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Against Reductionism: Complexity Science, Complexity Art, and Complexity Studies

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Interest in interdisciplinary work has been on the increase for a number of years now, and phrases such as "art and science" and "science and religion" are frequently offered to point towards new frontiers of exploration. All too often, however, those in one discipline will not take seriously the content of another discipline. Instead the first discipline will merely treat the second as a specimen subject to standard analysis without regard to the claims it makes. Explored here is the impact of this kind of theoretical reductionism, especially as it pertains to the topic of complexity. Examples include the way philosophers of art have increasingly ignored the stated interests of artists, the way the arts and humanities have reduced the claims made by the sciences to mere social constructions, and the way complexity scientists have offered views of art orthogonal to art itself.

It is my position that the result has been experts talking past each other and not building a set of common interdisciplinary insights, despite their sincere wish to do so. As a remedy I propose the creation of "complexity studies" as an interdisciplinary effort that eschews theoretical reductionism.

Introduction

I am writing this paper for a conference on complexity and philosophy, and in doing so I am reminded of thoughts I've had about the meeting of broad disciplines. Phrases such as "art and science" or "science and religion" or "religion and philosophy" always seem to reference a dynamic field of interdisciplinary potential where there are both areas of significant and resonant consonance, and areas of unavoidable incommensurability. Certainly one cannot assume an obvious synthesis is possible, and it is a safe guess that any overall account will be hard earned.

So any paper on complexity and philosophy will be difficult. This is further compounded here by the fact that I approach these matters as an artist, a third potentially orthogonal broad discipline. For example, for an artist the implications of complexity for philosophical aesthetics brings into play the traditional tensions between art practice and philosophy.

One of the points that I'd like to hover near, and not develop or even strongly claim, is that there can be no well defined meta-method by which one can fix with certainty the appropriate relationships between broad disciplines such as science, art, and philosophy. To try to fully justify, or even describe, such a meta-methodology leads to an infinite regress of meta-meta-methodologies. While notions from philosophy, science, and art may appear to cluster in various ways, ultimately they are mutually unanchored and free-floating without either cross-disciplinary foundation or limit.

Finally, there is a subtle difference between considering "complexity and philosophy" and "complexity science and philosophy". Just as plants and animals enjoy an existence that is real and self-sufficient apart from biology, complex systems exist apart from and ontologically prior to complexity science. Complexity science is an invention of man, but complex systems are an invention of the universe. It is not at all clear that science has an a priori primacy claim to the study of complex systems.

Unfortunately the term "complexity" is ambiguous as to whether it references complex systems as apart from any scientific study of them, or the notion of complexity as a scientific concept. "Complexity and philosophy" may mean a philosophic response to complexity science, or a separate philosophical consideration of complex systems that may or may not be constrained by the notions of scientific complexity.

So what kind of writing is this to be? Obviously I am not doing science here, and I would be foolhardy to claim anything like the execution of professional philosophy. There is no intent here to create a work of art, and some would say that is enough to disqualify it as such. For now I'll just allow that I am an artist with an interest in philosophy, science, and complexity, and that I will discuss a certain point of view that allows these interests to hang together for consideration in a comfortable and productive way, and may contribute to a working context (but not a singular universal method) for something one might call complexity studies.

For the most part I'll consider the nexus of art and complexity science with particular attention to contemporary art theory and philosophic considerations from the realms of (analytic) aesthetics and (continental) epistemology. I will consider (by example) how various disciplines attempt to look outside of themselves, and all too often fail in doing so. Ultimately I propose complexity studies as a compound study of complex systems that does not assume the dominance of scientific, philosophic, or artistic methods, but seeks to draw from the strengths of all of them.

What is reductionism?

Reductionism can come in at least three forms. Ontological reductionism posits descriptions of hierarchical being such as, for example, the common scientific understanding of matter as molecules made of atoms which in turn are made of subatomic

particles and so on. Methodological reductionism suggests a parallel activity and mode of exploration whereby large systems are iteratively broken into smaller systems until one finds a set of simple systems that can be understood and explained. Theoretical reductionism refers to any attempt to describe and explain a field of study solely within the paradigm of another, possibly incommensurable, field of study. A number of examples of theoretical reductionism follow.

Complexity science is a new science in that it eschews the methodological reductionism of previous scientific practice, and produces results that suggest that the models provided by ontological reductionism are inevitably incomplete. Complexity science eschews reductionism by focusing on emergent properties. Emergent properties are exactly those that come from the (often nonlinear and feedback related) interactions of the parts. Complex systems typically exhibit what Kauffman [1] calls “order for free”, where in the words of an old cliché “the whole is more than just the sum of the parts”.

For those familiar with the popular literature around complexity science ontological and methodological reductionism should be well understood. Theoretical reductionism may not be. Kuhn [2] suggests that scientific revolutions take place when new paradigms replace those of the past. Some, like Feyerabend [3], contend that because such paradigms are incommensurable there is no rational way to choose between them purely on the basis of truth-value. Of course Feyerbend’s view is not generally accepted by working scientists, but most will allow that the leap from, say, Newton to Einstein is a mind bending experience.

But if crossing paradigms within the discipline of science is challenging, how much more challenging is it to compare potentially incommensurable paradigms from widely separated broad disciplines such as art, science, and philosophy?

To approach this question four points of view are surveyed: (1) analytic philosophers considering art, (2) art theorists and cultural studies specialists considering contemporary art and science, (3) complexity scientists considering art, and (4) artists considering complexity. These surveys are not complete or even somewhat comprehensive. They are sets of examples from good sources that will likely resonate with knowledgeable readers as typical of interdisciplinary accounts in those fields.

What I hope to explore is how theoretical reductionism takes place. It is my position that the result is experts talking past each other and not building a set of common interdisciplinary insights, despite their sincere wish to do so. As a remedy I propose the creation of “complexity studies” as an interdisciplinary effort that eschews theoretical reductionism.

How do analytic philosophers view art?

Analytic philosophy attempts to achieve clarity by carefully inspecting ordinary language for suppositions and assumptions, and by

developing a technical language that helps to eliminate ambiguities and faulty reasoning. It is worth noting that analytic philosophy is generally "friendly" to the natural sciences, and enjoys a healthy dialog in the consideration of the scientific method and related problems surrounding empiricism, epistemology, and speculative topics such as consciousness and its relationship to brain science.

It isn't surprising that when analytic philosophers turn their attention to art they invest a great deal of attention in the deceptively simple question "What is art?". Analytic philosophy has other contributions to the field of aesthetics, but given its emphasis on clarity in language the answer to this question is a key point of departure that will condition any subsequent considerations. To define art is to state a theory of art.

What follow are the briefest of summaries of the best known "theories of art" in roughly chronological order. Much of this presentation follows Noël Carroll's excellent introductory text Philosophy of Art [4], but the comments and conclusions are my own. The intent is not to explore these theories with any rigor, but rather to offer a feel for the tone and the direction of the discourse, and to consider where it may lead.

Art as Representation

Dating back to the earliest considerations of art by Plato and Aristotle, the notion that the essence of art has something to do with truth in representation survives even today as a popular understanding of art.

Beginning with the visual arts in the nineteenth century, however, the development of non-representational styles and the invention of photography called into question representation as being either necessary or sufficient in determining whether a given item is a work of art. In addition there are various forms of representation which are clearly not works of art such as schematics, maps, blueprints, ID photos and so on. Today even though a rich variety of representation is common across the arts it is no longer viewed as the defining nature of art.

Art as Expression

Championed by writers such as Tolstoy and R. G. Collingwood, the view that the virtue of art is its ability to express emotion is also a common one that survives to this day, and provides a useful corrective to overreaching representational theories. Music, for example, has the miraculous ability to evoke deep and complex emotions without any representational content at all.

But like the representational theory, art as expression fails as a universal theory of art due to an abundance of obvious counter examples. Forms such as conceptual art are about ideas rather than emotion, and in the current postmodern era an attitude of ironic distance is often substituted for emotional expression. Additionally one can imagine all manner of everyday emotional expression that would not be mistaken for art.

Art as Form

With the advent of modernism in early twentieth century art an emphasis on what Clive Bell famously termed "significant form" became the new candidate for an essentialist theory of art. And even today we recognize that formal concerns were not limited to modern styles such as cubism. The great art of earlier times certainly includes an element of celebration and exploration of form as the instantiation of truth as beauty.

However some art is content focused, which is to say its value is found in what it is about and what it says rather than the way it says it. To push formalism forward as the basis for a universal theory of art fails because work clearly worth consideration as art falls outside of the formalist net.

Art as Aesthetic Experience

One technical problem with the notion of art as "significant form" is that significance here is typically assumed to be understood without further definition. In a sense this begins to shift the basis of the definition from the object to the observer's appreciation of it.

The notion of art as aesthetic appreciation emphasizes and completes this shift. Clearly the appreciation of fine art photography is not the same as the appreciation of family snapshots, and the reading of a great novel is an entirely different experience than the reading of a computer owner's manual. Clearly the sensory pleasure and opportunity to appreciate characteristics such as proportion, balance, complementary color and so on is valuable.

But aesthetic experience as a universal theory of art suffers from problems that parallel those found in the theory of art as form. There is art that is not primarily intended to induce a sense of formal appreciation in the viewer but rather, for example, to relate a narrative story or to offer moral instruction. Additionally there are non-art functional objects and communications that exhibit proportion, balance, and the like. Again the target of necessary and sufficient

Art as Open Concept and Family Resemblance (Neo-Wittgensteinianism)

In considering the above one might begin to wonder why a theory of art must focus on a single essence. Perhaps art is an ever-evolving practice with no fixed essence from which to form a definition. This is the position that has been taken by those who, following in Wittgenstein's footsteps, reject essentialist attempts to fix a theory of art. Instead art is considered an open concept that allows for the possibility of expansion and even radical change.

The Neo-Wittgensteinian theory of art rejects essentialist views but is not merely a skeptical position. It is also proposed that at a given point in time a new work is considered art when it resembles the family of art that has preceded it. A given work will, of course, have the opportunity to introduce incremental innovation. But it is the notion of so-called family resemblance that creates a process by which art maintains a degree of group coherence while changing and

diversifying over time.

The advantage of this approach is that it (presumably) reconstructs the sensibilities by which art of previous eras has been identified, and it rehabilitates the various prior theories noted above folding them into a story with a broad embrace.

Because it seemed to eliminate the need for essentialist definitions, while at the same time allowing a sort of synthesis of previously mutually antagonistic theories, the Neo-Wittgensteinian theory dominated through the 1950's and 1960's. Taking a stand against a definition of art, and thus avoiding the attendant problems, and at the same time describing a dynamic process by which art comes to be considered art, the Neo-Wittgensteinian theory seemed robust to all manner of potential objections.

Eventually significant weaknesses were identified. First some questioned whether it can be shown that art must be an open concept. Arguments to that effect seemed to conflate art practice with art objects by ambiguously using the term art in a non-specific way. Second, it became clear that the notion of family resemblance is highly problematic. Left unqualified it would allow nearly anything to be considered art because any two objects share some form of resemblance. But preventing this problem would require specifying which resemblances "count" and which do not. Which returns the philosopher to the problem of defining art.

Art as Institution

In the wake of Neo-Wittgensteinian theories of art come attempts to avoid having to specify which resemblances "count" when determining what is art, and to instead describe how such resemblances are specified.

The institutional theory of art, as developed by George Dickie, begins with the recognition that there is a difference between resemblance and family resemblance. The former is potentially contingent on all manner of influences, but the latter posits a mechanism by which resemblance is inherited from one generation to the next. In the case of the family of artworks Dickie proposes that social institutions, rather than genes, actively maintain resemblances from one generation of artifacts to the next.

Typically an artist creates an artifact or performance that is then offered up to the society at large for consideration. Dickie focuses on this as a distinctly social process noting that membership in "artworld", the social institution concerned with art, is a requirement of those that would "confer the status of art" upon an object. And membership in the artworld requires a participatory shared understanding of preceding art and the surrounding issues. Thus, for example, Duchamp can confer art status upon a urinal or a snow shovel but a hardware store employee (as such) cannot.

While the art as institution theory has much to recommend it, it has also been the site of intense and close criticism. For example, the theory in a sense begs the question by creating a new problem. Who

is a member of the Artworld, how are they selected (if they are selected), and what are the criteria for doing so? And more fundamentally is calling the Artworld an institution a misapplication of the term? Other institutions such as governments and churches have well defined procedures and hierarchies, whereas the Artworld does not. The institutional theory also seems to give short or no consideration to so called “outsider artists” who work outside of the typical social structures that surround art, or prehistoric “first artists” whose work predates any notion of art institutions. Dickie and others have over the years revised the art as institution case in detailed ways to try to address these objections.

Art as Historical Definition

Jerrold Levinson proposes a different approach to describing how resemblances are determined for the purposes of including given artifacts in the class of artworks. In his formulation an object or performance is an artwork when a person with a proprietary claim intends for that object to be considered as a work of art in a way similar to the way other works have already been correctly or standardly regarded. One advantage to such an approach is that it can include all manner of historically established considerations such as representation, expression, significant form, and so on. Additionally it allows for the addition of art objects from other cultures, or the retroactive conferring of artwork status to objects from prehistoric eras.

The problem with the historical definition theory of art is that it is too open and it confers the status of artwork to too many objects. For example, one historical regard for artwork is that relating to representation. But does this mean that any representational object, such as a snapshot, a map, or a blueprint, can validly be considered a work of art? Another historical regard has to do with objects intended to induce a sense of visual pleasure through the use of symmetry, balance, proportion, interplay of color, and so on. But every well-tended lawn in the world should likely not be considered artworks even as they are pleasing to the eye.

Observations

The preceding summary is by no means complete as contemporary analytic philosophy offers both alternate accounts as well as corrective variations to the above. What is of interest in this discussion is the broad direction the discourse in analytic philosophy seems to have taken.

As each succeeding account attempts to include the widening array of concerns, such as the forms and modes of execution in nineteenth and especially twentieth century art, the theories of art provided by analytic philosophy paradoxically seem to have less and less to do with the stated concerns of artists working in the field.

Recent accounts seem to commit a form of theoretical reductionism as art as a discipline is increasingly viewed as a social construction in a way that is orthogonal to the actual content and practice of art. In attempt to improve philosophy less and less is said about how artists

think, what they are concerned with, or why they do what they do. An emphasis on objects rather than artistic enquiry leads to an emphasis on the vetting of art objects rather than art ideas. And an emphasis on the vetting of objects leads to a discussion where social mechanisms rather than a good faith consideration of what artists have to say dominates. One can almost imagine a proposal in the limiting case to define art in such a way that artists and art ideas are not needed at all.

How do art theorists view contemporary art and science?

If analytic philosophy flirts with the theoretical reduction of art to social construction, contemporary art theory rooted in skeptical continental philosophy seems to have already tied the matrimonial knot.

Postmodernism, deconstruction, 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 activity…an activity that in fact is in the business of destabilizing apparently clear and universal propositions.

For better or worse, critical theory, postmodernism, and deconstruction are the dominant world-views within which contemporary art theory and criticism operates. And in so far as a given artist may be interested in scientific topics such as complexity, or worse yet embrace the paradigms of contemporary science, this is highly problematic as postmodernism and deconstruction are fundamentally skeptical enterprises openly hostile to the truth claims made by science.

Where modern art aspired to progress towards the absolute, postmodern art celebrates the circulation of a plurality of ideas while denying any notion of ultimate progress towards singular totalizing views. In his foundational treatise “The Postmodern Condition” Lyotard [5] cites both political and linguistic reasons why, in his view, this must be so. In his formulation of deconstruction Derrida [6] emphasizes this break with structuralism. He denies the notion that language corresponds to innate or specific mental representations, and rather that at most language is an unfixed system of traces and differences, and that regardless of the intent of the author texts (a general term for all media including art) always present multiple equally legitimate meanings.

Without going into any detail, it is worth mentioning here that all of the conflicts, charges of faulty scholarship, and the like invoked by the phrases “science wars” and “Sokal hoax” are entirely in play in the arts. [7-9] For the most part the art world is aligned with the forces of critical theory, and inherits all of the problems that that implies.

Art and Technology

The conflict between contemporary art theory and science is especially acute where artists address scientific concerns. Not

surprisingly most mainstream artists who approach scientific concerns do so with skepticism, irony, and political antagonism. And contemporary commentary on technology art is firmly rooted in the postmodern critique.

One example of this is Lovejoy's "Postmodern Currents – Art and Artists in the Age of Electronic Media". [10] This book documents the recent history of media art, and is something of a standard text in art schools. 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.

This is hardly an isolated idea. As the title indicates, postmodernism is the conceptual thread upon which Lovejoy strings all manner of (often unrelated) examples of technology art. The supposed influence of critical theory would no doubt come as a surprise to those "authors" who actually create technology without reference to those guiding principles. (And would it be unfair to ask why having ones publications cited in the humanities remains a carefully protected claim even while there is a supposed consensus that the ontological status of authorship is nil?)

Another example is Wilson's encyclopedic survey "Information Arts – Intersections of Art, Science, and Technology. [11] This recent publication includes all manner of art using digital technology, especially those which somewhat recursively address 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 in 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.

The point here is not to say that Lovejoy and Wilson alone set art, and especially technology related art, in a postmodern context. They, as careful commentators surveying the field, have correctly identified postmodern ideas as dominating the field. Artists who embrace truth and science find themselves in the minority and the object of

dismissal as remnants of long discarded modernism.

Cilliers on Complexity and Postmodernism

It is worth noting that at least one author, Paul Cilliers, has attempted to reconcile complexity and postmodernism. His book Complexity and Postmodernism [12] is, however, riddled with misleadingly overloaded terms and strained analogies, and he uses unusually restricted definitions for both complexity and postmodernism to force the appearance of a merger where none using the general understanding of the terms actually exists.

Without offering a lengthy exposition, here are a number of objections to his presentation offered in no particular order:

- Cilliers claims all complex systems have memory. It is not entirely clear what he means by this. If by memory he means the ability to store and recall information this is clearly not true of all complex systems. If by memory he means the current state is the result of previous events, this is true of complex systems, but only because it is true of all physical systems (possibly leaving aside random quantum effects).
- Cilliers claims that all complex systems must be 'open", that is to say must have a constant source of information and/or energy introduced from the outside. Thermodynamic concerns about positing perpetual motion machines aside, there is no reason to think that a closed system cannot exhibit, for example, emergent behavior, feedback, high degrees of connection among components, etc.
- Cilliers states that language is a complex system. But language, per se, has no dynamics. It is only the interaction of language capable brains that exhibit relevant dynamics. But to say the brain is a complex system is nothing particularly surprising.
- Cilliers claims that the brain does not use representation because the connectionist memory is distributed. It is not clear, however, why distributed representation is impossible or not a useful way to think about information.
- Cilliers engages in a constant equivalence of connectionist models and post-structural notions about language. But his arguments slide without warning between metaphorical comparisons and proposed physical mechanisms.
- As an example of this, he posits that a weight in a neural network is the same as Derrida's notion of a trace. This is a misreading or distortion of Derrida.

This is not to completely dismiss the Cilliers project. When he speaks of complex systems he really seems to mean connectionist systems. And when he speaks of postmodernism he really seems to be mean deconstructionism. The better title "Connectionism and Deconstruction" would go a long way to strengthen his position, and the implied research agenda to find in connectionism the kinds of mechanisms suggested by post-structuralism is a worth one. It is an

idea I reiterate at the end of this paper.

Observations

In short, the artist who uses art to explore complexity in a way largely sympathetic with a scientific view finds himself outside of the primary art world discourse, and caught in the crossfire of the so called "science wars".

How do complexity scientists view art?

The new book "Art and Complexity" [13] provides a treasure trove of art related observations by complexity scientists as well as some complexity related observations by artists. Edited by John Casti and available only in preprint form at the time this paper was written (2002), this book is a collection of papers from a corresponding conference held in 1998 at the Royal Swedish Academy of Sciences.

Included among others are papers by:

- Barrow - where he considers how various complexity measures can be applied to works of art.
- Casti – where he touches on the representational theory of art and then shifts gears considering the complexity implication of 2 forms of highly algorithmic art (Karl Sims and Escher)
- Gell-Mann – where he provides a nice analysis of regularities and randomness as it relates to complexity but only tangentially to art
- Taylor – where he presents the results of a remarkable study demonstrating the fractal nature of Pollock's most important "drip and splash" paintings. He further shows how those fractal structures are the result of 2 combined chaotic processes intrinsic to the skilled use of the "drip and splash" technique.

As insightful and interesting as these studies are they are ultimately somewhat disappointing if one is interested in art as art. Taylor's paper is particularly dissonant in that it seems to provide new insight, but that insight is completely and utterly disconnected from any account of Pollock's work whether one is considering the Greenberg's modernist reading or Guilbaut's postmodern deconstruction of abstract expressionism or any other in between. From private conversation I know that Taylor is acutely aware of this disconnect.

Observations

It is hardly new that the general trend in the sciences to treat art not as a peer discipline making truth claims, but rather as a dusty collection of artifacts to bring into the lab for physical or information theory inspired measurement. Over fifty years ago Abraham Moles in his groundbreaking book Information Theory and Aesthetic Perception [14] took a similar approach.

But it is my contention that art as art has more to offer science than art as a collection of objects.

How do complexity artists view complexity?

Ellen Levy and I have organized a show called “Complexity” that will take place at the Samuel Dorsky Museum in the fall of 2002 at SUNY New Paltz. In our research for this show we have found that artists engage complexity in four modes:

Portraiture - Artists can create realistic presentations of natural complex phenomena that transcend typical scientific visualization, evoking both a visual understanding and an emotive response in the viewer (e.g., Andreas Gursky and Harold Edgarton).

Descriptive Systems - Artists also experiment at various levels of conceptual abstraction. Artists will often invent innovative, possibly idiosyncratic, systems, which describe complex phenomena in a way that does not occur in the sciences (e.g., Mark Lombardi).

Commentary – Just as artists have commented on scientific and technical paradigms such as computers, genetics, and the like, they have also offered critiques of physical and social systems (e.g. Hans Haacke).

Technical Application – The study of complexity offers a new rich toolbox for artists who create works via generative systems. Such techniques include: genetic algorithms, swarming behavior, parallel computational agents, neural networks, cellular automata, L-systems, chaos, fractals, a-life, and other forms of emergent behavior (e.g., Karl Sims. John Simon Jr., and Woody and Steina Vasulka).

One of the things Levy and I had in mind in creating this show was to shine a light on works which take a different tack on the intersection of art and science than the typical one found in the arts which are under the sway of critical theory. This collection of works, and ideas, show how good art can still regard science as science, and take its truth claims in good faith, without abandoning what it is that makes art art.

Theoretical reduction in art, science, and philosophy

What is going on here? It seems like the above generally well meaning and intelligent people are not so much disagreeing, although there is plenty of that as well, as simply talking past each other.

Complexity artists are currently working in earnest but are locked out of the primary art world discourse, because there science is subjected to (art) theoretical reduction and treated as mere relativistic discourse.

Complexity scientists who study art more or less ignore the claims and content of art, as they treat artifacts as mere physical

phenomena and subject the artistic enterprise to (scientific) theoretical reduction.

Analytic and continental philosophers not only differ on the value of the scientific enterprise, but both in their own way commit (philosophical) theoretical reduction as the intended content of art is more or less set aside as a mere byproduct of orthogonal social machinations.

Perhaps one reason for this is that art simply resists any purely rational account. After all, art is one of the few disciplines where dreams are a legitimate time to do business. At least one theory of art is that it is the expression of (irrational) emotion.

Of course scientists and philosophers also tap into the unconscious and are driven by intense passions. The history of science is full of eureka moments that seem to come out of nowhere…after many years of hard earned preparation. But methodologically dreams are, of course, scientifically insufficient. An idea without verification is only an idea, and not yet science. A proposition without careful development and argumentation is only a proposition, and not yet philosophy. And this is not to imply that art is the simple venting of raw emotions.

Art engages, addresses, and concerns itself with the entire body. Where science and philosophy seek to peel away aspects of human experience that threaten to cloud rational judgment, art does not privilege the prefrontal lobe and language centers of the brain. The limbic system, the ever-changing tide of hormones and neurotransmitters, and all of the other organic sources of passion and emotion are treated in art as legitimate peers rather than threats. Following Nietzsche, any account of art that doesn't address both the Apollonian and Dionysian aspects of culture is incomplete.

Suggestions for a program of Complexity Studies without theoretical reductionism

There is value in retaining complexity science as science, and in having a clear if evolving notion of what the scientific method is as we explore complexity. Perhaps the findings of science will remain incommensurable with those of philosophy and art. But just as in everyday life where conflicting and contradictory influences cannot be allowed to freeze us into a state of indecision and stasis, intellectual life must go on.

To that end it would be useful to consider a program of complexity studies that contains but is not restricted to complexity science. Each broad discipline should be taken in good faith for the claims each makes for itself. Taking a moderated cue from Derrida, in comparing broad disciplines differences should be viewed as plural opportunities, and we should defer to the value each has to offer.

Complexity studies should embrace complexity science, complexity art, and all other forms of complexity related enquiry while resisting all forms of theoretical reductionism. To the extent science can

consider art as art, and art can consider philosophy as philosophy, and philosophy can consider science as science, and so on, we are likely to be all the more enriched.

The suggested procedure for interaction among the broad disciplines when considering complexity is for discipline X to take the truth claims made by discipline Y in good faith and at face value, but for discipline X to use its own intrinsic methods to verify or falsify those claims.

To provide examples of how this might work a number of potential cross-discipline projects in complexity studies that would not be guilty of theoretical reductionism are noted below. I don't mean to imply that these topics are novel or not already underway. They are noted here to lend specifics to the general notion of avoiding theoretical reductionism.

Use notions from art practice to form hypotheses for scientific investigation.

Artists do not simply transmit information. Artists design and create experiences. In doing so artists target a number of levels; raw perceptions, processed perception, sense and emotional memory, the rational capacity, and potentially every aspect of human neurology.

Art practice includes a body of heuristics for stimulating the vast variety of human experience, and each technique suggests a hypothesis worthy of scientific investigation. An inspection of art from the point of view of information complexity is interesting, but to stop there is to miss a number of scientific opportunities in psychology and the various brain sciences not limited to simple perception.

Hard earned lessons from the arts can be used as points of entry into the scientific study of the brain as a complex system.

Use notions from postmodernism, deconstruction, and post-structuralism, to form hypotheses for scientific investigation.

In a similar way continental philosophy makes claims about the way language works and how the world and concepts are represented in the mind. These claims can be used to set an agenda for scientific experimentation. Questions regarding representation and language, epistemology and language, deep structure and language, and related issues may be somewhat beyond the reach of current science, but the implications for the humanities are compelling in the current intellectual climate.

Use the mechanisms of scientific complexity as a means to energize formalism in art.

As noted previously, one way artists are starting to respond to complexity is to create systems that exhibit emergent behavior. In the postmodern art world beauty and form, traditional values in art, have diminished in perceived value nearly to the point of disappearing.

By working with complexity artists can once again connect form to meaning as they gain a sense of participation in processes that are universal rather than relativistic and local. For the audience such art should make clear both resulting form and the underlying process.

Working from the insights discovered by complexity scientists, artists can explore the relationship between form and process, and reestablish in the arts the lost connection between beauty and truth.

NOTE – The first draft of this article was prepared as a position paper for the First International Workshop on Complexity and Philosophy organized by the Institute for the Study of Coherence and Emergence (**http://www.isce.edu/**). What follows is a finished version of that draft recently published in PhysicaPlus Online, the Web-Magazine of the Israel Physical Society (http://physicaplus.org.il).]

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Philip Galanter is an artist, theorist, and Assistant Professor in the Department of Visualization at Texas A&M University. His activities include the artistic exploration of complex systems, and the development of art theory bridging the gap between the cultures of science and the humanities. Philip creates generative hardware systems of his own design, video and sound art installations, digital fine art prints, and light-box transparencies. His work has been shown in the United States, Canada, the Netherlands, and Peru.