

Research Article

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A Context for Complexism: Between Neoliberal Social Thought and Algorithmic Art

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Abstract: Among the many genres of visual art to emerge in the wake of computerisation, the subset of generative or algorithmic art known as complexism seems uniquely keyed to the social and technological mainsprings of everyday life in the twenty-first century. Complexism typically deploys computer algorithms to demonstrate how complex phenomena can emerge through the reiterative enactment of simple rulesets. The light and sound installations and the videos that complexist artists produce, alongside the discourses surrounding the works, stand out as singularly contemporary, not necessarily for their exploitation of now-ubiquitous telematic tools and techniques, but for their deep commitment to the trailblazing problems, methods, and hypotheses set out by the new science of complexity. Practitioners of and commentators on complexism (the work and writings of Philip Galanter feature most prominently here) persistently invoke this booming interdisciplinary field of complexity research. Against this trend, I argue that for all the leverage the tools and terms of complexity science supply to complexist art, the concept of complexity itself remains surprisingly vague and shorn of any historical sensibility. One preliminary aim of this essay is to bring more theoretical rigour to the artists' use of this concept by beginning to fill in the missing backstory. From there, I move to complicate this genealogy by introducing a somewhat controversial figure—the social theorist, political economist, and legal philosopher Friedrich Hayek, who had posited similar problems concerning the emergence and maintenance of complex, self-organized systems as early as the 1930s, and whose theoretical solutions to these problems were instrumental to what historians and sociologists have subsequently described as capitalism's late “neoliberal turn.”

Keywords: neoliberalism, generative art, algorithmic art, complexity

Consider the economy as forever becoming, burgeoning with new ways of making a living, new ways of creating value and advantages of trade, while old ways go extinct... The economy, like the biosphere, is about persistent creativity in ways of making a living.

—Stuart Kauffman, *Investigations*, 229.

So far, the epistemological challenges from twentieth-century science and mathematics have yet to be put in[to] an accurate and useful cultural context. The accurate assimilation of these powerful ideas into the general culture will provide complexity artists with subject matter for many years to come.

—Philip Galanter, “What is Complexism?” 159.

A Context for Complexism

In a 1948 essay called “Science and Complexity,” mathematician and communications theorist Warren Weaver claimed that Western science, armed with new electronic computational tools developed during World War II, was on the verge of a “third great advance,” one on which “the future of the world [would] depend” (Weaver 540-42). Only with the advent and promise of modern computing could humankind

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adequately address what Weaver described as problems of “organized complexity.” Weaver, a research and development administrator for the U.S. government during the war who later held influential posts at Sloan-Kettering and the Rockefeller Foundation, is perhaps best known for his coauthoring with Claude Shannon of *The Mathematical Theory of Communication*. Written one year prior to that field-defining collaboration, Weaver’s 1948 essay was among the first to articulate the wide-ranging ramifications that thinking in terms of complex systems would have within the broader scientific community. Weaver’s “Science and Complexity” functioned both as a précis of problems that remained unsolved by current mathematical and statistical techniques as well as a program for the next half-century’s scientific research. At the heart of his text is a delineation of three sorts of empirical phenomena: “simple” objects amenable to classical physics’ two-variable equations; ensemble objects displaying “disorganized complexity,” which statistical methods could account for in the aggregate; and structures displaying “organized complexity,” which involve more variables than analogue calculus could handle but also exhibit a unitary form that evades the statistician’s grasp (539). These latter problems of “organized complexity” were only beginning to be grasped as such at the time of Weaver’s writing, a recognition made possible through a combination of radical social and economic acceleration after the war and rapidly advancing tools and techniques for scientific measurement. Problems of organised complexity “deal simultaneously with a *sizable number of factors which are interrelated into an organic whole*” (Weaver 539). Such “organic whole[s]”—integral and self-maintaining despite constant environmental modulation and no direct human intervention—have subsequently been discovered and analysed in domains ranging from physical chemistry to neural networks to financial markets.

In the last couple of decades, artists working under the banner of *complexism* have sought, with the help of digital computers, to allow such complex self-organising formations to manifest within spaces of installation, performance, and video art. Among complexism’s most prominent proponents is Phillip Galanter, whose work mobilises concepts and tools of complexity discourse to extend ancient techniques for incorporating algorithms into artistic practice and, ultimately, to advance the didactic project of reconciling the arts and humanities with the physical and natural sciences. Despite being, as Galanter points out, “as old as art itself,” algorithmic—or *generative*—art remains quite young as a cohesive cultural force. It is only in the last decade or so that the field has begun to be institutionalised through exhibitions, international conferences, programming guidebooks, and art school curricula. My aim here is to problematize this emergent institutionalisation on the grounds that complexism illustrates and even reinforces the market mechanism that supplies the core infrastructure for capitalist societies of the twenty-first century. What I have in mind is far removed from critiques of the art market as a site for the commingling of financial capital and aesthetic taste. As useful as such critiques can be, my concern is in fact almost the opposite. In the case of complexism, the affinity between capital and culture is significantly more abstract. Complexist artists tend to make “things” that are experiential, ephemeral, and often virtual, so the usual problematics of commodification and acquisitiveness hardly apply. Rather, the problem arises in how the motivating principles of complexist art take shape alongside the increasing hegemony of neoliberal thought. Here, the work of economist, social theorist, and political philosopher Friedrich Hayek—who assembled his vastly influential free-market ideology atop notions of spontaneous order, complex systems, and the “primacy of the abstract”—will play a pivotal role. Tellingly, Galanter’s go-to examples of complex systems are almost identical to those Hayek was fond of citing half a century earlier: natural language, the brain, the mind, phylogenetic evolution, and “the rise and fall of cultures” are all products of similar mechanisms of bottom-up self-organization, that is, the laterally coordinated but undirected activity of multiple agents. In the final analysis, complexist art, as a subset of generative art, offers a deeply troubling aestheticisation of the market mechanism as it was uniquely theorised by the foremost architect of neoliberal policy and thought.

Upon encountering Weaver’s essay on complexity, Hayek immediately recognised a kindred body of research (Hayek, *New Studies* 26). Prior to that encounter, his social epistemology and philosophy of markets had led him to insist on a sharp divide between the natural and human sciences.¹ He took pains to

¹ See, e.g., essays collected in *Individualism and Economic Order*.

elaborate on how some of the most disastrous policy ideas of the modern age arose out of a failure to respect the fundamental limitations of natural science applications towards the study of human interaction. Taking aim at positivist social theorists like Auguste Comte and Henri de Saint-Simon, whose hyper-empirical methods reduced society to a set of ready-to-hand physical facts, Hayek argued for a radically “subjectivist” approach to social phenomena.² The fields of social and human sciences, he claimed, must be as attentive to perceptions, ideas, qualities, and relations as to empirical data. In Weaver’s paper, as well as in encounters with mathematicians, systems theorists, and others loosely affiliated with the early cybernetics movement, Hayek saw that the natural sciences themselves, under the banner of complexity, were in many respects heading towards a similarly *subjectivist* approach. This approach would underscore the importance of non-coerced, non-generalizable, local decisions for the emergence of “natural” prices for goods and services and the shifting yet stable social orders that coalesce around them.

The early rumblings of complexity science, in Hayek’s view, suggested what we might call a *becoming-social* of the natural sciences. Hayek accordingly redrew his line in the sand. In his philosophy of social science, the emphasis would no longer be on the distinction between the natural and social sciences but between those sciences which posit laws pertaining to more or less mechanistic and calculable objects and processes versus those observing the “essentially complex” phenomena “of life, of mind, and of society” (Hayek, *Studies* 25). More recently, the philosopher of science Isabelle Stengers has captured the radical nature of the emergent paradigm of complexity, positing that “The vision of a complex world per se cannot be substituted for another scientific vision of the world; it is the notion of a vision of the world, from the point of view of which a general and unifying discourse can be held, that in one way or another must be called into question” (5). For science, this means that any discourse that purports to be “general and unifying” is no longer valid. This dovetails with Hayek’s rejection of economic planning on the grounds that social knowledge is always dispersed and can never be adequately centralised by bureaucratic institutions or policymakers. Translated into the sphere of art, Stengers’ pronouncement implies nothing short of the expiration of the notion of a singular creative “vision” belonging to an individual artist or group. Complexist artist Galanter’s work and writings supply a glimpse of just such a world, one where self-organizing and largely unpredictable patterns, usually driven by computer algorithms, take the place of human inventiveness and perception and, in the process, dismiss some of the most urgent ethical and political problems presented by neoliberal capitalism in the twenty-first century.

Galanter’s RGBCA #2 (2010) is an installation of more than one hundred multicolour LED lights arranged horizontally to span some thirty feet of the gallery wall. As they flicker and fade and change colour, patterns emerge and retreat, and they do so spontaneously, as each light cell adjusts its appearance according to instructions pre-set by the artist. The piece, like many of Galanter’s installations, is intended as an illustration of the core principles of complexity science. As Galanter describes in his artist’s statement,

Each cell is only ‘aware’ of its own current state and the states of its two neighbours. Using a simple set of rules each cell maps those three current states into its next state...The individual cells are simple but en masse, depending on the rule set, they can exhibit a remarkable diversity of behaviors...Like other complex systems this piece will exhibit patterns that include irregularities here and there. Sometimes patterns will dissolve into chaos, and others will converge on a static state or simple repetition... Tiny differences in rule sets can result in dramatically different emergent behaviors.

This basic method—by which complex self-organisation emerges from a reiterative running of a simple program—is a defining feature of generative or algorithmic art. (Images and video of RGBCA #2 and other works, as well as Galanter’s artist statements, can be accessed via the artist’s website.)³ The algorithms need not be electronic. John Cage, for example, deployed analogue algorithms to compose musical scores

² This is a running theme in *The Counter-revolution of Science*.

³ philipgalanter.com/art/rgbca2/images/. See also Galanter’s description of his piece XEPA, which names both the project and each of the “intelligent sculptures” that constitute it: “No coordination information or commands are sent via data radio. Each XEPA only sends a description of what it is doing at the time. Each XEPA independently evaluates the aesthetics of the other sculptures, infers a theme or mood being attempted, and then modifies its own aesthetics to reinforce that theme better. Each performance is unique, and a wide variety of themes and moods can be explored.” <http://philipgalanter.com/art/xepa/images/>

through chance operations.⁴ Similarly, the geometric patterns of medieval Islamic art have been identified as precursors to today's computer-aided reiterative processes.

With installations like RGBCA #2, Galanter seeks to infuse the genre of algorithmic art with a precise pedagogical task, namely, to “project... the worldview and attitude suggested by complexity theory into the problem space of the arts and humanities” (Galanter, “What is Complexism?” 151). He thus announces the dawn of a new field of the art research and the sub-genre of generative art practice he names *complexism*.⁵ The most novel and exciting projects in this field have, according to Galanter and others, been conceived and designed with this concept of complexity firmly in mind (c.f., Pearson). Galanter writes, with co-curator Ellen K. Levy:

The premise of our exhibition, COMPLEXITY, is that a broad swath of art reflects aspects of complexity and responds to the science of complex systems either intentionally or intuitively. ... [But] [W]hat is complexity? ... By “complex” scientists do not mean “complicated” or “perplexing.” Generally, complex systems include large numbers of components interacting in nonlinear ways, and often leading to surprisingly self-organized behavior. (Galanter and Levy, 2)

Among the many genres of contemporary visual art, generative or algorithmic art seems uniquely keyed to the social and technological mainsprings of everyday life in the twenty-first century. Granted, while electronic computation has supercharged the field, the application of automated, reiterative techniques—aka algorithms—to image-making activities is, as Galanter notes, “as old as art itself” (“What is Generative Art?”).⁶ Similarly, plenty of recent non-algorithmic art speaks to or makes use of our historically novel technologies and social arrangements—art, for example, that raises questions of telepresence, virtuality, relationality or globalisation, or art expressed through digital media platforms, immersive devices, or communications networks. My aim is to historically situate complexism not just as an art practice but as a discourse, an ideology, an ethos, and a set of techniques for governing the emergence and behaviour of complex patterns. Generative art stands out as singularly contemporary, not necessarily for its deft exploitation of now-ubiquitous computational tools and techniques, but, in its complexist variant, for its deep commitment to the trailblazing problems, methods, and hypotheses set out by the new science of complexity, which appeared as such in the late decades of the last century.

Design historian Christina Cogdell, taking a new historicist tack, reproaches complexism for championing ideals and methods that have already saturated the broader cultural realm, propelled by capital and in need of no further promotion by the arts. Twenty-first-century financial institutions serve as a leading example of the way concepts advanced by complexity science, like emergence and self-organisation, have been harnessed by postmodern capital with highly lucrative results. The complexist ideology espoused by Galanter, Cogdell argues, only encourages “the socio-economic and environmental expulsions occurring in the global economy” more broadly (Cogdell 33). Melinda Cooper brings a similar critique to bear on sunny scientific claims, dating back to the early 1970s, about the earth's autopoietic capacity to sustain the environmental and atmospheric ravages of global industrialisation on the late capitalist model. “[T]he political and economic consequences of... complexity science,” Cooper contends, “are becoming hard to ignore” (Cooper 41). Seemingly naive to such charges, Galanter himself highlights the stock market as a paradigmatic illustration of “a complex system with emergent properties.” There, he says, “billions of shares and transactions are linked,” “patterns ... emerge,” and yet “no one factor dominates or ‘plans’ the market” (Galanter, “Complexism and the Role of Evolutionary Art” 312). Not only does this gloss perpetuate a romanticised image of the financial market as an optimally efficient and operationally transparent

⁴ In Cage's *Atlas Eclipticalis* (1961), for example, the piece is composed by laying score paper over astronomical charts and placing music notes wherever a star is present.

⁵ A note on terminology: I treat *generative art* and *algorithmic art* as synonymous. I use *generative* at times to emphasise the complex, self-organising patterns that emerge from the procedures; alternately, I use *algorithmic* at times to emphasise the inextricability of the art object from the technical infrastructure. *Complexist* always refers specifically to projects expressly aimed at elucidating recent research in the hard sciences having to do with self-organisation, emergent properties, and the evolution of systems in non-steady environments.

⁶ Dorin, et al. take up this point about, demonstrating that “[g]enerative art is neither technological, nor specifically digital, despite the recent popularity of works that are both” (240).

machine, but it lines up complexism as an aestheticisation of free-market politics. Mirroring the third-way liberals' claim to "ideological neutrality" (Pearson 9.4 and 9.11), complexism both idealises laissez-faire policy platforms and naturalises the values and beliefs underpinning the socioeconomic immiseration endemic to the neoliberal era.⁷ The uncritical and non-reflexive appropriation of complexity science for the sake of complexist art risks further cementing locked-in ideas about the inevitability of market competition, the inelegance of government, and the social necessity of the machine.

Anti-politics in the New Cult of Nature

Galanter, whose complexist framework has permeated much of the discourse and thinking around generative art today, betrays little knowledge of the history of complexity science despite his profuse descriptions of how complexity infuses his own art practice. His expositions border dangerously on adoration and appear oblivious to the political and ideological implications of unchecked complexification. Much of this comes as a result of his self-anointed role as a sort of cultural emissary for trending scientific movements of the late twentieth century. He posits generative art, and complexism in particular, as an art-historical intervention capable of stemming the tide of postmodernism without reverting back to outmoded modernism. "Complexism," Galanter contends, "provides a higher synthesis that subsumes both modern and postmodern concerns, attitudes, and activities" (Galanter, "What is Complexism?" 158). His art, accordingly, aims to use generative systems to split the difference, as it were, between systems exhibiting a high degree of order and minimal information (modernism) and systems exhibiting maximal information and unfettered disarray (postmodernism).

Galanter's historical sketch is deeply reductive, but perhaps this is where its pedagogic power lies. Neither programming nor art, but both at once, complexism promises to reunite science and the humanities much in the way that it invokes complexity as an antidote to the technically simplistic extremes of order and disorder that mark modernist and postmodernist art, respectively. Galanter's portrayal of the rift between the sciences and the humanities (including the arts) arrives steeped in C. P. Snow's (short-sighted and duly refuted) midcentury Manichaeism and the later (but no less dated) debate over the "science wars." With few caveats, Galanter depicts an art world "moved from the modern culture it once shared with science to the postmodern culture it now shares with the humanities. Generative artists, especially those working with complex generative systems, are standing right where the foundation for a new bridge between the sciences and humanities must be built" (Galanter, "What is Complexism?" 158). The dichotomy that Galanter presents, however, is a false one; the bridge may be unnecessary. Part of the problem is that his theoretical (and ultimately pedagogical) punching bags appear as little more than a string of 1980s straw men and stereotypes. His perfunctory series of "postmodernis[t], deconstruction[ist], post-structural[ist], critical-theor[etical]" caricatures (Galanter, "What is Complexism?" 155), from which he hopes to liberate contemporary institutions of humanistic inquiry and the arts, were in fact cut from the same cloth as the revolutionary breakthroughs in chemistry and biology that constituted the first formal scientific approaches to complexity. Taking some liberties in paraphrasing, Galanter lays out what he takes to be truisms of a debased postmodern thought: "language has no fixed meaning (Derrida)"; "science is not objective discovery [but ...] social construction (Lyotard)"; "the author is dead, and any meaning is created by the reader (Barthes)" (Galanter, "What is Complexism?" 157). It does not take much work to align such theoretic concerns, even in Galanter's brutalising renditions, with the very same scientific advances the complexist artist takes as his inspiration. Consider the destabilization of all certainty in Ilya Prigogine's proof for the irreversibility of time, or his subsequent deposition of deterministic models, or the critique of the objectivity of the observer in second-order systems theory, or the corollary claim that observers themselves become integral components of the systems that they observe and that meaning can only be established in this space of radical intersubjectivity.

⁷ For evidence of such immiseration, see, e.g., Thomas Piketty's landmark work *Capital in the Twenty-First Century*.

At other times, however, Galanter does manage to grasp complexity science closely enough to reiterate its challenges to the field. Whereas what Galanter loosely refers to as “reductionist” science treats the observable world as something transparently knowable and capable of coming under full human control, complexity science is founded on the premise that we humans might be better served by a hands-off approach, allowing some “natural” processes to unfold, in the words of complexity theorist Stuart Kauffman, “unguided by any intelligence” and “without careful crafting” (Kauffman, *At Home in the Universe* 83). Of the ontological and epistemological underpinnings of modern Western science to date, Kauffman says, “we appear to have been profoundly wrong. Order, vast and generative, arises naturally” (Kauffman, *At Home* 25), which is to say, not as a result of direct intervention and not with any concern to be fully understood in advance. In the aesthetic milieu, generative art employs “autonomous systems” to likeminded ends, intent on producing “potentially multiple results.” “The key element,” Galanter insists, is “the *system* to which the artist cedes partial or total subsequent control” (Galanter, “What is Generative Art?”). The work of art becomes “an ongoing process rather than a static object,” with the algorithmic output at any given moment remaining impossible to determine in advance (Galanter, “What is Complexism?” 164). Each element of the art-system follows simple rules for adapting to change in its immediate environment, so that a truly complex, “self-organizing” whole emerges—“many components that interact with other nearby components and form a coherent pattern or entity without any central control or plan as to how that should happen” (Galanter, “What is Generative Art?”).

Within the rubric of generative art, the algorithms and computer codes that decide what and how things appear become harbingers of a new sort of naturalism, embracing whatever processes subvert the “reductionist” classification schema and its correlative “command-and-control” style of management and design. The programmer, algorist, and author of *Generative Art* Matt Pearson likens computer algorithms to soil and water; “generative art isn’t something we build,” he claims, but is rather “something we ... grow” (Pearson xviii). “Algorithms,” he points out, “are a part of the natural world” (Pearson 9). For Galanter, algorithmic artworks, if they are to successfully capture the essential unpredictability of complex systems, “emerge ... as the result of naturally occurring processes, beyond the influence of culture and man” (Galanter, “What is Generative Art?”). I propose we reject such *naturalising* tendencies at work in complexism, which perpetuates a style of dualistic thinking (nature/culture, modern/postmodern, science/humanities) that few serious scholars could wish to preserve. Contrary to complexism’s aim to *naturalise* the arts, to liberate them, as it were, from their postmodernist tethering to “culture and man,” I follow Fredric Jameson’s injunction to “always *historicize*.” For all the leverage it supplies to generative art discourse, the concept of complexity remains surprisingly vague and shorn of any historical sensibility. In the pages that follow I will continue to flesh out the genealogy of complexism, to bring more theoretical rigour to Galanter’s use of this concept by retracing some of the many lines of natural and social scientific inquiry that converge upon this core reference point for contemporary aesthetics.

Among the highlights in the history of complexity science are the physical chemist and Nobel laureate Ilya Prigogine’s work on “dissipative structures” in the 1960s and 1970s, which gave rise to formal descriptions of self-organization processes in “far-from-equilibrium” systems, and the founding, in 1984, of the Sante Fe Institute, now the world’s leading hub for research into complex, adaptive systems, taken to include everything from nervous systems to civilizations to the Internet. As Weaver had predicted in his 1948 essay, the electronic computer would prove indispensable to complexity research (Weaver 540–42). In the words of the particle physicist and systems theorist Fritjof Capra, our “new machines” have “revealed very surprising patterns underneath the seemingly chaotic behavior of nonlinear systems, an underlying order beneath the apparent chaos” (Capra 8). Without the electronic computer, the mathematical calculations behind the many revelations of complexity science would have never been possible. The “underlying order” of the universe (or of the nervous system, or the ecosystem, or the economy) remains inaccessible to the observing subject. The vision promoted by complexity science is rigorously computational and definitively posthuman. Prigogine, for example, is quite explicit in describing how the radical portrait of the observable world that emerges from his research upends the basic ontological and epistemological premises of modern thought. Whereas “classical physics ha[d] emphasized stability and permanence... [w]e now see that, at best, such a qualification applied only to very limited aspects. Wherever we look, we discover evolutionary

processes leading to diversification and increasing complexity” (Prigogine, Allen, and Herman 5). In cellular and molecular biology, the observation of self-organised, complex phenomena, from metabolic reaction to gene expression, has revolutionised the inquiry into the origins of life. Stuart Kauffman has most comprehensively detailed this line of research and its paradigm-shifting implications, describing numerous examples of “stunning order... without careful crafting... randomly assembled, unguided by any intelligence” (*At Home* 83). Yet underneath the unplanned patterns and spontaneous orders lie simple rules that conduct the conduct of each individual element. Here, Kauffman explains, the Darwinian model is stood on its head, as researchers hypothesise how supposedly *random* mutations in organisms and species are in fact not random but governed by abstract laws that have yet to be fully understood.

Algorithmic artists, especially those like Galanter whose “works” tend towards the ephemeral and the experiential, replay in reverse this discovery in their refusal to determine the ultimate appearance of their work. Operating far behind the scenes, they craft sets of rules that dictate local behaviours without ever fully knowing what the end results will look like. Importantly, Kauffman distinguishes complexity science from classical scientific approaches by elaborating upon “the distinction between explaining and predicting”: “failure to predict,” he says, “does not mean failure to understand or to explain... even in our incapacity to predict details, we can still have every hope of predicting *kinds of things*” (Kauffman, *At Home* 16-17). I am especially interested in how this penchant for the abstract, this rejection of planning in favour of retrospective explanation and protocological intervention, plays out in neoliberal social theory and governmentality. On the whole, the formal introduction of complexity has pressed upon empirical science nothing short of “a new view of matter” (Prigogine and Stengers 9) and “a new view of life” (Kauffman, *At Home* 25). We must now explore in some detail how these “new views” fit within larger cultural systems and align with what we might call the “new view” of markets that originates in the same historical-intellectual ferment of complexity thinking.

Before Prigogine and others working in the natural sciences began interrogating and understanding complex systems, it was research in the human and social sciences that first heeded Weaver’s call to attend to problems of organised complexity. As early as the 1950s, international relations scholars and organisation theorists had begun to conceive of inter-state relations and corporate firms, respectively, in terms of complex systems. Hayek’s social theory and subsequent philosophy of governance closely aligned with such work and likewise anticipated the sorts of network dynamics and algorithmic adaptability heralded by later studies of complexity in the physical sciences. Hayek, in fact, was probing problems concerning the emergence and maintenance of complex, self-organised systems as early as the 1930s. His theoretical solutions to these problems were instrumental to what historians and sociologists have subsequently described as late capitalism’s “neoliberal turn.”⁸ These solutions are well known, but the impetus for Hayek’s early advocacy of free markets and governmental deregulation remain significantly under-appreciated. Hayek was keenly attuned to evolving research paradigms in the natural sciences, to mathematical advances ushered in by electronic computation and automated information-processing machines, and to the subsequent need to radically reconfigure the classical terms and analytical methods of the liberal arts and “sciences of man.”

The affinity between Hayekian social theory and contemporary complexist art and art discourse is surprisingly far-reaching. Particularly noteworthy are their shared prioritisation of local rather than universal knowledge, observation of aggregate rather than individual behaviour, and intervention at the level of an abstract rule rather than preferred outcome. Hayek’s regular exchanges with cyberneticists, systems theorists, evolutionary biologists, cognitive psychologists, and other forerunners to the new science of complexity significantly bolstered his longstanding reproach of classical, laissez-faire liberalism, which his position is often confused for. In fact, as he saw it, classical laissez-faire liberalism “failed to cope adequately with new problems” resulting from increasingly intricate social arrangements and accelerated rates of diversification and growth (Hayek, *New Studies* 144). In short, what was new about neoliberalism was that, rather than demand a fully hands-off approach, the state would acquire a clear *positive* function—namely, to create ripe conditions for “natural” prices to emerge and to curate, as it were, the spontaneous

⁸ Among the finest introductions to neoliberal *thought*, see, e.g., Mirowski, Peck, and Harvey.

and complex social phenomena that self-organize around such a price system.⁹

By invoking Hayek here, I do not seek to vindicate his long-neglected research in scientific methodology; nor do I care to rescue his social and political philosophy from his self-appointed heirs within the ever-widening fringes of American political discourse. Instead, I hope that constructing this particular constellation of complexism will help to shed new light on some of the fundamental claims, guiding principles, and rhetorical tropes at work in this corner of the field of algorithmic art, particularly for those attempting to stake out the genre's broader cultural function as a bridge between modern science and the postmodern humanities.

In its "higher synthesis" of the modern and the postmodern—carving out a middle way between total order and absolute disarray—the complexist brand of algorithmic art closely resembles the market system as described by neoliberals like Hayek. For Hayek, neoliberalism offered a third, ostensibly ideologically neutral, path between market socialism and laissez-faire radicals. The planned economy of the socialists, backed by neoclassical formulae for "perfect equilibrium," modelled society as a knowable, calculable object capable of being completely and consciously arranged; at the other end of the spectrum, laissez-faire radicals and anarcho-capitalists celebrated the unqualified freedom of disorder and chaos; Hayek, seeking to navigate away from those opposed yet, as he saw them, equally perilous models, envisioned the price mechanism and market competition as generative of "spontaneously formed orders" which "can be preserved throughout a process of change" (Hayek, *New Studies* 183-84). In other words, the neoliberal market pushes society to transcend both the simply ordered and simply disordered states by fostering an environment of dynamic disequilibrium from which self-organising, "supra-conscious" formations would be allowed constantly to emerge, struggle, and evolve. Because the ultimate contents—particular patterns, facts, outcomes—remain undetermined, the method of the market is said to bypass political and ideological partisanship entirely, anticipating the avowed "neutrality" of the artist in the generative or algorithmic art system.

From Algorithmic Governmentality to Regulatory Art

Recall Galanter's fundamental fascination with the way complex patterns and formations evolve from the reiterative operation of extremely simple sets of rules. A similar fascination underpins Hayek's defence of the detached and disinterested style of market intervention that would come to characterise neoliberal governmentality. For Hayek, "Even a relatively limited repository of abstract rules that can ... be combined into particular actions will be capable of 'creating' an almost infinite variety of particular actions" (Hayek, *New Studies* 49). An abstract rule, Hayek says, can be thought of as "a statement by which a regularity of the conduct of individuals can be described, irrespective of whether such a rule is 'known' to the individuals in any other sense than that they normally act in accordance with it" (Hayek, *The Market and Other Orders* 278). Such rules must be in force for any complex, feedback-driven system's normal sensing and reacting functions to take shape. Decrying what in the early 1940s seemed a "universal demand for 'conscious control or direction of social processes,'" Hayek frequently invoked the philosopher and mathematician Alfred North Whitehead's remark that "civilization advances by extending the number of important operations we can perform without thinking about them" (Hayek, *The Counter-revolution of Science* 87). For Hayek, this principle of the "primacy of the abstract" and the "non-conscious" was meant to cover phenomena at all possible scales, from rules for what frequency of waves an animal is able to process optically to rules for breathing and blinking to rules for deciding at what price to buy a given commodity.

At the heart of the neoliberal spirit lies a fundamental belief that, as Hayek has it, "the spontaneous interplay of social forces sometimes solves problems no individual mind could consciously solve, or perhaps even perceive ... thereby creat[ing] an ordered structure which increases the power of the individuals without having been designed by any one of them" (Hayek, *Counter-revolution* 87). By channelling dispersed information to locally situated decision-makers, the capitalist price system, as an emergent

⁹ See, e.g., "Competition as a Discovery Principle" 18.

and ever-evolving social institution, provides the *ur*-form for other complex phenomena. In other words, the economist-cum-social theorist Hayek anticipates the experimental methods and epistemological principles of more recent students of complexity like Prigogine and Kauffman. Kauffman himself seems to acknowledge this when he examines “the persistently innovative econosphere” as “an outgrowth” of the biosphere—“both built by communities of autonomous agents in their urgent plunging, lunging, sliding, gliding, hiding, trading, and providing” (Kauffman, *Investigations* 211-12). “Neither the biosphere nor the econosphere are merely about the distribution of limited resources,” he claims, “both are expressions of the immense creativity of the universe ... ever-expanding web[s] of diverse complexity” (Kauffman, *Investigations* 212). In Kauffman’s formulation, the distinct disciplines of economics and biology collapse into one another, become mere prefixes, interlocking “spheres.” Once the structural complexity of each is established, a given field becomes less about understanding particular outcomes and more about creating optimal conditions for “universal creativity” to flourish. The New, for Kauffman as for Hayek, is held up as a chief object of research and the overriding justification for refusing to pursue more particular aims.

Not surprisingly, Hayek’s affinities with complexity science have gone almost entirely unnoticed in historical overviews of the field.¹⁰ But Hayek, whose manifold insights helped to shape the postwar orientation of Chicago School Economics and the ensuing construction of neoliberal ideology in America, proffered a rich notion of spontaneous, complex order that not only gave direction to his political and economic philosophy but cannily anticipated the radical conjectures of natural scientists like Prigogine and Kauffman. When those later thinkers first presented their conclusions in the last decades of the twentieth century, they were seen as groundbreaking, and deeply controversial. When Hayek presented similar ideas about the methodological and epistemological limitations of standard modern science, from the 1940s onward, they tended to be either dismissed out of hand or else gently forgotten, in large part because his subsequent political prescriptions so fiercely transgressed mainstream Keynesian thinking about resource allocation, economic planning, and the status quo social mandates of the state.

In the rush to either celebrate or vilify Hayek for his role as a lead architect of neoliberal thought, latter-day commentators have not only expunged whatever ambiguities existed in his political program, but more problematic still, they have entirely obscured those findings in the philosophy of science that led him to espouse market freedom as a universal ideal in the first place. In other words, while Hayek’s political and economic research found backers in the uppermost echelons of the corporate and governmental power structure of the Cold-War West, his antecedent arguments and ideas—about how human knowledge evolves, why markets exist, what science is capable of, and when individual liberties might be justly curtailed—have hardly been reckoned with.¹¹ This intellectual-historical obfuscation is especially disconcerting, since Hayek’s contributions here revolve around original articulations of complexity, emergence, and the automatic procedures already embedded, as he understands it, in everyday psychological and social life.

Three core features of Hayek’s thought—three distinct but interconnected problems from which his philosophy of science takes off—deserve special attention in our genealogy of complexism and generative art. First, Hayek began to conceive the market anew as a multilateral “communication system,” or an all-purpose “information processor,” rather than a site of competition and exchange.¹² Second, he understood individuals to observe, make sense of, and conduct themselves in the world according to slowly evolved

¹⁰ Dupuy’s *The Mechanization of the Mind* serves as an outlier here, connecting Hayek’s concept of spontaneous self-organising systems with postwar research into cybernetics, autonomous systems, and, perhaps most strikingly, post-structuralist critiques of the subject-centred approach of the human sciences (176–78). Tkacz, likewise, demonstrates clear connections between Hayek’s liberal social theory, particularly as it was in conversation with the philosopher of science Karl Popper’s elaboration of the Open Society, and the discourse and ethos of “openness” promoted by contemporary hacker communities.

¹¹ Hayek’s thought has mainly been reduced to his notorious (and severely reductionist) “political book,” *The Road to Serfdom*. Even that book, a product of wartime worries about the threat of totalitarianism and a pitched critique of centralised social and economic planning, is hardly the ode to laissez-faire capitalism that right-wing business groups, politicians, and talking heads have understood it to be.

¹² First described in *Individualism and Economic Order*. Mirowski details this feature of Hayek’s work in *Machine Dreams* (235–41).

“abstract rules,” which they need not even know they are following.¹³ Third, he held that, from the reiterative processing of such simple rules over the course of many millennia, historically specific “spontaneous orders” emerge, “self-organized” and “non-hierarchical” social forms and institutions wherein collective human existence becomes part and parcel of the dynamic and metastable biological, physical, and technological systems with which it constantly interacts.¹⁴ These three pivotal ideas transcend their immediate functions within particular debates in the philosophy of science to form the basis for the neoliberal turn in economic, political, and social thought. In no uncertain terms, theories of complexity, emergence, and autonomous algorithmic systems have supplied the essential ideological conditions for the development of contemporary capitalist markets as well as contemporary capitalist culture, a fact that should weigh significantly on our present exposition of generative art.

For Hayek, the recognition of *social* complexity presents an equally troubling epistemological problem. As he saw it, the progressive but unplanned evolution of human civilisations over centuries hinges on the sustained cultivation of efficient means for transmitting and receiving the various bits of knowledge scattered throughout the social space.¹⁵ This, he charged, was “the economic problem of society,” and its very existence was entirely incompatible with both the old-style liberalism of Adam Smith and David Ricardo as well as the predilection for mathematical calculations, statistical techniques, and formal laws that guided both neoclassical and socialist economics.

“[T]he knowledge of the circumstances of which we must make use never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of society is thus not merely a problem of how to allocate ‘given’ resources ... [but] a problem of the utilisation of knowledge which is not given to anyone in its totality.” (Hayek, *Individualism and Economic Order* 77)

Anticipating Stengers’ recognition of the sheer inaccessibility of any complex whole to any central or singular observer, Hayek posits the market, and more specifically the price mechanism, as a massive communications network making it possible to maintain systemic integrity despite there being no plan in place for how that system will evolve. The market proves to be a more “efficient mechanism for digesting dispersed information than any that man has deliberately designed” (Hayek, *New Studies* 34). On the neoliberal model, the market is no longer primarily about the facilitation of commodity and monetary exchange, nor is it primarily about the facilitation of competition; rather, these take a backseat to the market’s newly minted function as “a kind of machinery for registering change,” or a system of telecommunications which “enables individual producers to watch merely the movement of a few pointers ... in order to adjust their activities to changes of which they may never know more than is reflected in [a] price movement” (Hayek, *Individualism* 87). In other words, for Hayek, because a society exhibits all the technical characteristics of a complex system, the market is indispensable to its continual growth.

As Hayek saw it, the positive task of the state in this situation is to ensure that each individual has access to whatever “information ... he needs to fit his decisions into the whole pattern of changes of the larger ... system” (Hayek, *Individualism* 84). As “information” is most transparent when it takes the form of a price, the goal of government is to create conditions in which the most “natural” prices will emerge—through, for example, maintaining property records, adjudicating civil disputes, guaranteeing the value of currency, cultivating competition, and so on. As the neoliberals have it, this is where intervention should occur, at an abstract level, with an eye towards *types* of outcomes but never in the name of reaching some exogenous, preconceived goal (“social justice,” of course, being among their favourite targets here).

The interventions of the complexist artist often neatly model this regulatory style. As in a controlled science experiment, one modifies the variables without directly dictating a particular outcome. Supplying evidence of his ostensible ideological neutrality, Galanter again imitates the neoliberal in promoting

¹³ First elaborated in *The Sensory Order*, then further pursued in “The Primacy of the Abstract” (collected in *New Studies*), among other places.

¹⁴ See, e.g., *The Market and Other Orders* and *Individualism and Economic Order*.

¹⁵ See, e.g., “The Use of Knowledge in Society,” collected in *Individualism and Economic Order*.

methods that, in the best cases, “have nothing to do with the content of the work at all” (Galanter, “What is Generative Art?”). In RGBCA #2, for example, each cell adjusts its behaviour based only on its localised knowledge of adjacent cells. The artist stands outside the system, tinkering with the base instructions to generate varying *kinds* of appearances but never this or that appearance in particular.¹⁶ The affinity with neoliberal governmental techniques is so profound that we might describe Galanter’s work as *regulatory art*. Market and artwork alike are governed from an experimentalist stance; sculpting with complexity, both regulator and art practitioner say: *change a rule and see what happens*. Observing scientists, regulators, or policy-makers—like the complexist artist—can never know with complete certainty which rules are at work behind a specific decision or action or how a given change in the rules will affect social evolution writ large. They can, however, decipher abstract patterns in the aggregate, and it is precisely here, in the algorithmic aggregation and filtration of data, that novel and genuinely complex structures emerge undirected by any conscious entity or process. While many individuals make conscious choices regarding their own positionality within a given system, the complex whole moves to the beat of what Hayek called a “supra-conscious mechanism.” In both instances—the economic and the aesthetic—it is through the distribution and undirected coordination of information that “the whole acts as one” (Hayek, *Individualism* 86).

The Neoliberal Style

In summation, the shortfall of complexist art and discourse is twofold. First, it remains ignorant of its own heritage, of the social, political, and economic roots of the contemporary constellation of complexity science. This leads to a set of naïve suppositions about the ideological neutrality of the genre and an inability to recognise its disquieting affinities with the logic of neoliberal governmentality. Second, it assumes a bluntly simplistic historical sensibility with respect to the fervent cross-pollination between natural and social science disciplines from the postwar decades to the present. This leads the complexist artist, in our study Galanter specifically, to propound a misguided sense of purpose while failing to accurately project the continual and complicated coexistence of ideas and styles from the modern and postmodern past into the complexist future.

To be clear, the outstanding dilemma for complexism has nothing to do with its adaptation of truly important scientific ideas or its articulation and illumination of complexity theory and all its attendant concepts. Rather, the problem has to do with the cultural-historical lacuna around which the discourse of complexism has up to now taken shape. Galanter’s assumption of “no particular motivation or ideology” is itself imitative of neoliberalism’s dispassionate—and shameless—refusal to staunch the swell of inequality that its policies have provoked. The politics of generative art, like the politics of neoliberalism, can be summarised as a politics of depoliticisation. And while critics of neoliberalism have long pegged its claims of neutrality to a broader strategy of ideological deception (what more likely place to find politics than where it is proclaimed to have been evacuated?), perhaps the gravest charge against generative art is mere political naïveté. By replicating and aestheticising the founding principles of neoliberalism’s market-oriented social theory, complexist art furnishes a de facto endorsement of its immiserating socioeconomic effects, inadvertent though it may be.

In his classic essay on “The Work of Art in the Age of Its Mechanical Reproduction,” Walter Benjamin denounces as dangerously fascistic art that seeks to aestheticise politics. Against this tendency, revolutionary art—communist art—must seek a politicisation of aesthetics. Today we have no doubt moved beyond Benjamin’s distinctly twentieth-century antagonism. Neoliberalism at its core operates according to a logic of depoliticisation, and, insofar as it refuses to pronounce upon outcomes, it would seem to supply no sense of style at all. At the same time, art has harnessed digital technologies to produce singular experiences and randomised results far beyond the realm of mechanical reproduction. With algorithmic art, we have less an aestheticisation of politics than an *aestheticisation of method*, an *aestheticisation of governmentality* that is

¹⁶ Betraying a cursory nature of his own research into complexity science, Galanter, remaining outside the system, fails to make the leap to second-order cybernetics, which locates the observer within the system being observed in a much more rigorous way that something like RGBCA #2 allows.

at the same time an anti-style. Galanter's modular light installations may be pleasant to look at, but what we need is not another "meeting place for the sciences and humanities," which is what the artist heartily prescribes (Galanter, "What is Complexism?" 165). What we need is an art that can challenge our vision, redistribute the sensible (as Jacques Rancière has it), and shake up our image of the world and of what remains possible therein. Complexism, in our analysis, seems to achieve just the opposite.

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