What is Complexism? Generative Art and the Cultures of Science and the Humanities

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Abstract

In previous papers I've discussed complexity theory as a context for generative art theory. This paper extends that discussion to consider the lessons learned from generative art about the cultural conflict between science and the humanities. It is argued that generative art is uniquely positioned to negotiate between science and the humanities, and suggests a new paradigm called "complexism" as a subsuming synthesis of modernism and postmodernism.

I've previously noted that both simple-highly-ordered systems, and simple-highly-disordered systems, are accepted as generating works in the standard art cannon. Generative art using complex systems, however, is much less understood or accepted. It is argued that generative art using complex systems, especially where it participates in a new form of dynamism, holds great promise to be particularly transformational.

This leads to the introduction of complexism. Complexism is, in a sense, the projection of the world view and attitude suggested by complexity theory into the problem space of the arts and humanities. Complexism uniquely addresses the problems of uncertainty and incompleteness introduced by science and mathematics in the 20th century. In addition, complexism offers a higher synthesis that reconciles the disputes behind the so called "science wars" of the late 20th century. While the modern/postmodern polarity seems to only offer irreconcilable differences between the cultures of science and the humanities, complexism provides a unique meeting ground for both. And generative art provides complexism with its most compelling voice to date.

1. Defining Generative Art via Complexity Theory

To define art is to propose a theory of art. In a similar way, to define generative art is to propose a theory of generative art. There are a number of theories of generative art in popular circulation, including the following:

- *Generative art involves the use of randomization in composition.*
- *Generative art involves the use of genetic systems to evolve form.*
- *Generative art is art that is constantly changing over time.*
- *Generative art is created by running code on a computer.*

In a previous paper [1] I introduced a theory of generative art that offered the following as the now possibly most widely cited definition of generative art:

> *Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art.*

This theory of generative art casts a very wide net that is independent of any particular past or future technology. It certainly includes, but is not restricted to, all four of the previously mentioned notions regarding generative art.

By including systems such as symmetry, pattern, and tiling one can claim that generative art is as old as art itself. And indeed the earliest known art objects are generative products. This view of generative art also includes 20th century chance procedures as used by Cage, Burroughs, Ellsworth, Duchamp, and others. This helps to tightly bind generative art to the standard art canon rather than leaving it isolated as an awkward art world orphan.

Given that this theory turns on the use of systems it should not be surprising that the contemporary scientific paradigm for the general study of systems, complexity theory, provides a context for the consideration of generative art. In brief, scientists such as Murray Gell-Mann [2] classify simple systems as being either highly ordered or highly disordered, and hold that complex systems exhibit a dynamic tension between order and disorder. This is illustrated in figure 1.1.

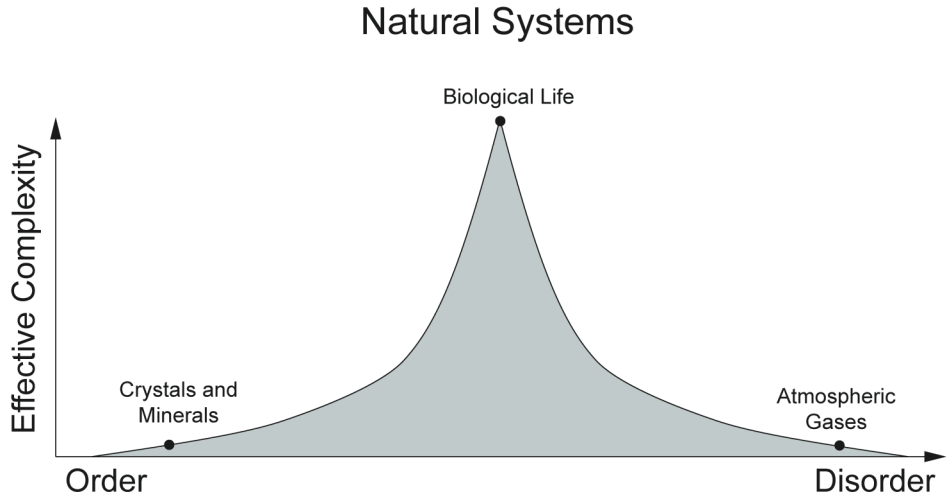

Figure 1.1

The earliest forms of generative art, those noted above as involving symmetry,

pattern, and tiling, exploit simple highly ordered systems. In the 20th century the use of chance procedures, i.e. randomization, introduced highly disordered systems in generative art. Arguably the most active area of research in contemporary generative art involves complex systems such as genetic algorithms and evolution, artificial life, chaotic systems, emergent behavior in networks, and so on. As illustrated in figure 1.2 the effective complexity model from complexity science provides a context for generative art.

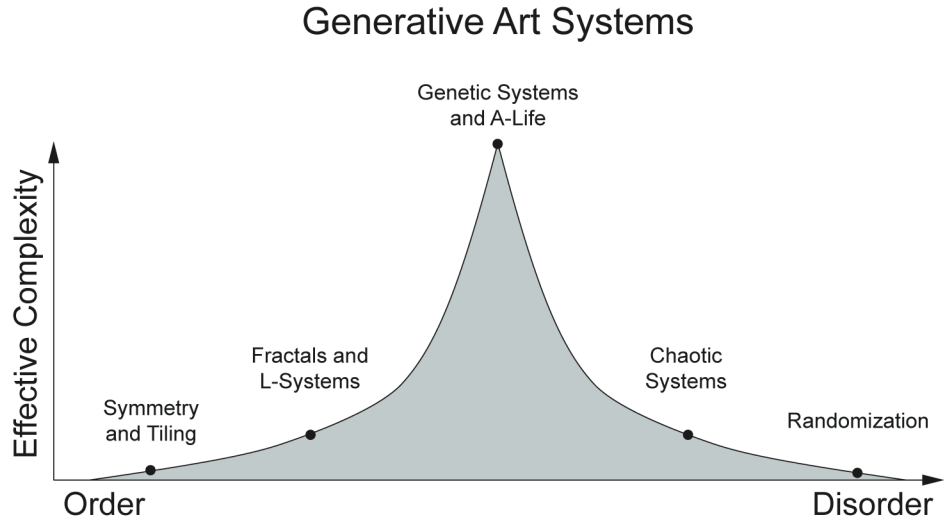

Figure 1.2

2. An Improved Definition

In the context of the full paper in which the related theory is introduced, the previously noted definition of generative art is fairly unambiguous. When standing alone, however, this definition has been misinterpreted and misunderstood. Again, what is important here isn't a definition per se, but rather a theory of generative art. To that end the definition could stand some improvement.

The first confusion is that many who are already of a mind to consider generative art as a subset of computer art tend to interpret this definition in exactly that way. They may allow that algorithms can be executed manually or by machines other than digital computers, but they all too often ignore or disallow biological or chemical processes, self-organizing materials, or other physical processes as being alternatives for the creation of generative art.

A second confusion has to do with rules-based art. In a previous paper I've outlined a number of types of rules-based art noting that some are generative, but some are not. [3] For example, Josef Albers and Piero Manzoni created paintings within self-imposed constraint rules. Albers created color studies but only used concentric rectangles, and Manzoni created paintings that were all white. Ed Rusha created an art book of photography with a thematic constraint

rule allowing only photos of small fires and milk. Richard Nauman and Richard Serra have created minimal performances by following rules in the form of instructions. On Kawara has created a series of boxed paintings consisting of that day's date lettered in paint. The rule calls for making such a painting every day.

Each of these rules-based art works cannot be considered generative art because the artist never cedes control to an autonomous system. There is an in-principle dependence on the artist from moment to moment, and at no point does the artist lose control of the art making process. As these examples show, it is a mistake to use the phrases "rule-based art" and "generative art" interchangeably.

A third confusion involves the required use of an autonomous system for making generative art. Some complain that no mechanical system can be considered as being autonomous because such systems are wholly dependant on humans for their continuing operation. Others insist that autonomous systems require free will and consciousness, and that pulls this theory of generative art into debates about complicated and contentious philosophical matters.

In the context of this theory of generative art the notion of an autonomous system is simple and modest. It follows the use of terminology from robotics. Some robots are controlled moment by moment by a human operator at a console not unlike those used to control model cars or airplanes by radio. More sophisticated robots have sensors, GPS units, image processing computers, and other technologies which allow them to navigate and adapt to their environment without a human driver. Robots such as these are referred to as being "autonomous" without any implications or claims regarding free will or consciousness.

It is in this sense this theory uses the term "autonomous." Generative art systems do not require moment-to-moment decision-making or control by the artist. These systems are autonomous *relative to the artist.*

In an attempt to avoid these theory-related misunderstandings the following improved definition of generative art is offered:

> *Generative art refers to any art practice where the artist cedes control to a system that operates with a degree of relative autonomy, and contributes to or results in a completed work of art. Systems may include natural language instructions, biological or chemical processes, computer programs, machines, self-organizing materials, mathematical operations, and other procedural inventions.*

3. The Cultures of Science and the Humanities at War[1]

The first popular airing of the growing 20th century rift between the humanities and science is usually attributed to C. P. Snow's 1959 Rede lecture "The Two Cultures." In this lecture he captures a difference in attitude that has only become greater in the intervening years.

> *Literary intellectuals at one pole – at the other scientists, and as the most representative, the physical scientists. Between the two a gulf of mutual incomprehension – sometimes (particularly among the young) hostility and dislike, but most of all lack of understanding.*
> *…*
> *The non-scientists have a rooted impression that the scientists are shallowly optimistic, unaware of man's condition. On the other hand, the scientists believe that the literary intellectuals are totally lacking in foresight, peculiarly unconcerned with their brother men, in a deep sense anti-intellectual, anxious to restrict both art and thought to the existential moment. And so on. [5]*

At least part of Snow's critique seems to be a prescient concern about the coming conflict between philosophically rational modernism (science) and irrational post-modernism (the humanities).

Postmodernism, deconstruction, post-structuralism, critical theory, and the like introduce notoriously elusive, slippery, and overlapping terms and ideas. Most adherents would argue that this must be the case because each is not so much a position as an attitude and an activity; an attitude of skepticism and activity that is in the business of destabilizing apparently clear and universal propositions. [6]

Relative to the modern culture of science, however, the postmodern culture of the humanities can be starkly contrasted. This polarity is summarized in the table shown as figure 3.1.

Modernism	Postmodernism
Absolute	Relative
Progress	Circulation
Fixed	Random
Hierarchy	Collapse
Authority	Contention
Truth	No Truth
The Author	The Text
Pro Formalism	Anti Formalism

Figure 3.1

[1] Parts of this section also appeared in a chapter I wrote for [4] Romero, J. and P. Machado (2008) The art of artificial evolution : a handbook on evolutionary art and music. Natural computing series. 2008, Berlin: Springer.

Exercising Enlightenment values, science and modernity move towards the absolute with a belief that the laws of the universe are real, stable, and knowable. Those in the postmodern humanities voice the kind of skepticism that can be traced back to the Scottish philosopher David Hume, and view any competing theories as ultimately unverifiable, leaving only difference without dominance. [7]

Modern science posits real progress in understanding by replacing old theories with new theories that offer more in the way of explanation and prediction. The postmodern humanities recognize a plurality of theories in perpetual circulation by way of discourse.

Modernity seeks fixed points of conceptual stability while post-modernity celebrates the random in an unanchored world of traces. The modernist culture of science has a tendency towards the hierarchical, expressed, for example, as taxonomical systems of categories and reductionist research methods. The postmodern culture of the humanities seeks to collapse hierarchies. This can be seen in the arts, for example, with the leveling of high art and low art, the ironic appropriation of both, and the creation of arbitrary cross-cultural mash-ups.

While it provides venues for conceptual competition, the culture of science creates and embraces authority both in terms of expert practitioners and totalizing theories. The culture of the humanities embraces never-ending contention through deconstruction and other post-structural strategies.

Ultimately this leads to a state of affairs where the culture of science expresses a modern optimism that Truth is within the reach. And the culture of the humanities takes the opposite position; a postmodern pessimism that no single truth can ever be arrived at. At best, one can be aware of a multiplicity of equally valid different truths.

At the extreme postmodernism reduces the entire Enlightenment/scientific project to mere social construction, no better or more certain than the mythologies of other cultures now or in other times. [8, 9]

Not surprisingly modern art and postmodern art are also directly at odds. In modern art the author, meaning the writer, painter, composer, etc., is the center of attention. In postmodern art post-structural concerns emphasize the text, meaning the book, painting, music, etc., and the way it can lead to multiple, possibly contradictory, readings via deconstruction. And where the modern heroic artist pursued formal beauty to ever-higher levels of the sublime, the post-modern artist disavows any such claim to privilege, and at most eclectically appropriates formal styles and places them within ironic quote marks. These points are further detailed later in sections 5 and 6.

Art students are steeped in postmodernism without explicit exposure to its derivation and development or the philosophical alternatives. At this point postmodernism has become for most young artists uninspected received wisdom, and a conceptual box from which they can find little escape. And so generations of art students now take as axiomatic the conclusions of postmodern writers, most often in the form of slogans such as:

> *Science is not objective discovery, it is merely social construction.*
> *(after Lyotard)*
>
> *Language has no fixed meaning. There are only traces and word games.*
> *(after Derrida)*
>
> *The author is dead, and any meaning is created by the reader.*
> *(after Barthes)*
>
> *There is no truth, merely discourse and (political) power.*
> *(after Foucault)*

The schism between the arts and humanities reached a new high with the so-called "science wars" of the 1990's. Seeking to problematize science as the last bastion of modernity, "science studies" was established as a branch of humanities research to fully explore Lyotard's vision of science as social construction. The debate reached fever pitch when physicist Alan Sokal's essay, published in the fashionable academic journal "Social Text", was revealed as a content-free parody of postmodern critical theory. It was intended to demonstrate by way of a hoax the lack of rigor in postmodern science studies. [9, 10]

For better or worse postmodernism, deconstruction, post-structuralism, and critical theory form the context within which contemporary art theory and criticism operates. One might think with the rise of "new media" and technology-based art, that artists could find shelter from postmodern skepticism. But contemporary commentary on technology-based art is firmly rooted in the postmodern critique.

For example, in "Postmodern Currents – Art and Artists in the Age of Electronic Media", Lovejoy reiterates the popular claim that somehow contemporary media technology is the physical manifestation of postmodern theory.

> *George Landow, in his Hypertext: the Convergence of Critical Theory and Technology demonstrates that, in the computer, we have an actual, functional, convergence of technology with critical theory. The computer's very technological structure illustrates the theories of Benjamin, Foucault, and Barthes, all of whom pointed to what Barthes would name "the death of the author." The death happens immaterially and interactively via the computer's operating system.* [11]

Another example is Wilson's encyclopedic survey "Information Arts – Intersections of Art, Science, and Technology." His embrace of postmodernism as a context for the artistic exploration of science is less committed, but he leaves no doubt about its nearly universal effect on the field, and is candid about his use of critical theory as an organizing principle for his book.

> *In recent years, critical theory has been a provocative source of thought about the interplay of art, media, science, and technology. Each of the major sections of this book presents pertinent examples of this analysis. However, in its rush to deconstruct scientific research and technological innovation as the manifestations of metanarratives, critical theory leaves little room for the appearance of genuine innovation or the creation of new possibilities. While it has become predominant in the arts, it is not so well accepted in the worlds of science and technology.* [12]

In general the art world has moved from the modern culture it once shared with science to the post-modern culture it now shares with the humanities. Artists who embrace Enlightenment values and science find themselves in the minority, and all too often the objects of dismissal as remnants of a long discarded modernism.

This is a problem, but also an opportunity. 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.

4. Complexism – A New Paradigm for the Arts and Humanities

The arts were once a full partner in modernity, the thesis that is still operative in the sciences. The arts are now primarily associated with modernism's antithesis, the postmodern culture of the humanities. However, even though modernity and postmodernity as outlined above may seem irreconcilably opposed, complexity based generative art can both lead to and suggest a synthesis that subsumes both.

The term I've suggested for this synthesis is complexism. Complexism is the projection of the world view and attitude suggested by complexity science into the problem space of the arts and humanities. Complexism provides a higher synthesis that subsumes both modern and postmodern concerns, attitudes, and activities.

4.1 Epistemological challenges from 20th century science and mathematics

With the 20th century move from classical to modern physics, the Laplace clockwork universe was replaced by the statistical universe of quantum mechanics, Heisenberg uncertainty, and chaos theory. Meanwhile Hilbert's program to formalize all of mathematics surrendered to proven limits in logic and

mathematics as revealed in Gödel's incompleteness theorem [13], and expanded in related work in computation theory by Church [14] and Turing [15], and later work by Chaikin [16, 17].

At times postmodern science studies has appropriated and misinterpreted these epistemologically loaded ideas in an attempt to undermine the stability of the very modernist institutions that produced those ideas in the first place.

Complexism can provide a corrective account that contextualizes scientific uncertainty and mathematical incompleteness. This requires providing understandable explanations for lay audiences, and in particular presenting these explanations to students in the humanities. So far the epistemological challenges from 20th century science and mathematics have yet to be put in 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.

4.2 Complexism as a new synthesis

Without any specific commitment to literal Hegelian philosophy, complexism's reconciliation of modernism and postmodernism can be best understood as the final stage of a thesis-antithesis-synthesis process. As a paradigm for the arts and humanities complexism is informed by contemporary science, but is put into practice as a form of qualitative cultural study.

Complexism is shown here as a point-by-point synthesis that in its totality suggests a new paradigm. A synthetic attempt like complexism should be expected to take many years to develop, but a first approximation is offered in the table shown as figure 4.1 and the following discussion.

Modernism	Postmodernism	Complexism
Absolute	Relative	Distributed
Progress	Circulation	Emergence & co-evolution
Fixed	Random	Chaotic
Hierarchy	Collapse	Connectionist networks
Authority	Contention	Feedback
Truth	No Truth	Statistical truth known to be incomplete
The Author	The Text	The generative network
Pro Formalism	Anti Formalism	Form as a public process and not privilege

Figure 4.1

Modernity, whether in the sciences or in the hands of painters such as Rothko and Pollock, reflects Enlightenment values in reaching for the absolute, the sublime, and the fixed. The postmodern attitude rejects the absolute, and

instead posits a multivalent view of arbitrary relative positions that are functionally random. Complexism reconciles the absolute with the relative by viewing the world as a widely interconnected distributed process. Complexism posits processes that are neither fixed nor random, but are instead complex feedback systems that often lead to deterministic chaos. In the broader culture complexism can nurture a visceral appreciation of how the world can be mechanical and yet unpredictable.

Where modernity posits progress, and postmodernity rejects progress for multiple contingencies in perpetual circulation, complexism looks towards the emergence of co-evolved solutions. Co-evolved entities achieve real progress in the relative context of each other, even while success remains a moving target rather than a fixed end-state.

Modernism posits hierarchies, and postmodernism seeks to collapse them. Complexism doesn't erase relationships, but it doesn't mandate hierarchies either. Complexism emphasizes connectionist models and networks, creating systems of peer agents rather than leaders and followers. Modernism aspires to absolute truth while postmodernism denies any possibility of a single final truth, Complexism embraces known limits to human knowledge, but takes seriously the incomplete and statistical scientific truths that are achievable.

As suggested in Figure 4.2, complexism views both modernism and postmodernism as committing similar and yet opposite errors. Modernism moves towards understandable simplicity by creating crystal-like systems that are highly structured and highly ordered. Postmodernism moves towards understandable simplicity by breaking down and leveling structures leaving behind something like an undifferentiated cloud or mist. In other words in trying to gain partial understanding the modernist seeks to avoid the disorder that is clearly part of our world, and the postmodernist seeks to avoid the order that is also clearly part of our world. Both modernism and postmodernism commit an error of reductionism leading to oversimplification.

Complexism embraces both order and disorder and in doing so addresses all of our experience in all of its complexity.

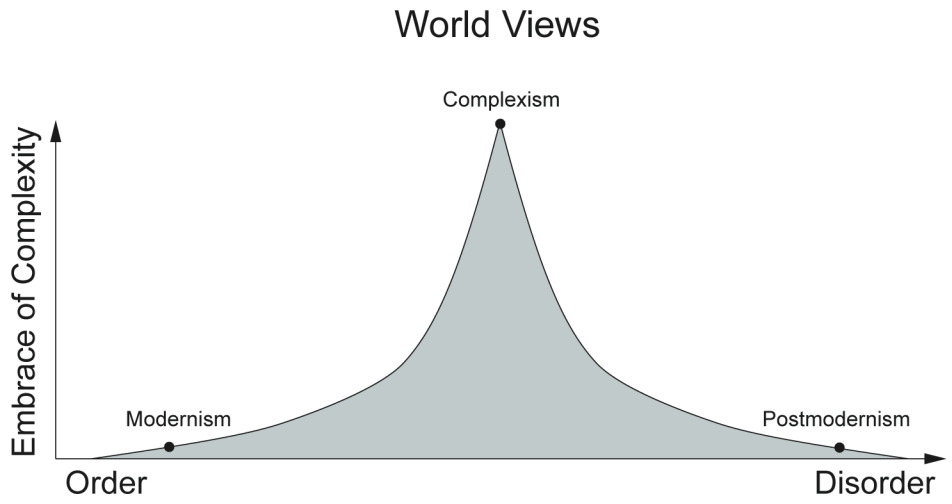

Figure 4.2

5. Complexism and Texts

When considering social communication the modernist ideal is the heroic author in a high-stakes battle to create what will become a timeless a masterwork. The reader doesn't enter the picture except as an afterthought as the fortunate beneficiary of the author's genius and labor. (In this usage an author can be a painter, a composer, an architect, and so on, and the text the created painting, music, or building design.)

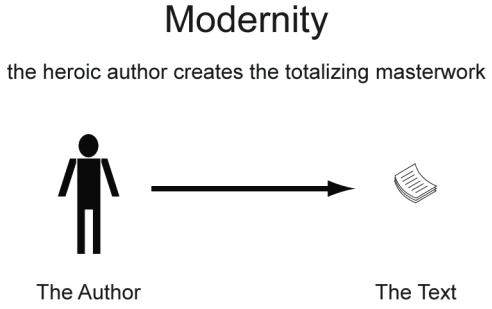

Figure 5.1

The postmodern attitude questions the privileged role of the author, and the stability of language itself. For Barthes "the author is dead." This means that the text itself is the object of central interest. In his formulation of deconstruction Derrida leverages the poststructuralist break with structuralism. He denies the notion that language corresponds to innate or otherwise absolute mental representations, let alone the noumenal world. Rather, at best, language is an unfixed system of traces and differences. And regardless of the intent of the author, texts (i.e. all media including art) always reveal multiple, possibly

contradictory, meaning [18]. It is the reader that creates meaning, and that is best done by intensively close reading, i.e. deconstruction.

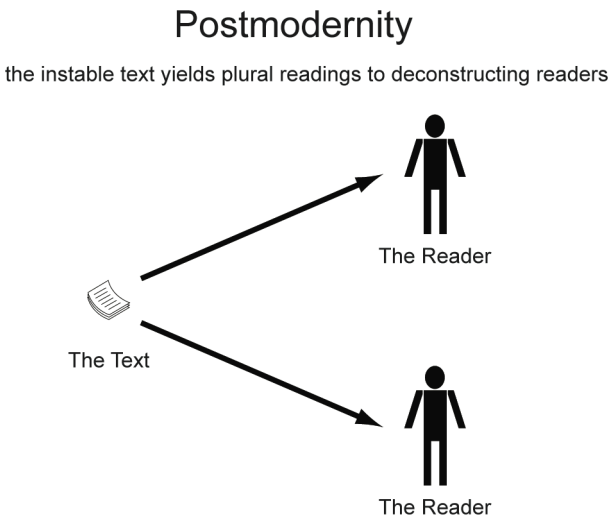

Figure 5.2

Complexism doesn't privilege the author, the reader, or the text itself. Rather these are viewed as parts of a system, and the removal of any one of them renders the system inoperable. Even the smallest unit of social communication requires an author, a text, and a reader.

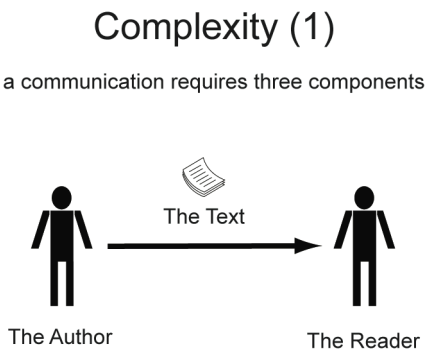

Figure 5.3

And usually individuals act at times as authors, and at other times they act as readers.

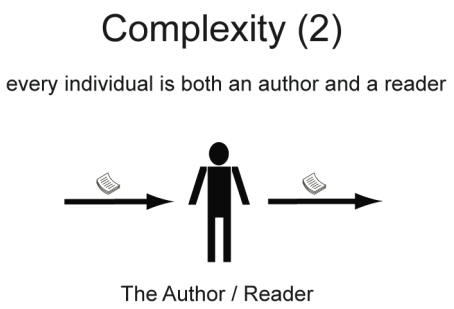

Figure 5.4

Finally, as illustrated in Figure 5.5, large numbers of individuals acting as author/readers form complex feedback networks.

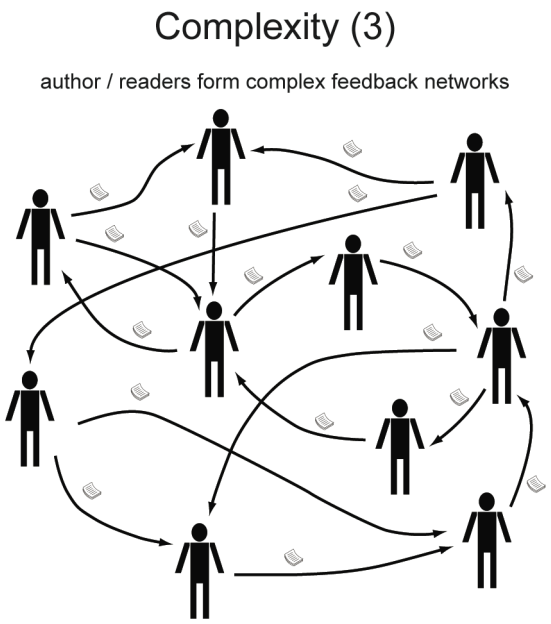

Figure 5.5

The challenge for those in the humanities is to come to understand the cultural implications of these communication networks. Some of this has already begun as those in the humanities consider the impact of the Internet, social computing, and so on. Unfortunately most of this analysis is rooted in the postmodern paradigm and is therefore commits the kinds of reductionist errors noted earlier. The research is yet to be done, but perhaps concepts from complexity science such as scale-free networks will yield greater insight into not only the cultural implications of the internet, but all human communications as viewed from the perspective of complexism.

6. Complexism, Formalism, and Dynamism[2]

Complexism has revolutionary implications for art. For example, modern art embraced formalism, i.e. the study of significant form. Whether by representation or abstraction, formalism was celebrated as a heroic pursuit of the specially gifted artist. Postmodernism rejected formalism as a fetishistic pursuit of meaningless beauty that makes false claims to authority and privilege along the way.

Complexism rehabilitates formalism, but not as a privileged view. Complexist formalism is a public process where form is an understandable property created by underlying generative processes. Static form is no longer meaningless but rather serves as an icon for, and instantiation of, the systems from which it emerges.

Using generative systems in the studio is of great utility. It can be done to create artifacts that would be difficult to design and/or fabricate any other way. But as useful and interesting as that may be, it is the generative works that expose their systems running in real-time that best communicate what is revolutionary about complexism. In its purest form generative art displaying complex systems can most directly and viscerally communicate about the dynamics of complex systems.

But complexism not only rehabilitates formalism. It also, perhaps more importantly, reintroduces the artistic notion of dynamism. As originally introduced by the Futurists, dynamism celebrated the aesthetic of the locomotive and the racecar, and called for the exploration of motion and process rather than portraying objects as being frozen in time. [19]

Dynamism in complexity art is the visceral appreciation of the beauty of dynamics as more fully revealed in the context of complexism. In a sense, formalism is to nouns as dynamism is to verbs. With its focus on complex generative systems, complexity art encourages artists to move from art objects to art processes, i.e. from nouns to verbs.

Up through the 19th century generative artists primarily used simple highly ordered systems. The 20th century saw the rise of generative art using simple highly disordered systems. In the 21st century we are starting to see an explosion of generative art using complex systems in the realm between order and disorder. Complexity art, and complexism as it relates to art theory, completes the full spectrum and future history of generative art.

Presented in its purest form rather than as a means to some other end, complexity-based generative art takes complexism as both its content and working method. In this way generative art demonstrates the reconciliation of the

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[2] This section also appeared in a chapter I wrote for [4] Ibid.

sciences and humanities by providing a visceral experience of the distribution, emergence, co-evolution, feedback, chaos and connectionism that are the hallmarks of the new paradigm of complexism.

Generative art, especially when offered as an ongoing process rather than a static object, presents the dance of formalism and dynamism. It underscores how each arises from the other, and marks a radical rebalancing of emphasis away from nouns and towards verbs.

In short, generative art creates the dynamic icons by which complexism can become known and understood, and in doing so creates a new paradigmatic meeting place for the sciences and humanities.

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