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Contemporary Art and Cybernetics: Waves of Cybernetic Discourse within Conceptual, Video and New Media Art

Etan J. Ilfeld

While ideas and concepts have always been the creative fuel of both the arts and the sciences, the defining characteristics of “information” have remained vaguely drawn, polemicized and a constant topic of investigation within 20th-century art and academia. The artworks surveyed in this paper will illustrate a set of artifacts highlighting the thematic overlap between cybernetics and art. We can trace these correlated developments by linking the *skeuomorphs* of information theory and cybernetics within the conceptual art of the 1960s and the video and new media art of the 1970s and the 1990s. A *skeuomorph* is a term from archaeology, indicating a design feature that is no longer functional. In the development of cybernetics, *skeuomorphs* can signify and act as threshold devices/ideas denoting a transition and influence from one wave/constellation to another.

The first wave of cybernetics began with the Macy conferences in New York City between 1946 and 1953 and drew together an interdisciplinary set of participants, which included some of the period’s top scientists. *Cybernetics* stems from the Greek root *kybernetes*, meaning steersman or governor; Norbert Wiener defined cybernetics as the study of communication and control in both animals and machines [1]. Cybernetics has since diverged into a number of fields, such as information theory, artificial intelligence, artificial life and bio-informatics (Fig. 1).

DEFINING “INFORMATION”

Information as a word is often used loosely and is rarely delineated. It is the noun of action for *to inform*, where both *inform* and *informatio* had previously existed in Latin. *To inform* traditionally meant “to give form to” or “to form an idea of.” Thus, to inform can be thought of in a multiplicity of ways: It can define that which has no form (i.e. pure content) or rather that which creates form. In *The Republic*, Plato often used the Greek word for “form,” *Eidos*, as the essence of something (i.e. ideal form), which could also denote a concept, thought or even proposition. Ultimately, Plato’s *Eidos* denoted a disembodied, immaterial and transcendental ideal. According to Katherine Hayles, one of the first concepts to come out of the Macy Conferences was the reification of information flows

such that information itself began to be considered more important than the physicality of matter, energy and noise, thereby returning to a pseudo-Platonic ideal by envisioning information as a disembodied entity [2].

After debating possible definitions of information, in an attempt to pin down a mathematical definition, scientists Wiener and Shannon argued for a decontextualization of information as a probability function that quantifies a message that is independent of a receiver’s frame of reference. Thus, the conceptualization of information emerged as a signal whose opposite is entropic and statistical noise, and information was mathematically defined such that it would have the same numerical value regardless of its content [3].

ART AS CONCEPT AND IDEA

It should come as no surprise that many artists were fascinated by the meaning and possible interpretation of information. Indeed, Marcel Duchamp had already deflated the aesthetics of materials by working with an assemblage of immaterials, or rather, ideas. One of Duchamp’s first readymades was a standard Bedfordshire urinal that he purchased in 1917 and submitted to an art exhibition that had proclaimed it would display all art entries. The piece, entitled *Fountain* (Fig. 2), was rotated by 90° and signed with the pseudonym “R. Mutt” [4]. Although Duchamp was on the committee of the exhibition, the board members were unaware of his involvement with *Fountain* and subsequently decided to hide it during the exhibition, as they could not agree whether or not *Fountain* could be considered an artwork.

Certainly, Duchamp’s readymades precipitated 20th-century conceptual art, which further entrenched its immateriality via its McLuhanite and cybernetic emphasis on information theory in the 1960s.

CONCEPTUAL ART: 1950 TO MID-1970s

Everything we do is music [and] everyone is in the best seat.

—John Cage [5]

Duchamp’s ideas were developed by conceptual artists including Sol LeWitt, who further stressed that the idea/concept

ABSTRACT

This paper aims to highlight the interplay of technology and cybernetics within conceptual art. Just as Lucy Lippard has illustrated the influence of information theory within 1960s conceptual art, this paper traces the technological discourses within conceptual art through to contemporary digital art—specifically, establishing a correlation between Katherine Hayles’s mapping of first-, second- and third-wave cybernetic narratives and, respectively, 1960s–1970s conceptual art, 1970s–1990s video art and new media art. Technology is shown to have a major influence on conceptual art, but one often based on historical, social and cybernetic narratives. This paper echoes Krzysztof Ziarek’s call for a Heideggerian poiesis and Adorno/Blanchotnian “nonpower” within conceptual art and advocates Ziarek’s notion of “powerfree” artistic practices within new media and transgenic art.

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Period	Player	Homeostasis	Reflexivity	Virtuality	Artifacts	Skeuomorphs
Homeostasis <i>1945</i>	Shannon MacKay McCulloch Pitts Kubie von Foerster	feedback loop information as signal/noise circular causality instrumental language			electronic rat homeostat electric tortoise	man-in-the-middle
Self-Organization <i>1960</i>	von Foerster Maturana Varela	quantification	reflexive language autopoiesis structural coupling system-environment		frog's visual cortex	homeostasis
Virtuality <i>1985</i>	Varela Brooks Moravec			emergent behaviour functionalities computational universe	simulation mobile robot	self-organization

of a work is more important than the aesthetics of the object and focused instead on the communicated content [6]. LeWitt's premise became anti-formalist or rather informalist, and LeWitt developed conceptual art as a "postobject" art form. Meanwhile, the conceptual artists of the 1950s were very much aware of the cybernetic discourses that were prevalent at the time. As early as the 1950s, John Cage's composition *4'33"* could be viewed as a subversive deconstruction of Shannon's information/noise binary. *4'33"* was first performed by David Tudor in 1952 at Woodstock, New York; the piece consisted of three movements during which Tudor would open and close the keyboard lid while waiting silently for the audience to settle, thereby allowing the audience unknowingly to "perform" and alluding to the fact that there is no such thing as silence. Even the length of 4 minutes and 33 seconds was chosen by chance using an I Ching process. *4'33"* can be viewed as a rebuke of Shannon and Wiener's signal-based information, which had championed signal over noise; after all, it is precisely the "noise"—whispers, coughs and ambient sounds—that became the actualized message/signal in *4'33"*.

gradient” [8]. In 1970, the “Information” show at the Museum of Modern Art (New York) celebrated the American apogee during which the synthesis of cybernetics and conceptual art was manifested in films, videos and avant-garde works such as John Giorno’s *Dial-A-Poem* and Adrian Piper’s blank notebooks that asked the viewers to collaborate: “write, draw or otherwise indicate any response suggested by this situation (this statement, the blank notebook and pen, the museum context, your immediate state of mind, etc.)” [9].

1. The recorder is equipped with a continuous loop tape.
2. The recorder will be set at record. All the sounds audible in the room will be recorded.

4. Proof of the existence of the information does in fact not exist in actuality, but is based on probability [10].

Certainly, Kozlov's notion of information as probabilistic is much in line with Shannon, and *Information: No Theory* emphasizes the dematerialized and transient nature of conceptual art. Similarly, Jack Burnham's seminal 1968 essay "System Aesthetics" claimed that the "non-objects" of conceptual art establish a "transition from an object-oriented to a systems oriented culture [where] change emanates, not from things, but from the way things are done" [11]. Lippard's text *Six Years: The dematerialization of the art object* further traces conceptual art's de-emphasis on the traditional materialist aspect of art as unique, permanent or aesthetically attractive; as a result, conceptual art began dematerializing the artworld. However, Lippard admits that "dematerialization" was an exaggerated term, since conceptual art is still physically stored or embodied via a piece of paper or photographed documentation.

Conceptual art's emphasis on the immaterial coincided with its critique of capitalistic and materialistic/consumer culture. In fact, much conceptual art during the 1960s was not meant to be sold but rather to be kept as part of a gift-economy of ideas. In many cases, when conceptual art was sold the purchase was largely a matter of supporting the artist financially.



Fig. 2. Marcel Duchamp, *Fountain*, 1917. (© 2011 Artists Rights Society [ARS], New York/ADAGP, Paris/ Succession Marcel Duchamp. Photo: Alfred Stieglitz, © 2011 Georgia O'Keeffe Museum / Artists Rights Society [ARS], New York.)

Cultural theorists Scott Lash and Celia Lury explain 1960s conceptual art as follows:

The ideas or concepts of [1960s] conceptual art are a “self-regulating series and systems of rules for the production of objects out of preformed materials. They are a series of propositions, systems of rules (and the parallel with the feedback loops of computers and other new media objects such as brands is worth drawing)” [12].

The circulation of ideas maintained a primacy over their material channeling. In the spirit of Duchamp’s ready-made, Cildo Meireles “hacked” Brazil’s social systems of distribution by recycling Coca-Cola bottles after painting “Yankees Go Home” onto them; in a similar interventionist manner, Meireles added authentic-looking stamped messages onto banknotes, with oppositional political slogans [13].

Arakawa’s *Sculpting No. 1* (1961–1962) attempts to transcend materiality by utilizing arrows that point beyond the canvas’s edges, thereby directing the viewer toward an invisible work outside the painting. By igniting the viewer’s imagination, *Sculpting No. 1* relinquishes control of the perceptual experience yet maintains its influence through its physicality. Thus, the expected and unexpected are intertwined—a central motif in conceptual art—analogueous to information theory’s signal and noise interdependence.

In Argentina in 1969, Graciela Carnevale welcomed visitors to his show, which consisted of an empty room with a glass window; he locked the visitors inside and waited for over an hour, until they finally broke the glass window and escaped [14]. Carnevale’s experimental art created an interplay between unexpected behavior and the expected/controlled physical structure, which was sufficient to motivate the audience to perform Carnevale’s intention of breaking the window: His piece transformed his audience from an indeterminate mob into a controlled signal, whose message was transmitted by their breakout. Meanwhile, the amount of time it took the audience to escape remained indeterminate until the event was actualized.

VIDEO ART: 1970s TO MID-1990s

In the second wave of cybernetics, Gordon Pask extended its realm to include the study of information flows in *all media* (e.g. feedback loops in cosmology, cognitive science and the theoretical in-

teraction of any actors/agents) [15]. Certainly, it is not surprising to imagine that this conceptual expansion might seep into the art sphere and be synthesized with the technology of video.

Some art texts claim that between the mid-1970s and the early 1990s, media art had faded in response to the counter-culture, which included many artists and curators who began to associate technology with the Vietnam War and corporate capitalism [16]. However, conceptual artists, along with newcomers, kept experimenting with video art and produced a great deal of thought-provoking work during this period. Curiously, whereas the first wave of cybernetics followed the antiquated scientific paradigm of an observer outside a system—as Hayles points out, the term “reflexivity” does not appear at any single point of the original Macy transcripts—the second wave was determined to incorporate notions of reflexivity [17].

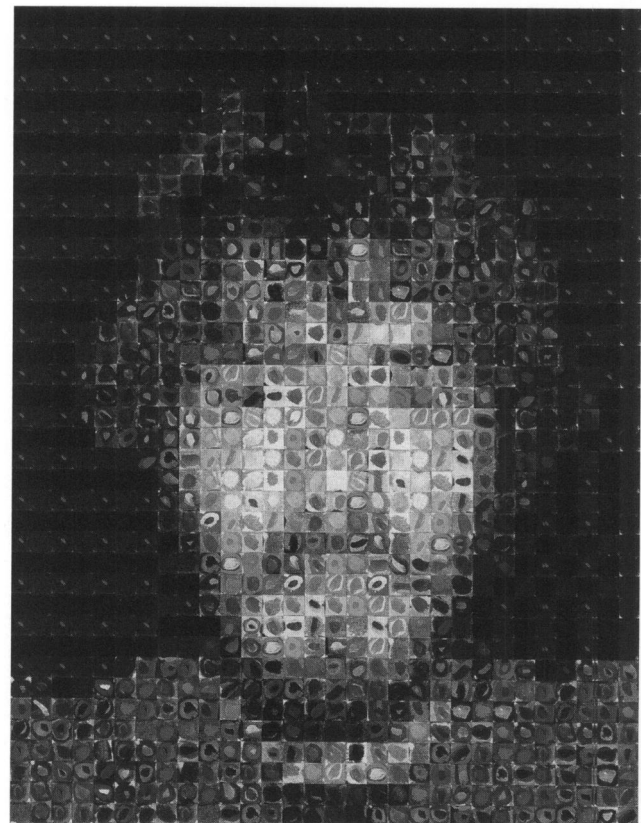
Scott Lash has suggested that video art may be a possible model for second-wave conceptual art, whose ideas often involve the “mediascape” and the information economy [18]. Curiously, much of the video art from the 1970s into the 1990s also corresponds with second-wave cybernetic thought.

Indeed, Humberto Maturana’s neurophysiology research proved in the late 1950s that a frog’s visual perception con-

structs reality into what it wants/needs to see, which are small and fast-moving flies rather than large and slow-moving animals such as cows. Later, with Francisco Varela, he developed the term *auto-poiesis* to describe a living system through its ability to self-organize, while insisting that organisms were structurally coupled with their environment. Second-wave cybernetic discourse stressed that language is structurally coupled as a social system founded on a “reciprocal consensus” and therefore not representative of an external reality but rather of “consensual objects” [19]. Thus, Maturana and Varela emphasized reflexivity and an inevitably constructed subjectivity that permeates disciplines ranging from philosophy all the way into the hard sciences.

Video art’s specificity is inherently reflexive: Video’s closed-circuit feedback technology enables the transmission of live images capable of denoting their own structural organizations; this feature stands in direct opposition to the illusionism of film and TV, motivating the slogan “VT ≠ TV” (videotape is not television), which was employed during this time [20]. Additionally, video art maintained the dematerialist trend of first-wave conceptual art, as both tape recordings and live feeds projected onto screens dematerialized physical objects into visual representations—prompting a videotaped Jean Baudrillard in 1988 to

Fig. 3. Scott Blake, *Self Portrait Made with Chuck Close Filter*, net art, 1500 × 1950 pixels, 2008. (© Scott Blake)



ask: “Am I a man, or am I a machine?” [21]

Influenced by his participation in the Fluxus movement, Nam June Paik also began exploring video art and as early as the 1960s had created his first multitelevision-sculpture work, *TV Cross*. However,

it was not until 1974 that Paik created one of the first sculptural-video feedback installations, *TV-Buddha*. By creating a live feed of a Buddha statue, Paik’s work generated interplay between Western media and an Eastern icon—enabling the viewer to interlace his own image

into this media ecology. Paik considered broadcast TV to be an oppressive institution, which he attempted to subvert by turning the viewer into a user of the medium [22].

Akin to video, phenomenology contradicts realism by insisting that objects only exist for a user. Video’s structural coupling and phenomenology both shift objective judgment toward experience through the realization that there is no such thing as a subject-at-a-distance [23]. As a result, video art installations such as Paik’s *TV-Buddha* (1974) and Bruce Nauman’s *Live/Taped Video Corridor* (1970) address a subject that is fully immersed and invite the viewer to self-reflexively play with his or her environment, continuing conceptual art’s tradition of transforming its audience into an active user rather than a passive viewer.

MID-1990s TO PRESENT DAY

“You’re just analog players in a digital world.”

—*Ocean’s Thirteen* (Film, Warner Brothers, 2007)

The recent obsession to digitize is prevalent in everything from the Human Genome Project—completed 5 years ahead of schedule, in 2003—to Google’s attempt to digitize all the books within Stanford University’s libraries. Inevitably, as with Shannon’s noise-signal informatics, interpretation and digitization are confluent with discrimination (a close cousin of censorship) and are a loss of that which does not surpass the analog threshold from which a digital signal emerges. Additionally, digitization reinforces the realm of the virtual; as early as 1985, third-wave cybernetics explored the digitally structured worlds that could be created either as virtual representations of our physical world or as autonomous entities within the field of Artificial Life. Certainly, digital/virtual representations come with many advantages over “real”-world physical objects. Unlike physical objects, virtual objects can be transported at the speed of light and perfectly duplicated. Thus, the recent “Information Age” (or rather Digital Information Age, if we consider the information age to have begun with first-wave cybernetics) has sparked an all-encompassing digitized convergence. Even video art became digital in the 1990s and, as such, a sub-genre of new media art. Jean Baudrillard claimed that the digitization of biology (DNA), sound recording, TV/film, information

Fig. 4. Vuk Ćosić, *Deep ASCII*, ASCII animation, 1998. Programming by Luka Frelin. (© Vuk Ćosić)

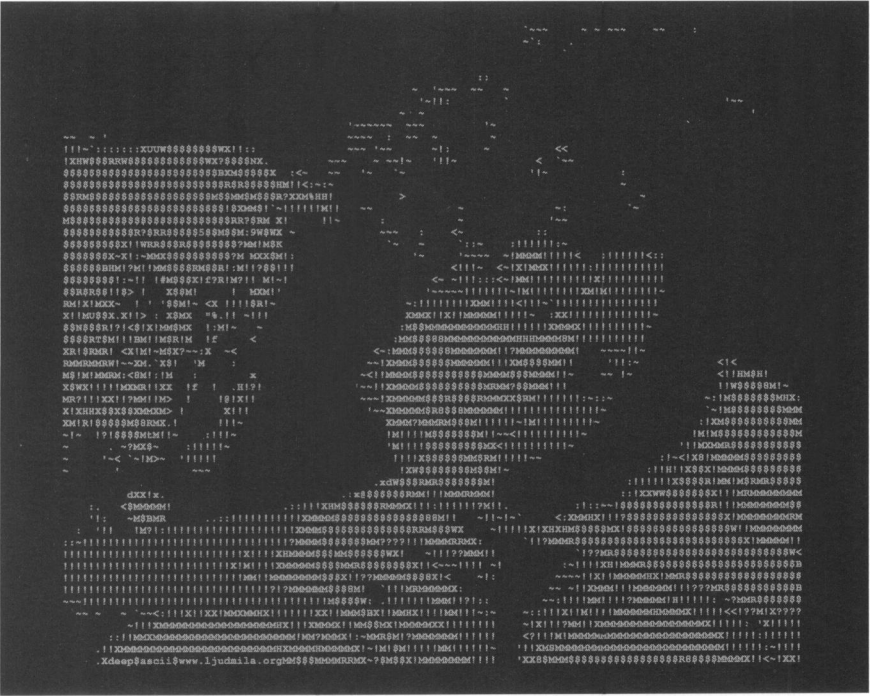


Fig. 5. Jeremy Wood, *My Ghost*, GPS drawing, 2000–2009. (© Jeremy Wood)



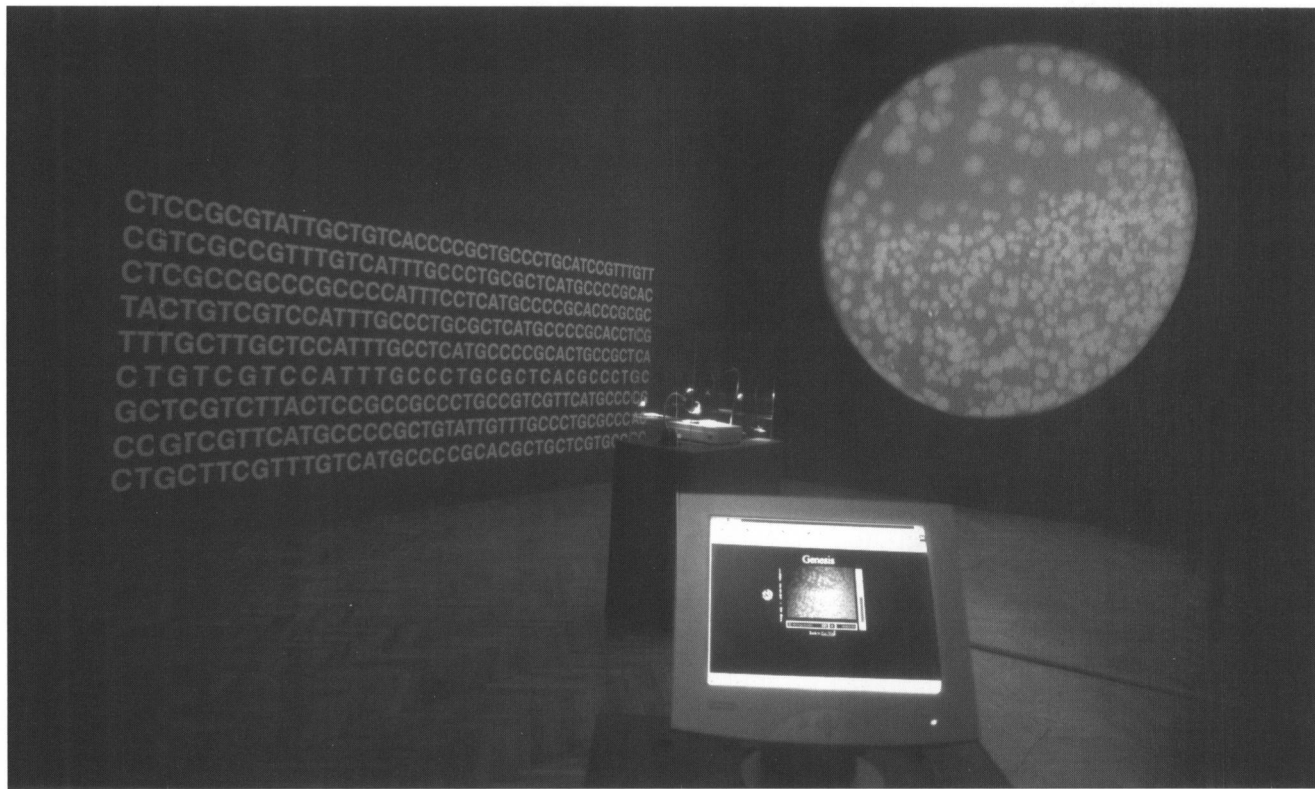


Fig. 6. Eduardo Kac, *Genesis*, transgenic work with artist-created bacteria, ultraviolet light, Internet, video (detail), edition of 2, dimensions variable, 1999. Collection Instituto Valenciano de Arte Moderno (IVAM), Valencia, Spain. (© Eduardo Kac)

technology, etc. generated the idealization of reproducible codes such that there is no longer any meaningful difference between a copy and its original [24]. Of course, 1960s conceptual art had already emphasized collaboration, de-authorship, dematerialization and the un-uniqueness of the art object; however, digitization shifted the notion of “post-object” art into a virtual object and introduced a digitized production process whose ontology intermixed creation with technological duplication.

In classical Greece, *Technē* was known as the patron goddess of practical knowledge and art, and the word *technē* was used to refer to art and was responsible for the Greek derivation *technē*—meaning “to create” [25]. In *The Origin of the Work of Art* (1935) and *The Question Concerning Technology* (1949) [26], Martin Heidegger pointed out that the root *technē* within *technology* originally implied a mode of revealing that which is hidden. Heidegger claimed that within art, *technē* was a “bringing forth out of concealedness” as a form of creative poiesis; whereas, within an instrumental context such as science, *technē* implies a mode of technicity that discloses intrinsically calculable resources. Technicity is that aspect of the creator/user/viewer’s identity that both forms and is represented via technological differentiation [27].

According to Krzysztof Ziarek, as technicity becomes digitized in the “Information Age,” Adorno and Heidegger’s terminology can be rephrased as: Calculation becomes computation; manipulability or instrumentality becomes programmability; enframing becomes formatting, or mainframing; resources and standing reserves become databases; and technicity becomes synonymous with digitality. Ziarek also claims that the technicity of digitization can be folded upon itself so as to reveal a form of poiesis; that is to say that technology can be operated in a non-instrumental mode of play, and that its digitization can be creative—thereby generating a space for digital art.

It is interesting to note that digital art does not necessarily need to be in binary code or magnetically archived. In fact, one could consider Chuck Close’s meticulous paintings within the realm of digital art, as their grid-based production process involves a form of digitization and strongly alludes to computerized pixels. Indeed, Close’s fractal-like pixel-within-pixel drawings bear a striking resemblance to JPEG compressions and to LCD monitor neighboring-pixel approximations.

As a post-photographic phenomenon, Close’s works hint at our photographic misreadings and at how we interpret visual stimuli. Certainly, the viewer of

Close’s works is as much a user, who is able to zoom in or zoom out of the paintings by walking a few feet closer or backward, severely altering his/her perception of these colossal canvases—often as large as 20 feet—and their unusually large “pixels.”

Artist Scott Blake has attempted to emulate Close’s pixel-aesthetics by creating a software program, *The Chuck Close Filter*, that emulates and utilizes elements of Close’s technique in order to create his very own Chuck-Close-like artworks. Scott Blake’s *Self Portrait Made with Chuck Close Filter* (Fig. 3) demonstrates the potential of appropriating Close’s aesthetics into a purely digital form and resonates strikingly with Close’s work.

Similarly, Vuk Ćosić digitizes classic films and TV shows—such as *Star Trek*, *Psycho* and *Deep Throat* (as *Deep ASCII* [1998] [Fig. 4])—into animations in which ASCII characters substitute for pixels [28]. According to post-structuralist theorist Maurice Blanchot, “power” cannot mark its own limit or “conceive” of a mode of “non-power,” and yet a nonutilitarian playfulness might provide an alternative, as a form of “non-power”—that is, neither active nor passive, but rather a mode of letting be [29]. Viewed in this light, Ćosić’s work synthesizes technical *technē* and poetic *technē* and illustrates the playful potential of ASCII text.

Period	De-materialization	Reflexivity	Digitization	Skeumorph
Conceptual Art 1960s-mid 70s	Primacy of Information Institutional Critique Ontological Crisis Collaboration (viewer as user) De-authorship Gift Economy (free communication of ideas) Chance/Noise/Probability			Readymade Minimalism
Video Art Mid 1970s-mid 90s		Structural Coupling Recursive Phenomenological Feedback loop		De-materialization
New Media Art Mid 90s to Present			Emergence Virtual Collaboration (viewer as user) De-Authorship Gift Economy (open source)	Reflexivity

Fig. 7. Constellations of 1960s conceptual art, 1970s to 1990s video art and new media art.
(© Etan Ilfeld)

Curiously, Ćosić is also famous for being the first to coin the term *net.art* in 1995, which was a sort of Duchampian readymade, since he had seen the words “net” and “art”—joined by a period—in an e-mail message [30].

Conceptual Net.Art has cultivated an alternative—albeit virtual—platform and infrastructure for the Information Age’s social and economic systems. In 2000, Michael Daines hacked the virtual worlds of finance and cyberspace by attempting to sell his body within eBay’s sculpture category. Similarly, in 2002, artist Keith Obadike tried to sell his African-American identity on eBay in *Blackness for Sale* (2001); by echoing the slave auctions within the virtual world, Obadike illustrated that the body’s identity politics (gender, race, ethnicity, sexual orientation, etc.) are just as significant in today’s digital/virtual age [31].

EMERGENCE IN CYBERNETICS AND DIGITAL ART

The key relation between third-wave cybernetics and digital art is exemplified in the conceptualization and practice of emergence, which has opened new horizons and modes of art production. Howard Rheingold correlates the emergence of an on-line “collective intelligence” as analogous to the behavior of swarm systems where agents residing on one scale produce higher-level behavior and patterns [32]. Emergence may also occur when a recursive feedback loop evolves within a system in such a way as to lead to previously unforeseeable phenomena.

Emergence provides an indeterminate and noninstrumentally playful evolution, allowing for a creative freedom. As a con-

ceptual framework it is aligned with Blanchot’s notion of non-power as a mode of letting be and with the technological synthesis of Heidegger’s *techne*’s poesis and technicity. Like Heidegger, Blanchot stated, “That which art discovers, or uncovers, or lays bare will not be found under any encyclopaedic subject heading. To put it very simply: art is useless matter . . . art uses matter such that it is unused, worthless, idle, useless” [33]. Similarly, Lev Manovich perceptively points out that new-media objects are readymades by default and are in line with Barthes’s criticism of the author as a sole-inventor, such that the text becomes a “tissue of quotations drawn from the innumerable centers of culture” [34]. Viewed in this light, the “computational ready-made” is a product of self-generated (emergent) algorithmic operations upon a new-media object and exemplifies the spaces within creativity, science and art.

Jeremy Wood is a GPS artist who carries a receiver with him religiously—everywhere he goes. His appropriation of GPS technology is both a form of emergent gameplay and a visual manifestation of emergence. In *My Ghost* (Fig. 5), Wood documents a decade of his movements throughout London and illustrates that the emergent patterns that are revealed as he treks are constrained within the city’s urban infrastructure. His practice takes place on several scales, and he often spells out sentences through his movements. Zooming in on the lower right of *My Ghost* reveals a *Moby Dick* quote tracing Wood’s movements, proclaiming: “True places are not on any map.”

John F. Simon’s *aLife* (2003) is a real-time software-driven animation that models the emergent evolution of six

miniature and artificial worlds [35]. Curiously, Simon’s *aLife* is not concerned with scientific or instrumental knowledge but rather with exploring aesthetic possibilities and “capitalizing on accidents” [36]. Thus, emergence can be used to blur the boundaries between signal and noise—facilitating a mode of non-power that allows the cultivation of the unexpected and indeterminate. Similarly, Eduardo Kac utilizes emergence in his transgenic bioart. In *Genesis* (1999), Kac translated a quote from the Bible (Genesis 1:26) into Morse code and then converted it into a DNA sequence—ordered from a genetics lab—and infused it into a Petri dish with fluorescent *E. coli* bacteria (Fig. 6). Finally, the bacteria’s light source was connected to the Internet such that web users could turn it off and on, influencing the *E. coli*’s unpredictable mutation. As a result, *Genesis* parodies genetics’ tendency toward technoscientific manipulation and exemplifies the potential of emergence as a bridge between technological *techne* and poetic *techne*.

CONCLUSION

Cybernetics concepts such as dematerialization, reflexivity and digitization remain highly influential within contemporary art practices. For example, Arakawa’s *Sculpting No. 1*, which consisted of a canvas filled with arrows pointing outside the frame, is much aligned with first-wave cybernetics and the idea of dematerialization, while John Cage’s *4’33”* highlights elements of chance and noise. Peter Kennedy’s 1970s 10-minute video piece in which he removes and transfers bandages from a microphone to a video camera illustrates the transition from silence to invisibility and exemplifies 1970s video art’s themes of reflexivity, structural coupling and phenomenology—in accord with second-wave cybernetic discourse. Similarly, new media art employs third-wave cybernetic discourse and champions notions of emergence, virtualization, de-authorization, gift economies and digitization.

The artworks surveyed in this paper have provided a set of artifacts that illustrate the thematic overlap between cybernetics and art. While the art practices surveyed are far from an exhaustive taxonomy, they provide examples of the prevalent concepts of each period (Fig. 7).

The question remains as to why there has been at minimum a 15-year lag between the ideas proposed in cybernetics and their artistic counterparts. What caused this delay? While it takes time for

ideas to seep into the social consciousness, artists are often capable of rapidly integrating ideas and conceptualizing new ones. Perhaps these ideas first had to be incorporated into the technologies these artists used. New media studies often suggest a form of technological determinism; however, scholars such as David Morley and Raymond Williams strongly oppose the idea that technology follows a path that is intrinsic to its inner structure (a sort of predetermined road of progress); instead they emphasize that technological history is often the outcome of social struggles between powerful interest groups [37]. Perhaps the correlation between cybernetics and art is itself a form of emergence? One thing is certain: Cybernetic thought and art's synthesis have revealed a poetic technicity within the technological and spawned an ever-emerging and continuous source of concepts and ideas.

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28. See also <www.leoalmanac.org/index.php/lea/exhibition/lea_new_media_exhibition_interview_with_vuk_cosic/> for an online exhibition of work by Cosić.
29. K. Ziarek, *The Force of Art* (Stanford University Press, 2004) pp. 144–145. Thomas Carl Wall, *Radical Passivity: Levinas, Blanchot, and Agamben* (State University of New York Press, 1999).
30. Tribe [16] p. 19.
31. Tribe [16] p. 38.
32. Howard Rheingold, *Smart Mobs* (Perseus Books, Cambridge, 2002) p. 178. The term "collective intelligence" was coined by Pierre Levy in 1994.
33. Ziarek [29] p. 69.
34. Lev Manovich, *The Language of New Media* (MIT Press, 2003) p. 125.
35. <www.numeral.com/panels/alife.html>.
36. Tribe [16] p. 86.
37. Morley [22] p. 241.

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Etan Ifeld launched Tenderpixel Gallery as a platform to showcase emerging artists in central London. Ifeld is particularly interested in the intersections of art, technology and media. After graduating from Stanford University he added to his eclectic education a Master's in Film Studies from the University of Southern California and a Master's in Interactive Media from Goldsmiths, University of London. He is also a professionally ranked chess master, filmmaker and serial entrepreneur. Additionally, Ifeld is a digital artist and his New Kind of Cinema work has been featured and archived in Rhizome's ArtBase.