspired[6] screen touches, or through the movement of matter through laser rays and the future creation of connectomes[7] along with the chances to download knowledge on computers within other exobiological contexts. Thinking of aesthetics as an open science highlights that the sensitive and intelligent matter of digital art and its creators becomes knowledge though interactive and intersubjective processes.

Innovation processes are also a constant element of daily life, and access to many devices offered as computer software languages can simulate how to face problems. This reflects, in part, the change towards a heuristics of knowledge. They are the exchanges offered by the technological world: multiplicity of images and circulating knowledge. P. Lévy (2007) called this aspect of cultural diversity and progress in the promotion of knowledge collective intelligence: an intelligence that encompasses planetary networks, borderless ecological and social niches, religious and political beliefs. The technological time of the networks is that of immediate creativity and of the opportunity to promote the possible worlds, future scenarios, and technological convergences aimed at correcting mistakes concerning natural resource pillaging, political hegemony, and domination.

The political idea for human development can be expressed using technological art as the basis,[8] as well as the idea of the time of other forms of sensitivity and knowledge, the process theory of what is qualitatively new, to reconfigure the symbolic fields and ecological systems in order to be able to imagine the cognitive and creative transformations.

When referring to open science one recalls what over four decades ago was called "the science that gives sense to creativity"[9] (Prigogine, 1997, p. 64). Thoughts that privileged the new alliance of natural and social sciences in order to work on

6 Among many others, one can cite the works of Karl Sims, Laurent Mignonneau y Christa Sommerer, John Brown, John Macormack, Peter Weibel, and Jeffrey Shaw in respect to this.

7 R. Kurzweil, M. Kaku, from a method of future scientific prediction, consider that these transformations will be possible due to the advances of computing and artificial intelligence.

8 This also allows considering what is non-human in the new ecology, implying the whole process of creation known in the science of artificial life.

9 "Our world is a world of changes and exchanges, and of innovation. In order to understand it, a theory of the processes, of the times of life, of principles and ends is necessary; we need a theory of qualitative diversity, of what is qualitatively new." (Prigogine, 1997, p. 70-71).

a multidisciplinary basis regarding the transformation of knowledge. This change creates a new philosophical body in which the cognition of rationality is not focused on the human condition but on the configuration of intelligent organisms that are capable of understanding otherness; the inter-subjectivity of the arts in their computational creation fields; the artificial life that has expanded its engineering -based spectrum in order to make it possible to understand life as we know it along with other sensitivities in relation to the integration in the micro, nano, information and cognitive-based worlds; and, experiences in the movement of subatomic particles, information flows, and bytes of the computational worlds. The philosophy that emerges from the foregoing relationships is an aesthetic condition inasmuch as it acknowledges these possible worlds. These are parallel worlds in which mental experiments of creation are subsequently expressed in computing languages, electronic and digital arts, and simulations, even for other physical dimensions.

The processes an open science aims at are simulation aesthetics, virtual environments and creative relationships. Thus, nowadays innovation processes emerge with strength in many directions; however, from an aesthetic perspective in the creative field, it is with digital art that a science of creative and innovation processes is experienced. Said conditions fall under technological nomadism, in which knowledge fields expand through the Net.

This transformation may be analyzed from the principles suggested by I. Prigogine e I. Stengers;[10] among them the "time's arrow" of the creation of digital arts and the use of the Net. The possibility of making new aesthetics-related contributions arises here with the purpose of analyzing chance and uncertainty, or the irreversibility processes entailed by the digital creative act. This signifies the creative exploration from algorithmic languages in which codes, languages and images are used through the simulation of poetics and metaphors; but also theorizing about what is qualitatively new, creating those concepts that explore qualitative diversity. Digital arts are the contemporary transformation, along with computing,

10 In the text of the *New Alliance*, these authors open the possibility to understand the sciences within a transformation process and contributions with their investigations that allow starting to build transdisciplinary relationships from dissipative structures between knowledge and links with different fields. It is about thermodynamics expanding to processes such as computing and networks. This transformation refers to qualitative changes in systems that are increasingly far from balance.

proposing creative conditions from the perspective of different sciences. We are talking about an open science to exalt transformations in temporary dissipative structures that serve as the basis for the construction of an innovative scenario to explain why evolutionary immersion includes fields from the arts, and their new relationships with sciences and technologies.

Indeed, technological advances have evidenced for over two decades that, based on interactivity, the use of algorithms and computational codes expand these relationships towards creation-related heuristics mainly through the use of the computer. Microchips, nanochips and a set of electronic devices that are present in artistic practices grant a place of study to aesthetics. Besides the understanding and hybridization of creating with these digital means, architectural spaces and the web-based dissemination design expose a place of transformations to the paradigms of aesthetics.

2. Evolutionary Immersion

This concept poses an interrelation concerning the collective creation experienced in the interactivity of the arts through Internet networks, which becomes one of the cultural and political singularities of the epoch, as well as of the technological innovations that focus on the science of artificial life (AL) as an aspect of the post-human condition.[11] The concept of Evolutionary Immersion comprehends these processes in order to accept contemporary adaptations, and explains the visibility and capacity of creative thinking within temporal constraints. Along with artificial intelligence technologies, the networks and digital transitions, such as computing and the evolutionary process of collective intelligence, announce visible aspects of technological ecologies[12] that are emerging in information systems, as well as in other expository media and circuits. This is also the moment to express that the

11 This name has been suggested by other authors; among them, P. Sloterdijk, R. Kurzweil, and M. Minsky in order to explain a possibility regarding the progress of the human condition due to scientific and technological changes, and from a different standpoint of the naturalistic approach to conservation.

12 Creative works and concepts tied to science were exhibited at File 2013 in São Paulo: bio-technological art, nanotechnological art, entropic art. See the catalogue: SESI-SP exposição. Festival Internacional de Linguagem Electrónica. File2013.

sciences of creation, besides making a transdisciplinary analysis of the links with the arts and the sciences, combine key relationships with the sciences of life re-defining the human condition vis-à-vis the living systems, and the creative forms through which the different systems reveal themselves, and to which we could refer within a possible configuration along with the complexity of life.

Evolutionary immersion increases the very purpose of life, as creativity is, in the words of G. Chaitin (2013, p. 107), configuring one of the axes of the evolution of the human condition due to the situation of the biological software in which changes for the human condition concentrate. At the theoretical level, this aspect opens study-related possibilities to aesthetics – which has moved the boundaries of knowledge from art and philosophy to transdisciplinary and convergence fields with other sciences and knowledge domains such as biology, physics and information sciences, including computing and the group of electronic devices that create a scenario for evolution. These research possibilities stem from the immersion in the arts, sciences and technologies where conceptual fields not only experiment with sensitivity and biological aspects but also with adaptation, control and the interactivity of computational worlds.

With the purpose of exploring the significant changes of immersion from the point of view of aesthetics, it is possible to outline the process that the image undergone since the Enlightment in its representative periods in the history of art towards innovations introduced by simulation systems, with the use of mathematical and algorithmic languages, as well as an important approach concerning the atomic-scale and nanometric particles through the exploratory use of information data with highly interpretive software. The contexts of these changes for immersive worlds pose the emergence of a new knowledge paradigm concerning the events we experience on a permanent basis, such as the revelation of the genetic map whose DNA structure involves a large number of living beings, including the human species, computing codes and systems. Therefore, when referring to creativity theories, we find new conceptual and perceptual guidelines regarding immersive environments in the arts, as well as in the digital and computing realms.

3. Event Horizon

Under this notion, it is possible to analyze and think abstractly about the transformations that new technologies[13] undergo whose software and hardware updating is constant. These are topics that serve as the basis for connections and interrelations for the dialogue between the arts, the sciences, and technology that makes it possible to place them in the event horizon where changes take place at nanotechnological speeds, the measure under which most of the microprocessors operate. The event horizon is understood, as such, because of the variation and multiple events whose complexity and growth are increasing, as it happens in the field of knowledge, or intellectual capital as it has been called lately, which is not only translated into a book or articles but also into the circulation of images, video art on the networks, videogames, the music recording industry, telecommunication, or devices: In other words, devices on which it is possible to watch, connect and also expand the specific instance towards other dimensions such as cyberspace. Another type of knowledge is promoted through technological networks in said horizon while another haptic sensitivity (Deleuze, 1994, p. 487) is displayed because digital media are becoming more intimate and personal.

Theories related to the science of the processes, sciences of the creation (Prigogine, 1991), converge in the current computational worlds or information sciences whose applications revolve around what is digital, its changes and modeling in art, science and technology. A first hypothesis on creativity theories is that their theoretical and conceptual condition (knowledge) is tied to science and technology processes since evolution also belongs to biological, physical and chemical sciences and, with a greater emphasis, to information sciences. Therefore, in order to understand these new aesthetic events, we resort to theories of creativity - not with the purpose of settling the main genealogies of their fields of expression but in order to commit creativity issues around the **science of processes**, as called by Ilya Prigogine.

13 Topics such as: Possible Worlds, Creation Heuristics, Artificial Life, Catastrophe Theory, Complex Adaptative Systems, Alternating Views, Open Systems, Aesthetics and Convergence, Creativity, Increasing Complexity, among others, make up an event horizon. There, it takes place a technological condition of time that can be modeled or simulated, as well as scales in order to have an idea of the width of knowledge attained due to computation.

The countless free-access creation software found in devices and on the Net is a clear example of the creative processes of and with information technologies in order to transfer mental processes to knowledge processes within information systems. In this sense, knowledge is algorithmic or mathematically complex.

It is worth asking from the perspective of the event horizon: What is the novelty of artificial life? The novelty of artificial life stems from being radically opposed to the life of living organic systems, and from being a conjuncture of creative relationships of knowledge networks, within scales and temporal restrictions of researched information; that is, scientifically produced and stored on interactive-memory supporting elements by devices, or **connectomes**, that depend on the knowledge networks interconnected from what is human with technological interphases. The foregoing implies an interpretative relationship concerning other forms of knowledge, scale and time.

The drift of the networks in each system or sub-system - not only biologically interconnected based on carbon structures but on electronic artificial networks - configures an artificial ecology of knowledge that allows simulating behaviors in particles with respect to their instability or self-organization, or also in terms of collective behaviors in other collective experiences such as bird flocks or shoals of fish: the bases for keys of algorithmic computational models arise from observation of these phenomena.

It is no longer a matter of approaching these issues from Darwinian gradualism scales, but about studying significant or magnificent time periods concerning the conditions for knowledge we have reached, mainly through advances in artificial life, robotics, artificial intelligence, and hypercomputation. Human intelligence may - and in fact it has been doing so - turn its structural connections in life into complementary ones to expand memory, creation processes, and the possibility of simulating impossible problems and experiences.

Creativity theories converge into cognitive, social and creative changes, as well as in the digital dimensions and their possible changes and modeling in art, science and technology. Aesthetics has moved itself from art and philosophy, concerning the first definitions that placed it in the field of representation, towards knowledge bordering fields in which it is related to information sciences and to technological and computational expansions that are ruled by the context of simulations in arti-

ficial life. Based on simulation languages, basically software programs, which have been appropriated and used in electronic arts, transgenic art, digital art, nanoart, meta-architectures[14] combine computational knowledge, ideas and science concepts, as well as creation poetics in their creative production. The main interests of aesthetics concerning perception, sensitivity, taste and beauty have been revalued by other languages for which, besides abstraction, knowledge is required in the fields of sciences and technologies. These aspects create other theoretical principles in order to define its theoretical essence as an open science vis-à-vis processes, diverse and innovative times. Thus, aesthetics is under mutation, hybridization, or transformation: Conceptual processes with structures that dissipate due to more complex and unpredictable processes. Consequently, in order to understand new changes in aesthetics we resort to creativity theories not with the purpose of settling the main genealogies of their fields of expression but in order to commit the issues of creativity around the **science of the processes**, in Ilya Prigogine's terminology (1997).

A first affirmative hypothesis concerning creativity theories is that their philosophical condition is linked to science and technology processes: biological, physical, chemical sciences and, with a greater emphasis, information sciences. As a whole, the comprehensible transformations in computational languages and the use of software for digital arts require that the scenario and the context of the science of processes be understandable; it is important to find the type of logic within which creative processes take place. Creative logic is correlational in terms of the logic of artificial life since it corresponds to computational worlds and algorithmic languages. This is the perspective in which all the efforts are focused in order to find the logic of biological machines (Emmeche, 1998, p. 61). Artificial life (AL) is a frontier science focused on the event horizon of the theoretical innovation of networks, electronics, and information sciences.

This science shall be the object of reflection and theorization in the field of aesthetics that includes electronic arts; that is, digital and computational arts that use codes, languages, augmented reality and holograms, which will be technical re-

14 Ref. Tania Fraga on Metainstalações [meta exhibits] at the 9th Symposium at the Universidad Federal de Santa Maria in 2014, Brazil.

sources for the image that migrates from bodily matter to its numerical condition.

The numerical image of algorithmic, fractal and processing scales, among others, is found in examples of bioart, bio-technological art, nanotechnological art, to explain the aesthetics that arise from knowledge networks. It is a computational cognition among the branches of technological and scientific knowledge which are interconnected from the human domain as synapses and technological interphases; that is, bio-electronic.[15] The foregoing implies an interpretative relationship and the understanding of other forms of knowledge in which it is important to acknowledge the increasing complexity of the systems.

The deciphering and the drift of the epistemologies that emerge in each system, computational sub-system, is the conjunction of multiple artificial systems that are no longer biologically connected only on the basis of carbon structures, but on electronic artificial, computational, social, or scientific networks, or on the structural connection that stems from knowledge thus having exceptional examples of collective intelligences.

Concerning the event horizons that refer to transformation and change-related times, it is important to place aesthetics as an open science, in order to implement the convergence with other dimensions and devices of creation; since the theoretical perspectives of a new philosophy that transcends the humanistic approach towards a philosophy of the sciences of complexity implies taking into consideration qualitative and exchange-related times in which simulation is displayed based on patterns and information codes. It is a matter of placing aesthetics as a frontier science, in which conceptual and theoretical contributions are related to the events in which the art of our time takes place mainly with new languages, codes and expository processes[16] on the Net.

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15 I have mentioned this construction, known as "Sinapsis bioelectrónica de creación" (Bio-electronic Creation Synapsis) in my presentation published in ROCHA, Cleomar; MEDEIROS, Maria Beatriz de; VENTURELLI, Suzete. (Orgs) A*rs - Arte e Tecnologia // Universal modus operandi*. Brasília: Programa de Pós-Graduação em Arte, p. 187-194, 2012.

16 Galleries and museums hold exhibitions and the presentation of works whose digital and electronic support is immaterial. The image and the infrastructure have been replaced by computing and video beams, sound landscapes. Some formal elements are kept such as curatorial texts. The information circulates mainly via other media through information flows and, in most of the cases it can be consulted from other knowledge domains such as those of research.

4. Bifurcations

The topic of bifurcations in this closing section of the article corresponds to the imaginative ideas implied by expressing the theoretical defense of current aesthetical approaches as an open science since it encompasses transdisciplinary fields. Thus, creative processes are interpreted according to their degree of plausibility in the field of computational heuristics since information-related fields of knowledge in electronic networks have been expanded through artificial life.

The constant transformation of technologies, with respect to creation and immersion, makes another evolutionary dimension of digital arts possible, as well. It is the use of computing in order to think about possible worlds and languages that widely exceed the four dimensions already known, based on simulation languages that we can see in digital works which circulate through flows on the Net or that are splendidly shown in exhibit spaces. This process influences interactors with respect to their immersion and participation capacity.

This closing section poses a wider concept concerning interaction, participation and concepts. In other words, being concerned with an event horizon in which the roles of time exceed the human scales of centuries, minutes and seconds, including nanotechnological scales in which microprocessors, micro and nanochip acceleration allows the creation of other languages, even mathematical languages, for creation in meta-architectures and metalanguages, among others. These processes entail that the evolutionary immersion in the digital world of the image, the electronic video, are able to transfer content in which abstractions of poetics, metaphors or scientific topics are relevant and art-based for the sciences and telecommunication media.

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