AUTOPOIETIC ART SYSTEMS AND AESTHETIC SWARMS:

Notes on Polyphonic Purity and Algorithmic Emergence

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Introduction

Modern art is often described as *art for art's sake*, as addressing its own manifest qualities while being largely unconcerned with external considerations — a view that tends toward closed, analytic systems of aesthetic purity. Figures such as Alfred Barr, Clement Greenberg, and Joseph Kosuth described a progressive, teleological drive in modern art, implying a final state of aesthetic and mediumistic perfection, a concretized *modernism as being*. I believe, however, that modern art was instead predicated on an open-ended, algorithmic process of *becoming*, a system more akin to biological unfolding than to finalizable processes found in resolvable systems like mathematics. Such an interpretive realignment has major implications for modernism in general and for our understanding of modernist differentiation and specificity in particular.

The present essay proposes an interconnected model of disciplinary differentiation as a nested aggregate of autopoietic systems, which interact as nodal points in topologically fluid networks oriented toward perpetual boundary exploration and signal exchange. These networks periodically undergo nonlinear, autocatalytic transitions into emergent phenomena known as swarm formations. The formal properties of any given swarm are determined by equilibrial tensions between the swarm's internal properties and the external pressures exerted by temporal and conceptual boundary conditions imposed by the adjacent possible, a kind of map of potentially-realizable "next-step" future conditions.

As we will see, this hybridization of concepts — operating at the intersection of biology, physics, and here, aesthetics — articulates a multivalent modernism that accounts for observed events in art history, while opening new possibilities for interpretation of those events' meaning and of their mechanisms of formal manifestation. The model here proposed has an additional virtue of articulating alternatives to antiquated, hazily defined metaphysical notions of "change" and "progress," offering instead a coalescent read of densely-interlocked, resonating paradigms from contemporary scientific approaches to flux, transformation and ambiguity. While the set of ideas invoked is admittedly complex at times, each concept will be defined as it is introduced. Further, while it is hoped that the ideas presented are robust enough to apply to a range of creative fields like literature and music, the examples herein are drawn from the visual arts, that being the field in which I am trained and with which I am most familiar.

I will establish the framework of modern art to which I am responding — primarily post-war American modernism, but extending briefly to earlier European forms — by considering particular ideas of Clement Greenberg, Joseph Kosuth, Immanuel Kant, George Wilhelm Friedrich Hegel, Mikhail Bakhtin, and Jack Burnham; reviewing the

literature of autopoietic systems by Humberto Maturana, Francisco Varela, Heinz von Foerster, and Niklas Luhmann; and concluding with select contemporary concepts pertaining to eventalization; complex adaptive systems; the adjacent possible and emergent phenomena, developed by John Holland, Alain Badiou, Michel Foucault, Arthur Danto, and Stuart Kauffman.

Analytic Autonomy: Art for Art for Art's Sake

The notion of art for art's sake originated in the early nineteenth century; by the midpoint of the twentieth century the idea of artistic autonomy had been concentrated to the point that, ostensibly, any themes or ideas extrinsic to the medium itself were to be purged for the sake of idealist purity. Such a reductive approach to artistic creation led quickly to closed, analytic systems in which the synthetic incorporation of representation, illusionistic picture space or narrative were considered impure — and thus aesthetically taboo.

Writing in 1960, Clement Greenberg claimed that the goal of modernist art was to eliminate from each medium any quality that might be shared with other mediums, and thus

> would each art be rendered "pure," and in its "purity" find the guarantee of its standard of quality …. "Purity" meant self-definition, and the enterprise of self-criticism in the arts became one of self-definition with a vengeance.[1]

Nine years later Joseph Kosuth pushed the idea of purity even further, defining a conceptually ingressive involution that we might call *art for art for art's sake* by writing that "a work of art is a kind of *proposition* presented within the context of art as a comment on art."[2] Kosuth quoted A.J. Ayer's surmise that a "proposition is analytic when its validity depends solely on the definitions of the symbols it contains,"[3] summing up with the declaration that works of art "are analytic propositions. That is, if viewed within their context — as art — they provide no information what-so-ever about any matter of fact."[4]

Through Greenberg and Kosuth we see art presented as *autotelic*, as an object or concept that only has purpose inherent to itself. While such a self-contained, analytic approach shares structural components with the methodology of Immanuel Kant, whom Greenberg describes as the first modernist, there is also a strong current of Hegelian, dialectical progress inherent in such a drive toward purity.[5] Without naming it as such, Greenberg writes of this dialectical drive by describing painting's progressive purging of impurities — in this case of sculptural, spatial illusionism — that occurred in European painting from the sixteenth to the twentieth centuries, resulting in a kind of painterly synthesis "so flat indeed that it could hardly contain recognizable images."[6]

It seems that the eventual goal of such a progression would be the achievement of a point beyond which an artistic antithesis would no longer be possible, having attained

a final state of purification and perfection. This long-term teleological drive in modern art is thus predicated on a notion we might call finalizability, borrowing the term from Mikhail Bakhtin: art is finalizable in that it is an endeavor that can be finished, a closed system that can be resolved and considered complete.[7]

Such a model provides a useful framework through which to understand reductivist tendencies in modernism, but it is nonetheless highly problematic. In his *Critique of Judgment*, for example, Kant describes the work of art as operating with a degree of open-endedness, a teleologically ambiguous "purposiveness without purpose" that distinguishes it from resolvable fields of human endeavor such as science or mathematics.[8] An end-game teleological interpretation of modernism — or at least of the modernism espoused by Greenberg, et. al. — would appear to imply its own purpose, that of an eventual conclusion through achievement of a final state. While Greenberg cites Kant with some frequency in order to ground his ideas about art, the kind of teleology his writings suggest is a type that Kant himself reserved for mechanical systems that operate according to a definable purpose, rather than the open, ostensibly endless processes one finds in biological life forms, works of art, and other phenomena not explicitly subsumable by concepts or final causes.[9]

Teleologically finalizable creativity might therefore be considered more akin to the work of a scientist or technician — and therefore perhaps not "art" at all — due to an essential difference

> between a work which, once created, can be studied and understood down to its very roots, and a work which provides endless food for thought and is as inexhaustible as the world itself. The steps of scientific progress can be repeated identically. A work of art cannot be repeated, and is always unique and complete.[10]

A finalizable, mechanical teleology of modern art is thus problematic because art in such a narrative is either incapable of attaining a state of purification — thus failing at what seems a major, if implicit, goal of late modernism — or else it is *not actually art*, being instead only a reasonable facsimile thereof that operates within the purposive, teleological framework of final causes and resolvable systems.

Such a narrow read of modern "art" then is predicated on an analytic autonomy, an ingressive dialectical progress toward finality that defines boundaries in order to prevent contamination from impurities like picture space, narrative, and other synthetic elements. Although this understanding of modernism appears to align with observed postwar American art history and discourse, it is my belief that modernism was not predicated on a teleologically static and closed *analytic autonomy* but rather on an emergent, algorithmic process that I will here call *autopoietic autonomy*, a conceptual realignment with important implications for understanding how artistic styles emerge, differentiate, and change.

Autopoietic Autonomy: Algorithmic Systems Aesthetics

Autopoietic processes drive bounded, interactive systems like cellular metabolism or ecosystems, capable of high degrees of both self-sustaining autonomy and interactive feedback relations with surrounding systems. An autopoietic model applied to postwar modernism would therefore be predicated less on the creation and reinforcement of boundaries for the sake of preventing impurity and more on the articulation and maintenance of boundaries in order to distinguish between the system in question and other systems operative within the same context. The difference thus hinges on the distinction between *boundaries for the sake of exclusion* and *boundaries for the enhancement and facilitation of interchange*.

A simple analogy is the difference between a bowl of water and a bowl of ice cubes. While each bowl contains the same substance, the liquid water is in a way incapable of interaction because it is manifest in a single, homogeneous form. The ice cubes, however, possess defined boundaries and can therefore interact with and be jostled into different configurations among the other ice cubes. Through the creation of boundaries by sectioning into discrete units, interaction is facilitated more effectively than by the undifferentiated, ostensibly "purer" liquid form.

The difference between analytic autonomy and autopoietic autonomy thus derives in large part from the functions of the boundaries set in place, including their roles in swarm formation, as will be shown below. *Analytic autonomous boundaries* keep impure elements out; *autopoietic autonomous boundaries* facilitate interaction and hybridization between aesthetic and memetic units. Notable examples include the reciprocal influences of early film on Cubism and of Cubism on stage design, the influence of Jungian thought on abstract expressionism, or Robert Rauschenberg's frequent interweaving of performance, visual arts, and dance. Such syntheses are common in art history but are often excluded from more analytic or formalist narratives of art perhaps because they do not fit such narratives' constructed storylines. Among such oft-overlooked models of art is that of systems aesthetics, a relational model proposed by Jack Burnham, which is predicated on the fact that while "the object almost always has a fixed shape and boundaries, the consistency of a system may be altered in time and space, its behavior determined both by external conditions and its mechanisms of control."[11]

Whereas Greenberg considered the mediumistic differentiation of modernism in a manner appropriate to the Cold War era — as a type of fortification — such medium differentiation may also be considered as an example of boundary articulation wherein a form stakes out a position from which to interact with other cultural forms. This alternative interpretation releases modernism from many of the extraneous discursive limitations that have accumulated over the years. For example, such a multivalent, explicitly interactive modernism not only explains the exploratory drive of the avant-garde, but also allows for the reintroduction of movements and artists once purged as "impure," such as Francis Picabia's late work, Surrealism and Art Brut. Further, this reading

facilitates a modernism that — as per Jacques Rancière's aesthetic regime and distribution of the sensible — breaks down the partitions "between works of pure art and … the decorative arts,"[12] asserting "the absolute singularity of art [while destroying] any pragmatic criterion for isolating this singularity [and establishing] the autonomy of art and the identity of its forms with the forms that life uses to shape itself."[13] It also accounts for the idea of "many modernisms" noted in recent years: there have always been many modernisms — autopoietic, interactive aesthetic systems operating in resonance — a fact that was obscured by end-game narratives that foregrounded only one specific modernist formulation.[14]

This ability of discretely articulated units to maintain coherence in relation to surrounding units leads to reciprocally defined boundary formation and dialogism grounded in autopoietic process: the boundary of any given self-sustaining system, such as a specific medium separated from others by formalist discourse, is mutually and differentially defined by the surrounding, self-sustaining systems. These relations create opportunities for exchange and interaction, creating a space of dynamic equilibrium in which each component maintains autonomy while also engaging in high-level interaction, much like cells in a body that maintain boundary coherence as individual cells yet also contribute to the formation of a larger organism.

The term *autopoiesis*, coined by the biologists Humberto Maturana and Francisco Varela, describes systems in terms similar to Kant's articulation of the qualities of mechanical and biological processes. Here is the definition of autopoietic machine systems used by Maturana and Varela:

> [An] autopoietic machine is a machine organized as a network of processes of production of components that produces the components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network. It follows that an autopoietic machine continuously generates and specifies its own organization through its operation as a system of production of its own components.[15]

I am combining this definition of machine autopoiesis with the same authors' definition of biological autopoiesis, a "self-asserting capacity of living systems to maintain their identity through the active compensation of deformations" in order to suggest a reading of the art world as an open, rather than closed, system.[16] Considered thusly, the art world operates in a conceptual space somewhere between a mechanical system — because art is, after all, a human-made construct — and a distributed series of feedback relations known as *complex adaptive systems*, conceptual networks incorporating quasi-autonomous agents that operate within loosely defined discursive frameworks.

As noted earlier, Kant posited a difference between a work that "can be studied and understood down to its very roots [and] a work which provides endless food for thought and is as inexhaustible as the world itself."[17] The former resolvable (and hence mechanical) interpretation applies more readily to a Greenbergian read of modern art: a system with a final cause, possessing an ostensibly understandable and definable end-point. An autopoietic interpretation of modernism, on the other hand, suggests a reading

akin to the latter "inexhaustible" and unfinalizable qualities.[18] An open system of modernism thus operates with what *appears* to be a progressive drive, predicated less on finalizable analytic linearity than on open, lateral exploration.

Does such a model fit the observed, historical facts? Art history shows a series of radical changes from 1860 to 1960, a sequence easily interpreted as analytic, dialectical progress. It's possible, however, to see these changes as less of a Hobbesian aesthetic battle of all against all and more as an exploration of possibility, an open system of algorithmic becoming. An algorithm is a sequence of step-by-step instructions that leads to the calculation of a result. Some algorithms reach a defined end-point — the problem is solved — while others are more open, reaching a series of intermediate conclusions from which additional stages continue. Still other algorithms are endless, such as the Fibonacci sequence or the self-similar algorithmic base of fractals (i.e. "*fract*ional *al*gorithm"), an example of which is a repetition of the instruction, *square self + 1*. By the very nature of its instructions, such an algorithm is structurally incapable of reaching an endpoint.

The idea of unfinalizable, algorithmic unfolding is relevant because it accounts for the apparent avant-garde progressive drive while obviating the need of a teleologic endpoint. In other words, modernist formal and conceptual exploration did in fact operate with a certain type of purposiveness albeit one primed not so much toward analytic purity as toward synthetic interactivity. However, as per Kant this algorithmic progressive drive was a purposiveness without purpose — similar, for example, to the way a Fibonacci or fractal algorithm operates with a directed yet non-specific purposiveness that differs from the explicitly defined purposiveness of a proprietary algorithm that anticipates and proposes future purchases on a commercial website. An algorithmic, teleonomic model of modern art thus reframes the exploratory, progressive force of modernism, no longer as a linear, dialectical drive toward an endpoint, but instead as a stage-by-stage exploration of adjacent aesthetic possibilities.[19]

Considered as an unfolding series of definable stages — goal-driven in the short term but not oriented toward a conclusion — modernism comes to be understood as a self-amplifying aesthetic cycle of [.../being/becoming/being/becoming/...], a step-by-step oscillating system of iterative, reciprocally-coded patterns in a state of dynamic equilibrium, which alternately crystallize and disperse in aperiodic aesthetic cycles that manifest as trends, fashions, and styles. These cycles of [crystallization/being] and [dispersion/becoming] create what is interpreted as the formation, evolution, and dissolution of art movements, systemic input/output composites that explore the local topological semioscape of available communicative and conceptual possibility.

In many ways similar to the nonlinear, unpredictable Kuhnian paradigm shifts that occur when enough incongruities have accumulated in a previously stable discipline, such a model of art is unfinalizable since each exploration opens additional exploratory possibilities. The Cubist exploration of the relationship of picture plane to picture surface, for example, was not an end in itself but rather opened up a vast range of possibilities and implications that were rigorously explored across future decades.

From Art System to Emergent Art Swarm

In addition to boundary articulation, an equally important feature of autopoietic systems is their self-generative, autocatalytic capability. It can be argued that the art world possesses what is effectively — if only metaphorically — a metabolic system, made up of a dense network of artists, artworks, galleries, museums, theorists, curators, journals, discursive formations, and schools, that is by now self-sustaining and self-regulatory. Such an art world operates of its own accord: like cells in a body, artists, critics, and galleries may come and go, but the system itself continues, sometimes with a slow metabolism — low-innovation periods that produced relatively few well-known innovations in the visual arts — at other times with a fast metabolism — relatively high-innovation periods like the 1890s or 1960s. In this sense too, the art world is autopoietic, a system comprising smaller systems that "generate the elements of which they are composed precisely by means of those very elements,"[20] and in which "art thus becomes a self-determining and self-generating system that regulates itself according to its own internal coherences and contradictions,"[21] an idea that resonates intriguingly with what Hegel called art's inner necessity.[22] Recall that autopoietic systems emphasize autonomy and boundary differentiation in order to better define a position relative to which an entity can most effectively interact with other entities in the local environment. This suggests the need to introduce a further definition of autonomy, drawing perhaps on physicist Heinz von Foerster, who defines an autonomous entity as a "recursively computing system [that] regulates its own regulation."[23]

Visual art, an autopoietic cultural system among other autopoietic cultural systems like literature, film, or music — each of which is embedded within and regulated by still larger systems — regulates itself by way of its own internal, autopoietic subsystems like painting or sculpture. Each of these subsidiary autopoietic systems, while regulated from above, is also to a degree self-generative and self-regulatory according to critical, historical, commercial, and discursive priorities. In a series of metabolic feedback loops, these cumulative effects cyclically and syntagmatically scale up and down, shared by macrosystems and subsystems.

For example, in the "painting" autopoietic system shown in Figure 1 — a subsystem of the "art" autopoietic macrosystem, which is in turn a subsystem of the still larger "culture" autopoietic system — brushstrokes and color choices (microscale) emergently coalesce into individual artworks (midscale), which accumulate to become an artist's recognizable style (macroscale). This in turn feeds back into the system to influence individual artists (microscale) who interactively coalesce into schools of art (midscale), which contribute to the macroscale art world, which feeds back to influence microscale individual artistic choices in brushstroke, color, and so on.[24]
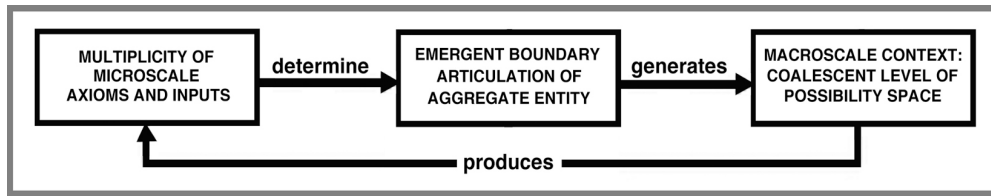
Figure 1: Painting as an autopoietic aesthetic feedback mechanism.
Image by Jason Hoelscher.

Considered thus, the feedback loops between art practices and art world suggest modernism as a type of complex adaptive system known as an emergent phenomenon. Emergent phenomena are nonlinear integrative effects that arise from a multiplicity of small inputs. "[T]he system is synthesized by combining a simple, fixed set of building blocks: rules, axioms, instructions or elements" which emerge from patterns or properties

> that appear under the constraints imposed by the rules of combination. In complex adaptive systems, emergent properties often occur when coevolving signals and boundaries generate new levels of organization. Newer signals and boundaries can then emerge from combinations of building blocks at this new level of organization.[25]

Examples of emergent phenomena include the creation of "wetness" from an accumulation of H_2O molecules, none of which individually is wet, or of individually non-signifying brushstrokes that coalesce into a meaningful painted image: the aggregate effect creates a quality empirically not present in, or predictable from, any individual component.[26]

The mechanisms of emergent phenomena closely correlate with Alain Badiou's description of the site in which an event happens, which he describes as

> an eventual site X ... *a multiple such that it is composed of, on the one hand, elements of the site, and on the other hand, itself* .... That is, the event is a one-multiple made up of, on the one hand, all the multiples which belong to the site, and on the other hand, the event itself.[27]

Such emergent eventalization — correlative both to Badiou's usage and to a Foucauldian polyhedral causality — can be seen in the schooling of fish: no single fish determines a school's path, but thousands of tiny, instantaneous behavioral feedback loops between thousands of fish result in what appears to be an intricately choreographed swarm. Such a swarm formation, akin to Badiou's description of the event as a "one-multiple," a macroentity made up of multiple smaller entities, arises from a multiplicity of causal inputs that coalesce in a nonlinear fashion: one moment the fish are distributed without apparent order, the next moment they swarm in response to their internal conditions, inputs from environmental pressures, and the actions of their immediate neighbors. Such a catalytic event reflects more than a simple model of linear cause and

effect, reflecting instead what Foucault termed "polyhedral" or multidimensional systemic inputs.[28]

Perhaps the sudden crystallization of art movements — such as Cubism, abstraction, pop or conceptual art — provides an example of what we might call *aesthetic swarming behavior*. Like schools of fish swimming in unison in response to an aggregation of tiny systemic inputs, schools of art and artists swarm in synchrony if the correct artistic, discursive, social, or technological precursor conditions are present. Analogous to biological swarms, such crystallizations emerge by way of nonlinear, multidimensional, polyhedrally causal inputs, forming a "one-multiple" macroentity — a school or stylistic category of art — composed of multiple microentities — artists who share discursive or pictorial concerns.[29] These create "behavioral pathways among the individual agents [that] are able to aggregate into these larger-scale organizations that survive and have behaviors on scales that are completely different from their constituent parts."[30] The autopoietic nature of such an art swarm emerges from the differential tensions between the relative autonomy of the macrosystem and the relative, relational autonomies of the microsystems from which it forms.

Considering the fact that there are many schools of art, the art world can be seen as a network of nodes, each node an emergent swarm of artists active around a particular idea-complex. A network diagram of European modernism circa 1915 (Figure 2) might include a large nodal swarm around the prompts that constitute Cubism — emerging from the interests, actions, reactions, and feedback loops of Picasso, Braque, Gris, Leger, and others — with peripheral sub-swarms of futurism and orphism (Figure 3). In various degrees of proximity within the network would be other nodal swarms driven by the elements and axiomatic concerns that prompted the emergence of abstraction, expressionism, Dada, and other art schools/swarms of the era. Within this network would be figures like Duchamp, swarming at the peripheries of the Cubist and Dada nodes, and whose systemic inputs would in turn contribute to a later swarm when conditions were right for the emergence of conceptual art in the late 1950s and 1960s.
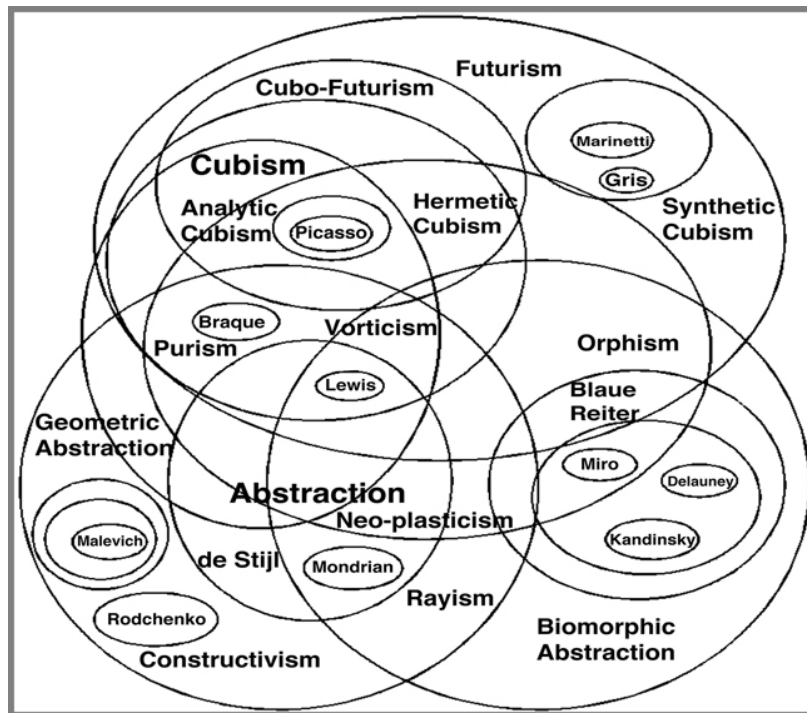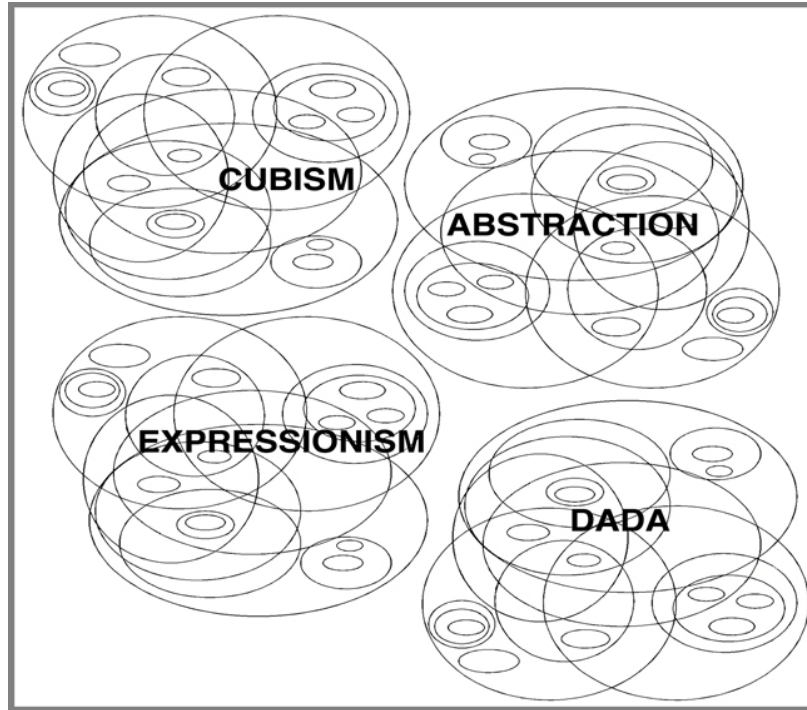
Figures 2 and 3: Emergent art swarm networks: European modernism. A model of the macroscale network of the European modernism art swarm ca. 1915, depicting four primary nodes of the era (above), with a detail view of an overlapping swarm node for Cubism and abstraction ca. 1915-1925 (below). Note that all nodal swarm positions and relationships are approximate and in flux. Images by Jason Hoelscher.

This latter quality of art swarms — that they crystallize fully only when the historical and conceptual moment is properly primed — can be clarified by a concept that theoretical biologist and complex systems theorist Stuart Kauffman terms *the adjacent possible*. The adjacent possible is the domain space of potential areas into which a system — whether it is evolutionary, technological, or economic — can expand or that it may reconfigure based on current resources and conditions.[31] As applied to art, breakthroughs in the adjacent possible prompt the self-organizational crystallization of new styles, discourses, and methodologies, depending on the prevailing conditions of the time — not by way of some type of essentialism or destiny but rather on the range of possible "next-step" developments opened by previous events. Like the conditions that led to such simultaneous, independent developments as the invention of calculus by Leibniz and Newton; the elaboration of the theory of evolution by Darwin and Wallace; the multiple inventions of the telephone in the 1870s by Alexander Graham Bell, Elisha Gray, and others; and hundreds of other examples across nearly all fields of human endeavor,[32] a set of precursor conditions and building blocks — physical or conceptual — become present, suggesting particular "next step" exploratory avenues of the adjacent possible that prompt an event crystallization to occur.[33] Again, note that this is not a deterministic process but an articulation of possibility space in which any given future stage may be more or less likely than others and subject to the vicissitudes of a range of inputs. Event A does not necessarily cause event B but rather opens a range of possibilities in which event B might manifest: for example, while the 1960s minimal art of Donald Judd was not "caused" by the development of geometric abstract art circa 1910, it could only have emerged in the space of possibilities opened up by the creation of abstract art in the western tradition.

Swarm formation occurs once a certain density threshold is reached, prompting a dramatic, nonlinear change in the total system: although inputs may have been accumulating for some time, the transition itself appears to be instantaneous. To take pictorial flatness as an example, an increasing flattening of picture space can be detected in many European paintings produced between 1550 and 1850, for example from Titian's *Venus with Cupid, Dog and Partridge* to David's *The Oath of the Horatii* to Courbet's *The Stone Breakers*. From 1850 to 1900 this process of flattening intensifies dramatically, from Courbet to Manet to Cézanne: consider Courbet's picture space to Manet's *Luncheon on the Grass* or to Cézanne's *The Bathers (Study)*. From 1900 to 1915, from Cézanne to Picasso to Malevich, the system changes state drastically, flattening more in 15 years than in the previous 450 by way of a radical surge of formal and material exploration, immediately obvious by comparing Cézanne's work to Picasso's *Les Demoiselles d'Avignon* of 1907 or to *Malevich's Black Square and Red Square* of 1915. The necessary ingredients for Cubism and abstraction as large-scale movements — a general turn away from mimetic representation, widespread attention to the material qualities of paints and physical supports, and the trend of flattening picture space — were widely extant in the adjacent possibility space of European painting by 1907 and 1911, respectively; accordingly those movements emerged quite suddenly among multiple practitioners, gaining prominence very quickly in multiple countries.[34] On the other hand Duchamp's readymades were a few stages past the immediate adjacent possible of their era: while the experimental approaches of the era certainly allowed for the development of the readymade, the

precursors and intermediate stages were not yet present for it to have full impact until decades later (Figure 4). In Duchamp's case the catalyst for swarm formation was present long before the possibility space was conducive to actual swarm formation.
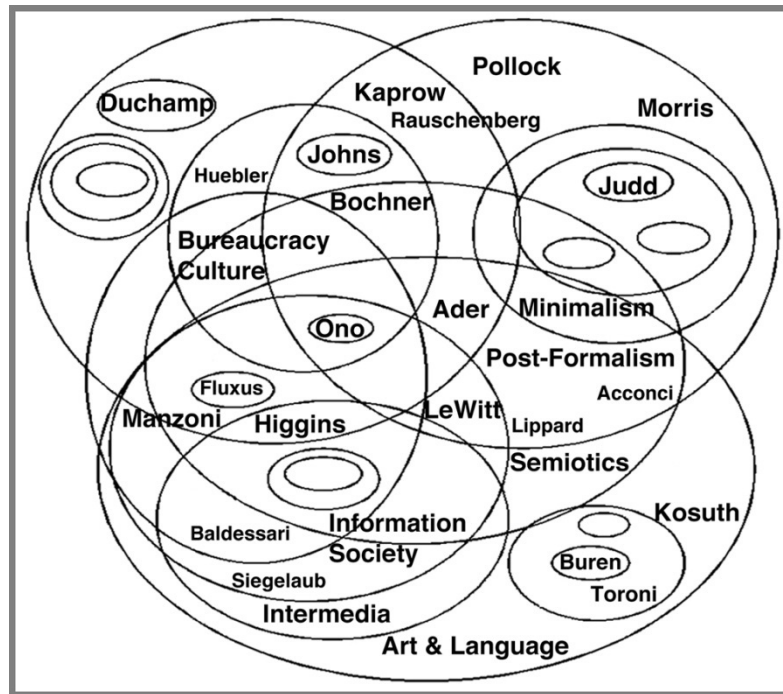

Figure 4: Emergent art swarm networks: Conceptual art, ca. 1965-1970.

A model of the conceptual art swarm node, which only fully emerged once precursor conditions such as bureaucracy culture, dawning information society, and post-formalist tendencies were present in its local, adjacent possibility space. Image by Jason Hoelscher.

In a compelling example of conceptual resonance, decades before Kauffman gave a name to the adjacent possible, Picasso's and Braque's dealer Daniel-Henry Kahnweiler described the multiple creation of Cubism in the summer of 1907 despite the fact that Braque and Picasso had not yet met and that "no connection existed between the two artists." Kahnweiler wrote:

> in the whole history of art, were there not already sufficient proof that the appearance of the aesthetic product is conditioned in its particularity by the spirit of the time, that even the most powerful artists unconsciously execute its will, then this would be proof. Separated by distance, and working independently, the two artists devoted their most intense effort to paintings which share an extraordinary resemblance.[35]

While the mention of "the spirit of the time" can be interpreted in a Hegelian manner, it might be that the concept in fact describes the cumulative sensitivity of an era's participants to the conditions of adjacent possibility inherent to that period. In the case of Cubism, of all the artists then working it was Braque and Picasso who were perceptive

enough — not to mention attentive, open to, and sensitive to the possibilities of their surroundings — to take the next step based on art's prevailing post-Cézanne, post-realism, post-Denis conditions.

Roy Lichtenstein and Andy Warhol provide a similar example of adjacent possible emergence over half a century later in 1961. Before either had shown their fine art publicly, they simultaneously and independently began to make — in what at the time seemed a highly unlikely and shocking turn — paintings based on comic strips. When Warhol visited the back office of Leo Castelli's Gallery that autumn, he was so shocked to see Lichtenstein's paintings — nearly identical in style and approach to his own — that he changed his own focus from comic strips to advertisements, soup cans, and pop stars.[36]

Such a seemingly unlikely overlap again illustrates how the presence of a specific set of building blocks prompts multiple, simultaneous emergent phenomena that we interpret as a *zeitgeist* : Hegel's "spirit of the time" is perhaps just another term for acute sensitivity to the composite input/output swarm formation potentials of an era's emergent possibility vectors. Here is Kauffman's description of the adjacent possible. Although this passage describes organic chemistry, it is applicable to art:

> Note that the adjacent possible is indefinitely expandable. Once members have been realized in the current adjacent possible, a new adjacent possible, accessible from the enlarged actual that includes the novel molecules from the former adjacent possible, becomes available …. The substrates are present in the actual, and the products are not present in the actual, but only in the adjacent possible …. Other things being equal, the total system "wants" to flow into the adjacent possible.[37]

While Kauffman's quote suggests a teleologic reading, the quotes around his mention that "the total system 'wants' to flow" is more in line with the way water "wants" to flow to the lowest possible point: not because of some deterministic or teleological force but rather due to the way water interacts with physical conditions. If a defining feature of artistic creativity is the exploration of possibility and potential, it is not too big a leap to describe this feature as "wanting to flow" into the adjacent possible. Compare this to Hegel's assertion that "We may rest assured that it is the nature of truth to force its way to recognition when the time comes, and that it only appears when its time has come, and hence never appears too soon, and never finds a public that is not ripe to receive it."[38]

In 1964 Arthur Danto introduced the idea of the art world in an essay of the same name. For Danto the concept of an art world arose from his attempts to grapple with the fact that the art of his era had become difficult to recognize as art without a grasp of the theoretical underpinnings that defined it as such, creating a condition in which a viewer "might not be aware he was on artistic terrain without an artistic theory to tell him so."[39] For Danto the slippery terrain of the art world which is "constituted [as] artistic in virtue of artistic theories," was exemplified by Warhol's *Brillo Box* of 1964.[40] Of the *Brillo Box*, Danto notes that

> without theory, one is unlikely to see it as art, and in order to see it as part of the artworld one must have mastered a good deal of artistic theory …. It could not have been art fifty years ago. But then there could not have been, everything being equal, flight insurance in the Middle Ages …. The world has to be ready for certain things, the artworld no less than the real one.[41]

As with Kahnweiler's description of Picasso's and Braque's independent co-creation of Cubism, and Hegel's claim that truth forces its way to recognition when the time is right, Danto's observation that the world is only ready for certain things at certain times provides an additional illustration of adjacent possibility operating at the deepest sublevels of autopoietic, artistic emergence.[42]

The challenge can be raised that an emergent, autopoietic model of artistic swarm formation by way of the adjacent possible undervalues the creativity of the individual, perhaps reconfiguring the role of the artist from that of an independent, creative subject to that of a mere vehicle through which historical forces are deterministically manifest. I believe it does quite the opposite, reframing the "genius" as an individual particularly attuned and perceptive to the undercurrents and subtleties of their era. In the system I describe the artist's creativity emerges not by way of some mysteriously metaphysical, vaguely defined "gift of creativity," but through a heightened sensitivity to the prevailing intertextual and intersubjective conditions at play within the cultural moment. This process does not just happen but can be cultivated through education, training, and practice. Anyone who has taken studio courses in art school will recall the emphasis on paying close attention to one's surroundings, training that perhaps goes beyond sensitivity to visual stimuli to include sensitive observation of possibility space as well.

Far from a deterministic model that robs the individual of agency, or an analytic autonomy that denies interactivity and dialogism, an autopoietic art emerges from the interplay among and feedback loops between every individual within a given sociocultural system: individual style arises because the patterns of possibility reveal themselves in different ways to different individuals. Art spreads and changes across time and space — in response both to external events and to internalized, inherited techniques, ideas, and concerns that have developed over centuries — by way of what we might consider memetic, aesthetic, and discursive evolutionary selection pressures. These pressures contribute to swarm emergence on a macro level of discourse by way of the limits and precursors of adjacent possibility and at the micro level by way of the competition, cooperation, and interaction between individuals that is facilitated by autopoietic boundary differentiation. Such a seemingly minor shift from an analytic to an autopoietic autonomy thus results in an intertextual, intersubjective system of considerable explanatory and exploratory power.

Conclusion

The model of modernism here proposed — a system of pluralistically autonomous swarms with interactive, permeable aesthetic information boundaries — argues against an interpretation of modern art as a closed form of analytic autonomy and hegemonic

purity, describing instead an open modernism of autopoietic autonomy and interaction. More than just a flight of fancy, this reformulation is testable in that it can account for such aspects of modernism as avant-garde exploration, the simultaneous, multiple emergences of key movements and trends, and the differentiation and specificity of disciplines and mediums.

Further, by deprioritizing artistic purification, an autopoietic and emergent model reconfigures artistic change from a goal-directed teleological progress — *finalizable analytic autonomy* — to a perpetual exploratory drive predicated on an open-ended algorithmic process —*unfinalizable autopoietic autonomy*. In effect dependent on interaction and feedback relations, art is thus seen to be an emergent, adaptive system driven not toward purified stasis but by the polyphonic, algorithmic interplay of its components in a state of perpetual aesthetic and conceptual signal exchange in pursuit of a goal that is by definition unattainable but that is worth pursuing precisely because of its very lack of finalizable attainability. 🄴🄰

Notes

1 Clement Greenberg, "Modernist Painting," in *Clement Greenberg: The Collected Essays and Criticism, Volume 4: Modernism with a Vengeance, 1957-1969* (Chicago, IL: The University of Chicago Press, 1993), 86.

2 Joseph Kosuth, "Art after Philosophy," in *Art after Philosophy and After: Collected Writings, 1966-1990.* (Cambridge: MIT Press, 1991), 19-20.

3 Ibid., 20.

4 Ibid.

5 Ibid., Greenberg, 85.

6 Ibid., 89.

7 While I am not aware that writers such as Greenberg and Kosuth explicitly prescribed a ideal artistic end-game, the sequence of artistic purges and purifications they describe — which are in fact illustrated by comparing Greenberg's essay at the beginning of the 1960s with Kosuth's even more stringent advocacy of purification at the end of that decade — seems to me to imply a direction toward an endpoint, a final resolution when a state of purity will be attained.

8 Immanuel Kant, *Critique of Judgement*, ed. Nicholas Walker, trans. James Creed Meredith (New York: Oxford University Press, 2007), 71.

9 Kant's consideration of differing types of teleology takes place in the second half of his *Critique of Judgement.*

10 Karl Jaspers, *Kant*, ed. Hannah Arendt, trans. Ralph Manheim, from *The Great Philosophers*, Vol. 1 (New York: Harcourt Brace and Company, 1957), 81. It might be argued that mechanical or digital reproduction of a work of art contradicts Kant's assertion vis-à-vis repeatability. I would argue, however, that what is repeated is not the art itself but rather *the delivery device for the art experience*. Artwork multiples, such as Cindy Sherman's *Untitled Film Stills* or Donald Judd's serial cubes, are not diluted into magazine pages or furnishings simply by being available as multiples; rather each individual manifestation maintains and delivers coherently unfinalizable artistic qualities that just happen to be available in more than one space at a time, like multiple windows open to the same scene.

11 Jack Burnham, "Systems Esthetics," *Artforum* VII, no. 1 (1968): 32.

12 Jacques Rancière, *The Politics of Aesthetics*, trans. Gabriel Rockhill (New York, NY: Continuum Books, 2006), 15.

13 Ibid., 23.

14 See for example the following: Fredric Jameson, *Signatures of the Visible* (New York: Routledge, 1992); Edward Winters, *Aesthetics and Architecture* (New York: Continuum Books, 2007); Katy Siegel, *High Times, Hard Times: New York Painting 1967-1975* (New York: Independent Curators International, 2006).

15 Humberto S. Maturana and Francisco J. Varela, *Autopoiesis and Cognition: The Realization of the Living* (Boston, MA: D. Reidel Publishing Company, 1980), 78-79.

16 Ibid., 135.

17 Jaspers, 81.

18 Of additional interest here is Eco's notion of the open artwork, a work that, though complete, remains open "to a continuous generation of internal relations which the addressee must uncover and select in his act of perceiving the totality of incoming stimuli." See Umberto Eco, "The Poetics of the Open Artwork," in *The Open Artwork*, trans. Anna Cancogni (Harvard University Press, 1989), 21.

19 In a similar vein, such a model of art allows for the reinstatement of something akin to a Lyotardian metanarrative, but without the imposition of constructed belief systems and other ideological baggage that tends to accompany notions of metanarrativity.

20 Niklas Luhmann, "The Work of Art and the Self-Reproduction of Art," in *Art in Theory 1900-2000: An Anthology of Changing Ideas* (Malden, MA: Blackwell, 2003), 1077.

21 Ibid., 1078.

22 G.W.F. Hegel, *Aesthetics: Lectures on Fine Art, Volume I*, trans. T.M. Knox (New York: Oxford University Press, 1975), 55.

23 Heinz von Foerster, *Understanding Understanding: Essays on Cybernetics and Cognition* (New York and Berlin: Springer-Verlag, 2003), 226.

24 This process can be further understood as one wherein the content that flows through a system modifies the formal parameters of that system and in which the formal parameters in turn loop back to modify the content further, creating a recursive cycle of mutual and differential content/form reconfiguration. Such reciprocal influence contributes to the formation of specific art styles: the differential form/content relationship of the stylistic system known as "abstract expressionism" exists in a different state of tension than does the form/content relationship of the stylistic system known as "neo-plasticism," for example.

25 John H. Holland, *Signals and Boundaries: Building Blocks for Complex Adaptive Systems* (Cambridge, MA: MIT Press, 2012), 108, 114.

26 A consideration of Jürgen Habermas' writings on intersubjective communication and meaning formation in terms of emergent swarm phenomena — as a semiotic swarm aggregate perhaps — would seem a potentially valuable enterprise. Similarly, his assertion of modernity as an incomplete project, vis-à-vis attempts at the reintegration of Enlightenment and modernist specialization, might benefit from the framework proposed in this paper as well. Unfortunately both ideas are beyond the scope of the present essay.

27 Alain Badiou, *Being and Event*, trans. Oliver Feltham (New York, NY: Continuum, 2006), 179. Emphases in original.

28 Michel Foucault, "Questions of Method," in *Power*, ed. by James D. Faubion, trans. by Robert Hurley and Others, vol. 3 of *The Essential Works of Foucault 1954-1984*, ed. Paul Rabinow (New York, NY: The New Press, 2001), 227. See for example, "As a way of lightening the weight of causality, 'eventalization' thus works by constructing around the singular event analyzed as process a 'polygon' or, rather 'polyhedron' of intelligibility, the number of whose faces is not given in advance and can never properly be taken as finite … the further one breaks down the processes under analysis, the more one is enabled and indeed obliged to construct their external relations of intelligibility." While Foucault is writing of the multiplicity of events that lead to the use of incarceration and prisons, the basic idea itself — of causatively complex, multivalent input/output matrices — seems of potential relevance to the development of artistic discourse as well.

29 Admittedly at the risk of mixing metaphors, the earlier mention of an art world metabolism provides a way to think of an art swarm, given that the constituent components of an art world "metabolism" must work in concert to crystallize a possibility into a movement or school. An artist working alone in a studio achieves little if the network of galleries, critics, and patrons do not amplify her or his creative input across and through the pathways of the system, setting up conditions for the possibility of emergent swarm behavior.

30 John H. Miller and Scott E. Page, *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. (Princeton, NJ: Princeton University Press, 2007), 49.

31 Stuart Kauffman, *Investigations* (New York: Oxford University Press, 2002), 142.

32 William Ogburn and Dorothy Thomas, "Are Inventions Inevitable? A Note on Social Evolution," in *Political Science Quarterly*, vol. 37, no. 1 (March 1922), 83.

33 While beyond the scope of this paper, it might be fruitful to consider the florescence of such philosophical "golden ages" as classical Greece, 18th and 19th century Germany, and post-World War II France through the framework of the adjacent possible and the attendant precursor conditions amenable to emergent swarms. Similarly, the relationship between Kuhnian paradigm shifts and emergent, spontaneous self-organizational conceptual systems would seem to be a strong avenue for study as well.

34 This could be seen as a model that affirms a previous state of affairs, thus contradicting Badiou's description of an event as a disruption of the order that supports it. My intent here is to argue a variation of this idea in which the new "event" of a swarm emerges from a recalibration — inherently neither precisely an affirmation nor a disruption while perhaps a bit of each — of the order that supports it, pushing the boundaries of its local possibility space and recrystallizing into a new state not predictable from the earlier state of affairs.

35 Daniel-Henry Kahnweiler, "The Rise of Cubism," in *Art in Theory 1900-2000: An Anthology of Changing Ideas* (Malden, MA: Blackwell, 2003), 210.

36 Tony Scherman and David Dalton, *Pop: The Genius of Andy Warhol* (New York, NY: HarperCollins, 2010), 70.

37 Ibid., Kauffman, 142-143.

38 G.W.F. Hegel, *The Phenomenology of Mind*, trans. J.B. Baillie (New York: Dover, 1807/2003), 42.

39 Arthur Danto, "The Artworld," in *Art and Its Significance: An Anthology of Aesthetic Theory*, third edition, ed. Stephen David Ross (New York: SUNY Press, 1994), 471.

40 Ibid.

41 Ibid., 479.

42 Such overlapping manifestations of the adjacent possible are the subject of a follow-up to the present essay, titled *Complexity Aesthetics: Recursive Information, the Adjacent Possible and Artistic Emergence*.

References

Badiou, Alain. *Being and Event*. Translated by Oliver Feltham. New York, NY: Continuum, 2006.

Burnham, Jack. "Systems Esthetics." *Artforum* 7, no. 1 (September 1968): 30-35.

Danto, Arthur. "The Artworld." In *Art and Its Significance: An Anthology of Aesthetic Theory*, Third Edition, edited by Stephen David Ross. New York: SUNY Press, 1994, 470-481. Originally published in *Journal of Philosophy*, vol. 61, no. 19 (1964).

Eco, Umberto. "The Poetics of the Open Artwork." In *The Open Artwork*. Trans. by Anna Cancogni. Harvard University Press, 1989.

Foucault, Michel. "Questions of Method." In *Power*, ed. by James D. Faubion. Trans. by Robert Hurley and Others, 223-238. Volume 3 of *The Essential Works of Foucault 1954-1984*, series editor Paul Rabinow. New York, NY: The New Press, 2001.

Greenberg, Clement. "Modernist Painting." In *Clement Greenberg: The Collected Essays and Criticism, Volume 4: Modernism with a Vengeance, 1957-1969*, edited by John O'Brian. Chicago, IL: The University of Chicago Press, 1993. Originally published in *Art & Literature*, no. 4 (1960/1965).

Hegel, G.W.F. *The Phenomenology of Mind*. Translated by J.B. Baillie. New York: Dover, 2003.

———. *Aesthetics: Lectures on Fine Art, Volume I*. Translated by T.M. Knox. New York: Oxford University Press, 1975.

Holland, John H. *Signals and Boundaries: Building Blocks for Complex Adaptive Systems*. Cambridge, MA: MIT Press, 2012.

Jaspers, Karl. *Kant* [from *The Great Philosophers*, Vol. 1]. Edited by Hannah Arendt. Translated by Ralph Manheim. New York: Harcourt Brace and Company, 1957.

Kahnweiler, Daniel-Henry. "The Rise of Cubism." In *Art in Theory 1900-2000: An Anthology of Changing Ideas*, edited by Charles Harrison and Paul Wood. Malden, MA: Blackwell, 2003.

Kant, Immanuel. *Critique of Judgement*. Edited by Nicholas Walker. Translated by James Creed Meredith. New York: Oxford University Press, 1790/2007.

Kauffman, Stuart. *Investigations*. New York: Oxford University Press, 2002.

Kosuth, Joseph. "Art after Philosophy." In *Art after Philosophy and After: Collected Writings, 1966-1990*, edited by Gabriele Guercio. Cambridge: MIT Press, 1991, 13-32. Originally published in *Studio International*, vol. 178, no. 915 (1969).

Luhmann, Niklas. "The Work of Art and the Self-Reproduction of Art." In *Art in Theory 1900-2000: An Anthology of Changing Ideas*, edited by Charles Harrison and Paul Wood. Malden, MA: Blackwell, 2003. Originally published in *Delfin*, no. 3 (1983).

Maturana, Humberto S., and Francisco J. Varela. *Autopoiesis and Cognition: The Realization of the Living*. Boston, MA: D. Reidel Publishing Company, 1980.

Miller, John H., and Scott E. Page. *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton, NJ: Princeton University Press, 2007.

Ogburn, William, and Dorothy Thomas. "Are Inventions Inevitable? A Note on Social Evolution." *Political Science Quarterly* 37, no. 1 (March 1922): 83-98.

Rancière, Jacques. *The Politics of Aesthetics*. Translated by Gabriel Rockhill. New York, NY: Continuum Books, 2006.

Scherman, Tony, and David Dalton. *Pop: The Genius of Andy Warhol*. New York, NY: HarperCollins, 2010.

von Foerster, Heinz. *Understanding Understanding: Essays on Cybernetics and Cognition*. New York and Berlin: Springer-Verlag, 2003.