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Cybernetic Philosophy, Performativity, and New Media Aesthetics*

Sibernetik Felsefe, Performatiflik ve Yeni Medya Estetiği

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Abstract

By drawing upon philosophical repercussions of cybernetics, this article reformulates the notion of performativity in the context of new media aesthetics. It links performativity to new media aesthetics via the cybernetic notions of information processing and generating systems, recursive electronic and digital feedback loops, emergency, complexity, dynamism, and autonomously evolving systems. In doing so, I argue that the operational logic and infrastructure of new media technologies can only be understood from a performative perspective. The term performance basically refers here to the movement which governs the generation and transformation of systems by putting them into action. It is through this action that the various components and parts of a system relay and process information and produce complex interactive systems. As a result, this kind of complex interactivity leads to the emergence of new forms. It is in this way that these complex systems produce new codes, configurations, and constellations. Such a formulation constitutes my starting point to describe a hybrid framework that may eventually lead to a better understanding of the essential characteristics of new media technologies and aesthetics. The shift from single, discrete, and isolated mechanical artifacts to technological systems laid the foundations for a new kind of aesthetics, the aesthetics of information processing and generating systems. The study of the art object as a system or an environment rather than a single object is crucial to address the way in which the system itself might be conceived of as an aesthetic medium. I foreground my definition of new media in the notions of medium and mediation and discuss the aesthetic possibilities brought forth by the emergence and advancement of information and communication technologies. The method used in this article is literature review.

Keywords: New media aesthetics, cybernetics, systems, networks, information.

Academical disciplines/fields: New media studies, media and communication studies.

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Özet

Bu makale sibernetiğin felsefi altyapısını inceleyerek yeni medya estetiği bağlamında performatiflik kavramını yeniden formüle ediyor. Bilgi işleme ve üretme sistemleri, öz-düşünümsel elektronik ve dijital döngüler, karmaşıklık, dinamizm ve özerk olarak gelişen sistemler gibi sibernetik kavramlar aracılığıyla performatiflik kavramını yeni medya estetiği ışığında açıklıyor ve yeni medya teknolojilerinin operasyonel mantığı ve altyapısının ancak performatif bir bakış açısıyla anlaşılabileceğini savunuyor. Performans terimi, temel olarak, sistemlerin oluşturulmasını ve dönüştürülmesini, onları eyleme geçirerek yöneten hareketi ifade eder. Bu eylem aracılığıyla, bir sistemin çeşitli bileşenleri ve parçaları bilgileri ileterek karmaşık etkileşimli sistemler üretir. Sonuç olarak, bu tür karmaşık etkileşimler yeni formların ortaya çıkmasına neden olur. Bu karmaşık sistemlerin yeni kodlar, konfigürasyonlar ve formlar üretmesi bu şekildedir. Böyle bir formülasyon, sonunda yeni medya teknolojilerinin ve estetiğinin temel özelliklerinin daha iyi anlaşılmasına yol açabilecek melez bir çerçeveyi tanımlamak için bir başlangıç noktası oluşturuyor. Tek, ayrık ve birbiriyle bağlantısı olmayan mekanik araçlardan teknolojik sistemlere geçişle birlikte yeni bir estetik anlayışın temelleri atıldı. Bilgi ve iletişim teknolojilerinin mümkün kıldığı yeni medya estetiği sanat eserini tek, bağımsız ve somut bir nesne olarak incelemektense sanat eserinin kendisinin ortam ve mecra olduğunu ve estetik olanın sanat nesnesi yerine ortam ve mecranın kendisi olarak düşünülebileceğini gösterdi. Bu makale yeni medya kavramını mecra ve dolayımlama kavramları üzerinden temellendirerek yeni medya sanatının yarattığı estetik anlayışı sistemler ve ağlar bağlamında tartışmaktadır. Bu makalede kullanılan metod literatür tarama ve değerlendirmedir.

Anahtar Sözcükler: Yeni medya estetiği, sibernetik, sistemler, ağlar, bilgi.

Akademik disipin(ler)/alan(lar): Yeni medya çalışmaları, medya ve iletişim çalışmaları.

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1. Introduction

By drawing upon philosophical repercussions of cybernetics, this article reformulates the notion of performativity in the context of new media aesthetics. It links performativity to new media aesthetics via the cybernetic notions of information processing and generating systems, recursive electronic and digital feedback loops, emergency, complexity, dynamism, and autonomously evolving systems. In doing so, I argue that the operational logic and infrastructure of new media technologies can only be understood from a performative perspective. Such a formulation constitutes my starting point to describe a hybrid framework that may eventually lead to a better understanding of the essential characteristics new media technologies and aesthetics.

Media studies frequently acknowledges the obscurity and the interchangeability of the usage of the terms medium, media, and mediation. The multifarious meanings of the concept of media occupies a broad range of definitions including more abstract and philosophical descriptions anchored in Heideggerian interpretations of technology as the primordial act of enframing, media as it relates to the diverse meanings of the term medium as the middle, mid-way, milieu, environment, context, point of contact, boundary, interface, as the means of doing something or a certain activity, and efforts of grounding the term in the idea of mediation, or media, alternatively, conceived as mass communication often channeled through technological devices such as newspapers, other printing texts, radios, television, computers, and the internet.

Because the technologies of new media accompanying the paradigm shift from the Industrial to the Information Age stress a continuity between the biological and the technological systems, proposing the networked environments as living, evolving, self-generating, and autonomously transforming systems, I will ground my approach to media in the question of what cybernetic medium is and from there expand towards understanding new media technologies in terms of networks and systems. The technological paradigm shift from mechanical artifacts to systems and networks with the Information Age relates the notion of medium back to the primal act of the enframing of the natural by revealing that the biological is already technological. New media technologies bring us closer to understanding media in terms of the technological act of enframing the biological.

Cyborg, the term referring to a cybernetic organism, integrates the biological and the technological via the hybridization of bodies and machines. Here, the blending of human and machine finds its expression in the exteriority of the mind. Clark's and Chalmer's (1998) idea of extended and distributed cognition relies upon conceiving mind as a complex entity that is transformed by technical artifacts such as a pen, paper, a watch, a calculator, a computer, and so on. From this perspective, the interaction between the technological and biological systems infinitely upgrades the two systems, simultaneously extending the capacities of both. What is intelligent is the technological environment or medium within which the mind is situated. If the human brain operates in relation to that which surrounds it, then it operates from outside of itself. The structural complexity of the brain depends on its ability to modify itself by externalizing itself into its surroundings. Therefore, these technical artifacts are not merely external supplements or prosthetic extensions, but they are the essential constituents of the mind itself. In that sense, the human brain is not a purely biological and natural construct, rather it is constituted through its complex relationships with its environment.

It is generally acknowledged that the relationship between the technological and the biological systems has extended media studies from its technical, social, political, and cultural aspects to studying natural or biological constructs as media, or anything as media, including artifacts, instruments, concepts, bodies, skins, sensations, and affects. Given that the emergence of information and communication technologies extended media studies to studying systems and networks as media objects, or studying objects as mediums, foregrounding the notion of media in the notions of medium and mediation is crucial to understand the information flow among complex mediums.

However, systems and networks are not new forms of organizations, they are as old as the Earth, and the same can be argued for information (Castells, 1996). What then is 'new' in new media technologies that are deeply interwoven into the Information Age? Is there a crucial difference between the print and electronic media and the new digital media technologies? This question of the relationship of old media to new media or whether new media is new at all is taken up by Bolter and Grusin (2000) through their notion of remediation. Remediation refers to our media-saturated culture which achieves its immediacy through hypermediacy: "Our culture wants to multiply its media and to erase all traces of mediation: ideally, it wants to erase its media in the very act of multiplying them" (2000, p. 5). While the proliferation and ubiquity of

new media threatens the legitimacy of old media, old media reemerges by incorporating itself into the forms of new media. The constant resurgence of old media in digital media complicates the question of the newness of new media whose hypermediacy is contingent upon its efforts to eliminate any trace of mediation to present its mediatedness as immediacy. It invokes this immediacy by opening itself to the intrusion of old media through whose resurgence it upgrades itself by transforming the old forms of media into new forms. If new media technologies enable the re-contextualization of old media by transforming it into new forms of media, then the notion of meta-media refers here to the fact that it is no longer possible to talk about the medium specificity of any media because new media is constituted by the integration or juncture of many different mediums. While old media was about the singularity of a medium as in traditional media such as painting, photography, or television, the defining characteristic of new media is its multiplicity; new media is about multi-media and mixed media. In that sense, Manovich's description of new media as it provides us with tools to translate old media into new forms corresponds to Bolter and Grusin's emphasis on media's infinite multiplication of itself by referring to itself or translating its older forms (itself) into newer forms. One might then argue that with the new media technologies, the act of mediation of media with itself or media's self-referentiality has become its newly found immediacy.

This theoretical approach to media is described by Kittler (1992) as the post-medium or post-media condition. It is interesting to note here that this perspective implicitly claims that media's self-referentiality is embedded in its posteriority. What is thus noteworthy is the interlocking themes of post-media and new media. As such, it is not farfetched to suggest that the prefix "new" contains within it media's posteriority with respect to itself. Exploring post-media condition then entails exploring media's temporality, particularly in terms of identifying medium as a hinge between the past, present, and future. What is implicated in approaching media from a temporal perspective is the question of how to write a media history or a media-related history. It is this historical analysis that led Kittler to argue that digital media "will erase the very concept of medium", because with digitality distinct mediums can be converted into one another (1992, p. 2). This proposed end of the medium corresponds with the erasure of the medium-specificity of information, because, as Kittler argues, with the optical fiber networks, "people will be hooked to an information channel that can be used for any medium—for the first time in history, or for its end" (p. 1). Information quantified in digitized numbers will result in the merging of distinct media such as radio, video, film, and television:

> Inside the computers themselves everything becomes a number … With numbers, everything goes. Modulation, transformation, synchronization; delay, storage, transposition; scrambling, scanning, mapping—a total media link on a digital base will erase the very concept of medium. Instead of wiring people and technologies, absolute knowledge will run as an endless loop. (Kittler, 1992, p. 2)

The effacement of the medium corresponds here with the digital condition's bringing of the historically different moments or mediums such as telephone, radio, television, and internet together. Kittler's conception of media's future dispenses with bodies and humans and defines media's self-referentiality in terms of the media networks created by technological devices that autonomously exchange information and communicate with each other. From this perspective, the new possibilities opened by digital technologies will lead to the erasure of the notion of the medium, because the convertibility of mediums to each other eliminates the role of the medium from the content of information. If information can be transferred from one medium to another without any transformation, then the content of information loses its medium-specific determination. In other words, information becomes indifferent to its embodiment.

Dispensing with bodies has become the dominant approach to thinking of information as an immaterial entity. The growing fascination with new media technologies led on to both theoretical and practical explorations of the information transfer and exchange among systems and networks. Theories and practices underlying cybernetics, which draws on information theory, probability theories, theories of artificial intelligence, and neuroscience, has been crucial to deploy new ways of engaging with the operational logic of immaterial systems, particularly in terms of how these systems exchange information and interact with their environments.

2. New Media Technologies and Performative Environments

The growing fascination with new media technologies led on to both theoretical and practical explorations of the information transfer and exchange among systems and networks. Theories and practices underlying cybernetics, which draws on information theory, probability theories, theories of artificial intelligence, and neuroscience, has been crucial to deploy new ways of engaging with the operational logic of immaterial systems, particularly in terms of how these systems exchange information and interact with their environments. Hayles traces the disembodied conception of information to the early stages of cybernetics and argues that Norbert Wiener's idea of telegraphing a human being exemplifies the belief that "the body can be dematerialized into an informational pattern and rematerialized, without change, at a remote location" (1999, p. 1). From this perspective, information that is dematerialized into certain codes and symbols and abstracted from its material base can be rematerialized and transferred to another medium without any change in its content. In other words, the medium in which information is materialized does not make any difference. Hayles' reformulation of the interaction between information and materiality leads her to present a different approach to the biological-technological interaction than the one proposed by the first-wave cybernetics.

The blurring of this distinction between the biological and the technological systems and its role in defining mediums as complex systems and networks also appear in Guattari's (1992) analysis of media systems and networks. In order to examine mediums as autonomously operating auto-referential assemblages that heterarchically link animals, plants, concepts, bodies, sensations, affects, tools, and devices in various media ecosystems,. Guattari's conception of the notion of medium from the perspective of ecology, cybernetics, anthropology, and psychoanalysis examines information and communication systems not merely in terms of the technological devices themselves but rather as operating systems moderating information flow among different mediums such as humans, machines, animals, objects, and plants. This perspective contributes to opening media studies onto a broad range of interdisciplinary work and diversity of approaches – from media ecological perspective examining mediums as ecological networks to the analysis of biological media such as digital organisms, viruses, bacteria, parasites; from media archaeological method adopting historiographical approach, expanding the study of media objects from the physical artifacts, tools, and devices to texts, documents, descriptions, books, illustrations, that is, to discursive as well as non-discursive media.

Guattari (1992) also discusses post-media in terms of the integration of previously different mediums, however his conception of assemblage anchors media's multiplicity in the medium's operation as a system that is constituted by the technical, discursive, material, practical, social, and political elements. In stark contrast to Kittler, Guattari shifts our understanding of medium from Kittler's technological deterministic conception of media as the autonomous operation of technological devices to mediums as assemblages of heterogeneous elements and components. Foregrounding the notion of media in the assemblages that integrate the discursive, technical, social, cultural, and political systems rather than in the erasure of the medium enables defining medium in terms of the interactive performance of the heterogeneous parts and elements that are brought together via the medium's act of enframing. Conceiving of mediums as systems and networks shifts our understanding of things, because it is no longer possible to consider physical artifacts, objects, and tools as stable and concrete things that circulate amongst different mediums. Instead, the act of circulation itself constitutes the identity of things as mediums. In other words, something becomes identical with itself by becoming the medium that constructs relationalities amongst the parts and elements of different systems. Describing things as contextual relationalities is anchored in describing them as acts that link discrete and dynamic components together. This is how I approach the notion of performativity in this article.

Approaching to new technologies as complex systems plays a key role in understanding the relationship between performative environments and technological systems. Given new technologies enabled the production as well as analysis of complex networks of relations, foregrounding the role of technology in the complexity of systems is crucial. The increased complexity of systems necessitates the need for a new conception of technology. Technology defined as a complex network of interconnected systems rather than single mechanical artifacts confronted the ways we understood the term technology.

The field of cybernetics was developed by thinkers from a variety of disciplines, ranging from philosophy and mathematics to life sciences and engineering, to examine the science of communication between humans and machines. By attributing agency to systems and emphasizing systems' autonomy, self-regulation, artificial life, and adaptation, cybernetics contributed to systems theory, information theory, theories of artificial intelligence, and complexity theory. In the same year with the cybernetic art exhibition,

Burnham (1968) published "Systems Esthetics", one of the earliest works pointing out the cybernetics' and new media art's aesthetic potentiality. By stating that the emergence of new technologies facilitated a shift from an "object-oriented to a system-oriented culture", Burnham argues that the shift from the mechanical and technical objects to complex technological systems[2] laid the foundations for a new kind of aesthetics, the aesthetics of information processing and generating systems.

Burnham (1968) defines this new kind of aesthetics as "systems esthetics." Burnham's approach emphasizes the aesthetics of systems rather than the formal qualities of single art objects, in that it does not restrict the aesthetic implications of technology to the formal analysis of discrete or isolated mechanical artifacts. Halsall describes Burnham's system aesthetics as "a paradigm shift from object to system." (2008, p. 23) The study of the art object as a system or an environment rather than as a single object is crucial to address the way in which system itself might be conceived of as an aesthetic medium. The significance of this argument proposed by Halsall is twofold. First, it attributes aesthetic qualities to the medium, through which systems perform themselves. Second, if object is dematerialized into complex networks of relations, then aesthetics is not objective. Hence Burnham's description of information-processing systems as unobjects.

According to Burnham (1968), these information-processing systems are the new machines, which transform the one-way contemplative relationship between the viewer and the art object into the two-way communication loop, which operates by the interactive feedback loops of information between the user-participant and the artwork: "It may be that the computer will negate the need for such an illusion by fusing both the observer and observed, 'inside' and 'outside'" (p. 98). In traditional science, the observer (inside) and the environment (outside) are viewed as two separate units in which outside world relays information to the observer and the observer upon processing this information internally produces a representation of the outside world and then interacts with the outside world by projecting the represented image onto the world. However, new technologies necessitate a different rationale and theory for explaining the interactions between systems and their environment. Rather than a cause and effect type of relation between an observer and the observed system, we are now going to consider that the observer constantly modifies or changes the environment and that the environment constantly modifies or changes the observer such that the observer and the observed cannot be separated from one another. My reformulation of performativity mainly explains how the various components and parts of a system relay and process information and through this interaction produce complex interactive systems. Systems operating in this manner can develop complexity through successive interactions of its components and eventually the boundaries between the observer and environment are lost in the transaction. Thus, observer and observed are considered here as components of a system, which autonomously generates and transforms itself.

In calling this hybrid model performative model, I am particularly inspired by Pickering's proposal of the performative idiom as a posthumanist critique of the production of scientific knowledge. In order to explain this paradigm shift, Pickering turns to cybernetics. "Cybernetics," he writes "is all about this shift from epistemology to ontology, from representation to performativity, agency and emergence" (2010, p. 2). While proposing the necessity of a paradigm shift from the representational to the performative idiom, Pickering subscribes to actor-network approach's subversion of the representational model by attributing agency to materiality. By decentralizing human from the knowledge production process, actor-network theory acknowledges the role of the non-human agents such as technical artifacts, machines, and instruments as the co-constructors of the scientific knowledge. Therefore, Pickering (2010) argues, science should be understood "as a field of performative material devices," which "act, perform, and do things in the material world" (p. 108). This argument is significant for at least two reasons. First, it defines performativity in terms of the interaction between human and material agencies. Second, it proposes that the scientific representation of the world is a performative act. That is, the act of defining, categorizing, and explaining the material world reconstructs the materiality, which it is trying to explain. Therefore, the performative idiom argues for a constructivist account of reality. At the moment you produce any knowledge, the material world that you have been trying to map becomes reconstructed, which, in turn, necessitates the production of new maps.

[2] The term technology in today's usage of the word, Marx argues, didn't exist until the nineteenth century. The term merely referred to the mechanical arts as distinct from the fine, creative, and imaginative arts:"Ever since antiquity, moreover, the habit of separating the practical and the fine arts had served to ratify a set of overlapping invidious distinctions between things and ideas, the physical and the mental" (1968, p. 14).

However, my conception of performativity differs from Pickering's and is closer to the actor-network theory's material-semiotic method, which presents the human and non-human agencies as co-producers or co-creators within a horizontal system, instead of the hierarchical one that Pickering proposes. Pickering differentiates between human and non-human agencies on the basis of intentionality. He writes, "We humans differ from nonhumans precisely in that our actions have intentions behind them, whereas the performances (behaviors) of quarks, microbes, and machine tools do not" (2010, p. 565). According to the material-semiotic approach, the complex webs of interactions among the disparate parts and elements of networks and systems are co-constructed by conceptual webs (human) and material webs (non-human). Therefore, what are agentive are networks and systems. In order to self-sustain, these networks and systems should constantly perform the relationalities that they embody. This is why Latour, one of the founders of actor-network methodology, states that "the object of a performative definition vanishes when it is no longer performed" (2002, p. 37).

I situate the notion of performativity in these performing networks and systems, which are co-constructed by conceptual and material webs that constantly transform into one another and transform each other such that they cannot be distinguished from one another. What is at stake here, I argue, is the a priori materialization of conceptual relations and a priori formalization of material relations. Therefore, when we refer to conceptual relations, we are already referring to material relations, and similarly, when we refer to material relations, we are already referring to conceptual relations. As Hayles (1999), whose approach resonates with the material-semiotic theory, succinctly puts: "Conceptual fields evolve similarly to material culture, in part because concept and artifact engage each other in continuous feedback loops. An artifact materially expresses the concept it embodies, but the process of its construction is far from passive" (p. 15). While material relations express the conceptual relations that they embody, conceptual relations express the material relations that they embody. However, because there is not any one-to-one correspondence between the conceptual and material webs of relations, this process is recursive. It repeats itself infinitely. That is, the conceptual webs reconstruct the web of material relations while mapping the material relations. These material relations necessitate the generation of new conceptual webs, which, once again, reconfigure the webs of materiality. The interaction between the two is always being reconfigured. The interaction between conceptual and material relations operates via this type of recursive feedback loop, because there is always dislinkage between conceptual and material relations. There is dislinkage because the spatio-temporal relations that conceptual relations construct are disjointed from the spatio-temporal relations that material relations construct. Therefore, the recursive feedback loops between the conceptual and material relations is essentially spatio-temporal. Rather than trying to rejoin this disjunction between the conceptual and material relations via representation and identification, performative approach affirms the potentiality of the spatio-temporal gabs that connect things together. My interest in new media art is related to the performance of these spatio-temporal networks and systems. It is for this reason that I turn to cybernetics.

3. Cybernetics

The science of cybernetics was developed by thinkers from a variety of disciplines, ranging from philosophy, mathematics, and biology to engineering, neuroscience, and psychology, to examine the operational logic of systems via information and communication technologies. Cybernetics attributes a status of vitality to mechanical, electrical, and digital phenomena. By arguing that the same principles can be used to explain the basic operations of both the living and the non-living, it erases the distinction between the biological and technological.

Cybernetics involves studying the contingency and dynamism of information flow among interconnected complex systems, which are co-constructed by human and non-human agencies. It attributes agency to relational systems rather than to independent, discrete, or isolated things. Whether these things are animate or inanimate does not matter. What matters is the operational logic of the system itself. If what is at stake here is erasing the distinction between human and non-human agencies and understand the world in terms of networks and systems co-created by human and non-human agencies, then the starting point should be neither the subject nor the object. I argue that the complex networks of interactions among things (human and non-human) can only be conceived in terms of the spatial and temporal networks among these systems.

It is crucial to note here that cybernetics and systems theory are considered as overlapping fields with many similarities and commonalities. The diversity of systems thinking, and its interdisciplinary nature, necessitates and fosters various disciplines and fields to engage with the subject and bring different

methodological strategies together catalyzing them to generate new forms of thinking. However, I am primarily concerned here with the contemporary conception of systems; systems as complex, dynamic, contingent, open, vital, heterogeneous, process-driven, non-linear, multiple, and interactive entities. This more recent approach that has replaced the static, mechanic, deterministic, causal, hierarchical, and stable models can be traced back to early twentieth century. It includes contributions from many diverse research areas. However, whether it is biological, ecological, linguistic, social, psychic, aesthetic, literary or technological systems, there is a general agreement among variety of disciplines on how systems operate. Broadly speaking, systems interact and communicate with their environment by constantly exchanging information and transforming the states of each other. The complex webs of interactions among disparate and heterogeneous elements makes the structure of communication among the systems dynamic, contingent, open, asycnhronic, decentralized, chaotic, non-linear, distributed, interactive, and dissociative. What concerns me here is the study of complex systems within a cybernetic framework.

Now, despite the constant transformations concerning the implications of cybernetics and the absence of any unified theory, The Macy Conferences, held between 1943 and 1954, provided the background to the development of cybernetics and introduced its basic characteristics. While my purpose here is not to provide a detailed historical analysis, a brief overview will help us understand the conceptual changes promoted by the ongoing research and publications continuing to date. This historical and conceptual overview will follow the three waves of development as they are outlined by Hayles in the following terms: "The first, from 1945 to 1960, took homeostasis as a central concept; the second, going roughly from 1960 to 1980, revolved around reflexivity; and the third, stretching from 1980 to the present, highlights virtuality" (1999, p. 7). I will also discuss Clarke and Hansen's overview. There are overlaps as well as discrepancies between the two approaches. However, engaging with both perspectives will enrich the conversation to a great extent.

According to Hayles (1999), while first-wave cybernetics conceived the information transfer in terms of homeostasis and stability of systems, second-wave cybernetics linked this informational feedback loop with reflexivity to explain the dynamism inherent in systems. Basically, reflexive informational feedback loop means that a system includes a map of itself by observing itself as a system to be observed. Put differently, the system perceives itself as an observing system via the feedback loops with the environment. Systems feed back onto themselves. It is through these reflexive feedback loops with the environment that the observer and the observed constantly transform into each other such that the boundary between the two disappears.

However, regardless of how important was the notion of reflexive feedback loop in understanding the information exchange and transfer among systems, it was disregarded in the Macy Conferences for two reasons. First, it was threatening for the well-established scientific objectivity. Second, the participants of the Macy Conference did not have the language to explain what it means for an observer to be integrated into the observed system, and hence, transform the very state of the system that is being observed: "Reflexivity entered cybernetics primarily through the discussions about the observer … the word 'reflexivity' did not appear in the transcripts"(p. 9). This passage demonstrates that analyzing information-processing systems within a cybernetic framework does not pertain only to the necessity of an integrated approach to the study of science and technology but also identifies the necessity of philosophical inquiry.

Hayles (1999) underlines the importance of philosophical inquiry while giving a description of the term reflexivity:

> (…) the more threatening and subversive idea of reflexivity … Reflexivity is the movement whereby that which has been used to generate a system is made, through a changed perspective, to become part of the system it generates. When Kurt Godel invented a method … he entangled that which generates the system with the system. (p. 8-9)

However, despite the explicit philosophical and mathematical references to the notion of reflexivity, Hayles does not give a detailed analysis of what her description means. To grasp how the feedback loops take place between an observer and the observed system, I will further explain the term reflexivity.

Before proceeding with this, I would like to refer to Clarke and Hansen's (2009) criticisms of Hayles' use of the term reflexivity. Through an exploration of Heinz von Foerster's texts, a famous cybernetician who initiated second-wave cybernetics, Clarke and Hansen argues that Hayles uses the misnomer reflexivity instead of the proper cybernetic term recursion. "Reflexivity," they write, "is inextricably inscribed within the discourse of subjectivity" (p. 1). They add that "subjectivity [is] embedded in the use of the

subject/object distinction to begin with – when, as von Foerster labored to show, it is the subject/object distinction itself that is the conceptual aberration to be deconstructed" (p. 1). Instead of reflexivity, Clarke and Hansen use the term self-referential recursion. Since the use of terms is context-dependent, in this context I don't think there is any difference between using self-referential recursion or reflexivity. Both Hayles and Clarke and Hansen use the terms reflexivity or self-referential recursion in order to explain the significance of operational closure of systems for the second-wave of cybernetics. In both approaches, Francisco Varela's notion of autopoiesis, through which Varela explains the closure of systems, plays a key role. To this end, Hayles writes: "the center of interest for autopoiesis shifts from the cybernetics of the observed system to the cybernetics of the observer"(1999, p. 10).

Along similar lines, Clarke and Hansen (2009) argues: "some of the most important theoretical and critical conversation going on today … stem from neocybernetic notions of self-reference, emergence, and autopoiesis" (p. 3). If, bringing von Foerster and Varela together, both perspectives situate reflexivity or self-referential recursion in the context of operational closure of systems, then the main question here is how the boundary separating a system from its environment is also what enables the communication to take place among systems. In other words, how does the observer *in-here* becomes integrated into the observed system *out-there* such that the boundary between the two disappears, but at the same time it is still there? By referring to the fact that von Foerster's revolutionary ideas on cognition had still not been understood by the mainstream academic thinking, Varela argues: "our current models about cognition … are severely dominated by the notion that information is *represented* from an *out-there* into an *in-here*" (*my emphasis,* quoted in Clarke and Hansen, 2009, p. 2).

Therefore, the basic failure in understanding how complex systems operate is the representational model with which we try to grasp these systems' operations. My purpose here is to show that there is not any unified system such as observer or observed, but there are many components and parts of these two systems that interact with each other. There is not any observed object that is outside the observer as there is not any observer outside the observed system. Both the observer and the observed are themselves systems with many components and parts. These components or parts interact with each other and form sub-systems. Thus, there are many systems within systems. This is how complexity is achieved. My reformulation of performativity is based upon these complex sets of interactions among the disparate and heterogeneous elements and parts of systems. The question here is how we can formulate the cybernetic notions of self-referential recursion, emergency, and autonomy in terms of performing networks or systems?

Now, according to Clarke and Hansen (2009), first-order cybernetics fails to capture the materiality of the medium in which information is instantiated. From this perspective, information can be abstracted from its medium and can exist independent of its material substrate. The basic idea is that information can be dematerialized into certain formulas and codes and the decontextualized information can survive without the medium with which it exists. However, neocybernetics (the term they use for second-order cybernetics) shifts the ground and formulates a radical thesis concerning materiality and embodiment: "The strong constructivism of neocybernetic systems … the environments and embodiments of systems" (p. 5). Engaging with embodiments of systems necessitate engaging with media in which information is materialized. This shift of attention from disembodied information to the embodiment of information in specific forms of media makes the matter/form dichotomy further complicated. In other words, this paradigm shift does not imply a shift from immateriality of information to the materiality of media. If the medium within which information is materialized demonstrates itself at the level of systems, then materiality refers here to the complex interactions between components and parts of systems. Information is always inscribed within a medium, it is inherently material. However, material is also inherently immaterial, because it operates at systems level. This idea demonstrates that the relationship between matter and form is entering a new phase. Clarke and Hansen identify this new phase as a transformation from matter/form dichotomy to the distinction between form and medium. Yet, the distinction between form and medium does not imply a duality here: "Forms are temporary fixations of elements within a medium, and when enough like forms coalesce, they become another medium for a new, emergent set of forms" (2009, p. 4). Although I agree with the way they address the emergence of new forms in relation to the notion of medium, I divert from their approach in terms of the distinction between form and medium. Instead, I define medium as the differentiation of matter and form. Form materializes itself in matter simultaneously matter is informed in form. Therefore, I think, information refers to the process of in-formalization of matter. Information does not then free itself from the material, but it differentiates matter from the matter it was. In other words, matter becomes information through form. It becomes information

by materializing the form, in that matter differentiates form from the form it was. It is through this differentiation that matter and form become identical. Medium is this differentiation itself.

Returning back to second-order cybernetics' emphasis on information's embodiment at systems level by forms of media, the question that still remains is why these forms of media within which information is instantiated operate by self-referential recursion. Autonomy is reconsidered as self-reference, because systems communicate with their environment only by closing in on themselves. Self-reference means here that systems turn back on themselves. They determine their own limits by closing in on themselves. This operational closure as the limit is the condition of system's presence. A self-referential system marks out its presence by crossing over its limits at the moment it is present. By marking itself out, the system marks its outside and inside spaces simultaneously. Limit is thus the mid-place, the medium between the inside and outside. It is an intermediary device that demarcates set of contact points between systems and their environments.

In order to clearly demonstrate how and why various components and parts of systems interact to produce multiple observing systems through the operational self-reference that Clarke and Hansen (2009) is discussing, I believe that one needs to approach to the complexity of communication among systems within the framework of space and time. What is missing in both Hayles' (1999) and Clarke and Hansen's (2009) conception of reflexivity or self-referential recursion is the discussion of the subject from a spatio-temporal perspective. In order to understand *the multiple observing systems* and the infinite regression of reflexivity, one needs to discuss self-reflexive or self-referential systems from a multi-dimensional perspective. Communication among complex systems takes place in multiple spatial and temporal realities, so it can never be fully comprehended by a two-dimensional approach.

As Hayles refers to Kurt Godel's theory, Karatani (1995) also explains self-referentiality by drawing on Kurt Godel's mathematical logic: "Godel discovered a…seemingly self-enclosed movement … a self-referential paradox" (p. 15). Now, to establish the logic of the relation between self-referential paradox and "changed perspective", let us begin with examining Karatani's commentary on Georg Cantor's conception of set theory:

> With this, the paradox of set theory emerged, which can be described as follows: 'if we grant the theorem 'Given any set, finite or infinite, a set with more elements can always be obtained,' then the moment one considers 'the set of all the possible elements,' a contradiction arises. (1995, p. 18)

What Karatani calls Cantor's self-referential paradox can be expressed as follows: once the set of all the possible elements is enclosed within a set, or when the set closes in on itself by forming one out of itself, it frames or delimits itself. The question then becomes: if the set of all the possible elements is the infinite set, how can the infinite set have limits? By definition, the infinite set is infinite, in that everything belongs to it.

The reason is the following: once a set closes in on itself, it not only determines its own limits, and hence, constitutes itself, but simultaneously, it determines its out-of-field, which does not belong to the set itself. Consequently, the set of all the possible elements is not the set of all the possible elements. If all does not belong to it, it is not infinite. However, it is infinite at the same time, because an infinite set could exist only in the condition of having a set with all the possible elements.

The self-referential paradox thus implies the fact that any set, by closing in on itself, makes this closure simultaneously possible and impossible. As we can see, the self-referential act (the set becoming one by closing in on itself) and self-differentiating act (by closing in on itself, it differentiates itself from its out-of-field) are one and the same movement. It is thus necessary, according to Karatani (1995), for anything self-referential to refer to its beyond to arrive at itself. The self-differentiating set can never close in on itself. Yet, simultaneously, it can only differentiate itself by referring to itself, that is, by closing on itself. Therefore, the *self-referential paradox* to which Karatani alludes is the difference between the structure (inside) and the metastructure (outside).

The infinite set is infinite, but it is not the only set that is infinite. By revealing the multiplicity of infinities, what Karatani calls Cantor's self-referential paradox demonstrates that there are multiple infinities that are interlocked within each other. Therefore, the set of all the possible elements becomes one with itself as it simultaneously becomes an infinite set. The out-of-field of any set is located beyond the frame of the set itself. That is, the metastructure is located beyond the structure of the set but is not transcendent to it. On the contrary, the beyond is with-in at the same time that it is with-out. Therefore, the infinite set, the set of all the possible elements, is a set that has become singular by closing in on itself as an infinite set. Basically,

infinity becomes singularized when the infinite set becomes one with itself. However, beyond the limits of infinity, there are other infinities. In other words, there are multiple singularized infinities. The interaction between different layers of sets makes the structure of communication among the sets multilayered. They interact at multiple spatio-temporal realities. Complexity results from the components or parts of sets interacting with each other simultaneously at different spatio-temporal realities and constantly forming new systems within systems on to infinity.

As a result, this kind of interactivity among closed systems leads to the emergence of new forms. Interaction with the environment operates as a mechanism that links discrete and dynamic components or parts together to constitute various sets of configurations, which are always open to new configurations. It is in this way that these complex systems are able to produce new codes, configurations, and constellations. Therefore, the aim here is to describe the systemic environment itself as a self-generating complex system. Consider, for example, computer-generated digital life forms and cybernetic organisms, which have the capacity to reproduce, survive, evolve, transform, mutate, and behave in the directions that had not been programmed by their designers. These systems autonomously transform themselves by interacting with their environment.

According to Hayles (1999), emergency is the essential element of third-wave cybernetics: "The third wave swelled into existence when self-organization began to be understood not merely as the (re)production of internal organization but as the springboard to emergence" (p. 11). One of these researchers, who coined the term machinic life to identify these new forms of life, is Johnston. Johnston (2008) points out that the main problem with this kind of research is the employment of representational and biomimetic models: "In practice this means that questions about the functionality and meaning of these machines are always framed in mimetic, representational terms" (p. 3).

By representational models, the assumption is that the feedback loop and structural and dynamic coupling with the environment is not a necessary component for the development of complexity. All of the prescribed conditions are generated by the designer during the initial implementation of the model. However, the investigation of the dynamics of artificial or physical life forms clearly demonstrates that complexity results from the embodied interaction with the environment. Johnston (2008) writes, "Note that feedback and self-regulation … are always understood by the cyberneticists in terms of pure physical embodiment and performance, not symbol making and representation" (p. 30) Therefore, that which creates complexity is not the inner-workings or operations of an isolated machine, but its interaction with the environment: In other words, complexity becomes a matter of process-driven programmatic flexibility. The spatial milieu or the environment is here a territory of incessant creative action and information. These organisms do not passively experience their environment according to pre-determined orientations and choreographies. They do not demonstrate an incredibly complex structural-engineering, but rather advocate an innovative experimentation in process-based learning. Therefore, they are not built by implementing a high intelligence and a high capacity of carrying out specific tasks, but rather by designing an organism that has the capacity to learn things by interacting with the environment in time and through accidents and trial and error.

4. Conclusion

According to Burnham (1968), these information-processing systems are the new machines, which transform the one-way contemplative relationship between the viewer and the art object into the two-way communication loop that operates by the interactive feedback loops of information between the user-participant and the artwork:

> The computer's most profound aesthetic implication is that we are being forced to dismiss the classical view of art and reality which insists that man stand outside of reality in order to observe it … It may be that the computer will negate the need for such an illusion by fusing both the observer and observed, 'inside' and 'outside'. (p. 103)

Traditionally, the observer and the environment are viewed as two separate units in which outside world relays information to the observer and the observer upon processing this information internally produces a representation of the outside world and then interacts with the outside world by projecting the represented image onto the world. However, it is necessary to consider a different rationale and theory for explaining the interactions between systems and their environment. Rather than the cause and effect relation between an observer and the observed system, we are now going to consider that the observer

constantly modifies or changes the environment and that the environment constantly modifies or changes the observer such that the observer and the observed cannot be separated from one another. This mainly explains how the various components and parts of a system relay and process information and through this interaction produce complex interactive systems. Systems operating in this manner can develop complexity through successive interactions of its components and eventually the boundaries between the observer and environment are lost in the transaction. Thus, observer and observed are considered here as components of a system, which autonomously generates and transforms itself. Burnham's vision of the cybernetic art endorsed deploying art objects as vital and living systems. The networked environment between the artwork and participant would merge the two systems (human-machine) by integrating the biological and the technological systems.

While the passive contemplation of an artwork is contingent upon visual perception, new media technologies disavow this ocularcentric view by defining the complex interplay between the machine and the human as an embodied interaction rather than a disembodied one. The interaction between the two is played out in the systemic level, constituting the machine as the extension of human and human as the extension of machine. This stresses the importance of the circuits between the human and the technological systems, generating the concept of networked environments. As Burnham writes, "a dialogue evolves between the participants – the computer program and the human subject – so that both move beyond their original state" (1968, p. 119). What is at stake here is neither the human nor the machine, but rather the medium, which is constructed by the recursive feedback loops between the two.

This performative approach seeks to transform the design of these physical and digital organisms from a linear model of top-down imposition into a multi-modal system of bottom-up co-ordination. The bottom-up approach disregards the linear organizational models and instead presents a horizontal rhizomatic system. In a serial system, there is one directional flow of information in the design of the different components of the system. There is a prescribed and predetermined path through which the productivity of the system is measured and evaluated. The performance of the system is based on a linear progression of the measurable variables or on the capability of the system to resolve each action one after the other. The system carries out functions in a linear order in which each part of the desired output is broken into discrete tangible actions which must be carried out in a specified sequence. Thus, if one action is not completed, all the other sequential actions cannot be performed. This can be one of the limitations in a serial system whereas in parallel processing multiple actions can be carried out simultaneously by different components interacting with each other to achieve the desired output. In this system, various components can arrive at complexity independent of one another creating a network type interaction.

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