Permitting Chaos as Creative Strategy

Daniel Della-Bosca
Queensland College of Art,
Griffith University
d.della-bosca@griffith.edu.au

Abstract

The study of creative thinking has much to gain from the field of non-linear dynamics. Chaos theory and complex systems have been shown to afford insight into physical and psychological systems and it is the goal of this paper to look to reinforcing those connections in terms of creative thought processes and creative action. The proposition is made that chaos is essential to the creative process and this is discussed using the dual strategies of generative and exploratory thinking and their place in the edge of chaos dynamics as explored by David Alexander and Gordon Globus. The correlations between psychological and physical creativity are made using the principles of pattern language as described by Christopher Alexander and Nikos Salingaros. This paper argues that the combined weight of these theorists suggest that creativity is influenced by our biologically adapted neurological structures which in turn deeply affect our art and design strategies and aesthetic appreciation.

Keywords
Art, Design, Creativity, Chaos, Complexity, Pattern

Introduction; Physical and Psychological Creativity

The Premise that creativity as not only a human endeavour, but explicitly attributed to natural systems is curious, but also a challenging and empowering idea. Creative thinking may be the realm of humans, but creative process may be something far greater.

The imperatives for a greater-than-human view of creativity, seem to point to universalities that, some argue, appear to be a natural process. Mea M. M. Lowcre, a pseudonym created to author the proceedings of a workshop on creativity in 2013 at Leiden University writes from the standpoint of combinatorial creativity and posits "that the simplicity of combination theory can deal with emergent aspects of creativity that occur in the natural world and in human creativity" [1]. The authors of the creativity workshop support the holistic notion that creativity as a process is not unique to humans and cannot be detached from physical systems. The argument is raised in terms of combinatory theory, that making novel combinations in nature can take place without involving any human agency [1]. Peter Stebbing's and Stephen Gould's concerns point to an awareness of evolutionary systems as a precursor to defining systems of aesthetic organisation [2].

The proposition of Stebbing and Gould is that the evolution of biological systems, whether through pre-adaptation or exaptation, fashions our ability for aesthetic organisation [2].

This in many guises is a common theme amongst some researchers whose neurological standpoint is that our aesthetic preferences are governed by our 'wiring', our inherent neurological structures. Lowcre makes the distinction that "creativity in physical systems is based on coincidence or chaos, but when psychological creativity is based on coincidence in accord with a willful search for connections between (psychologically) remote domains" [1]. If we follow the perceptual paths of the evolutionary biologists, we must begin to entertain the notion that our ideas of creativity and aesthetic organisation are entwined, and informed by physical systems.

Perhaps there is chaos in both physical and human creativity. The structures of dynamic systems at varying scales are chaotically organised, and coincidence or 'chance', plays a role in introducing potential combinations to a system. The very idea that we, as humans are not uniquely creative is in some respects more empowering as it provides that conceptual link to physical systems. We are not unique in that we are only a chapter in a long and developing path of evolutionary adaptations or mutations. What is unique to us as humans is the conscious awareness of when we have stumbled upon something new, and I mean to use the term stumble, because it is I believe, the surprise in the chance find, that brings creativity to our awareness. If we as humans rationally proceed in our endeavours we are no more than formulaic, but we do possess the remarkable potential to understand and implement the chance and chaos unveiled in us and in our world. The idea of agency must therefore be discussed in order to determine what humans bring to creative processes, do we, as humans bring something extra or something else or do we add to the statistical iterations of the ongoing chaotic processes.

The Agents of Chaos

What part do we play as human agents if the evolutionary adaptive systems of nature can be seen to be creative? The proposition put forward by Lowcre is that nature can be seen to be creative regardless of any human agency. Our species exists as a possibility amongst many combinatorial possibilities according to the theories of adaptation, mutation and selection. Humans simply exist as higher order complexities, or creative potentials, we consist of many component parts, a combination of combinations. Lowcre extends the idea of creativity by predicting "that the likelihood of the creative process will increase with interactive collaboration" [1]. This is an incredibly crucial point in unravelling the implications of creativity originating in physical systems, compounding in humans and extending beyond, because it literally just speaks of combinatory possibility.

It is reasonable to assume that our development, culturally speaking, is a result of our abilities to communicate, share information and ideas, and to be creative as a species, simply by extending the combinatory possibilities beyond the singular human. I do not propose that there is anything new and original in this assumption, it is a simple rational argu-

ment, the important conclusion is that creativity can now be recognised as something far greater than the resultant act of the individual, or the aesthetic considerations of the few. I am, I must note, speaking quite generally about the concept of creativity thus far and must acknowledge the many theorists of creativity and aesthetics in terms of historical, social, political and ethnographic contexts.

I am not offering new definitions of creativity, I am simply proposing variants and inclusions to existing theories. My proposed question is simple enough, what does chaos offer creativity?, and the hypothesis again is easy to follow. If we permit chaos in creative practice, the disciplines of art and design for example, our individual and collective creative potential rise, and the reason this is so, is as a result of the increase in combinatory possibilities afforded by divergence and disruption, and by the recursive nature of the successive iterations of combinatory possibilities.

A hypothesis offered by Lowcre is that mutations of DNA may be the evidence of acceleration of combinatory processes in organisms [1], and as Gould and David Buss suggest, it is not the adaptive processes of evolutionary biology that have profound 'creative' results, but rather the *exaptations*. Gould describes exaptations as an evolutionary process where an adaptation that occurred for one particular purpose becomes useful in another function or purpose. Buss does make the distinction between two classes of exaptation clear, one to refer only to mechanisms that have new biological *spandrels*, presenting useful characteristics that did not arise as adaptations but owe their origin to side consequences of other features [2].

Gould offers a contentious leap as to how to conceive of exaptations and spandrels, which serves to elucidate the role of creativity. Gould uses as an example of exaptation the capacity of the abnormally large human brain to produce speech, something that was not clearly adaptive, but nonetheless useful. Gould's reasoning is that the brain size increased as an adaptation for unspecified reasons in our remote past and the resultant increase in complexity produced many by-products that are not properly considered to be just functions.

Among the many spandrels, Gould cites as by-products of large complex brains, religion, reading, writing, the fine arts, the norms of commerce and the practices of war [2]. It is curious to find the fine arts and religion spoken of in the same sentence as essentially the outcomes of an evolutionary offshoot.

The point I would like to raise here is that the best creative outcomes can essentially arise from disruption as in crisis or error and I would like to offer as such, the idea of fine art, and of aesthetics and the human agency of the creative act to inform the creative potential itself of the spandrel, the presently useful characteristic that did not itself arise as adaptation.

Fine Art vs. Design

There are perceived separations of approach in the disciplines of design and fine art, and that perception commonly seems to relate to intent. By that I mean goal oriented approaches and problem solving strategies as applied to design practice, and freedom of expression and exploration in the fine arts. The concerns of design are often said to revolve around function, and in contrast, the fine arts are permitted the opportunities to explore meaning and its associated aesthetic connections with its audience. These are generalisations of course and there are always examples of interdisciplinary thinking and practice, but there may be some salient features unique to the disciplines that have relevance to approaches in creative thinking.

In evolutionary terms it seems applicable to think of design strategy as an adaptive process. For the most part it is logical, rational and linear, even when approached as bottom up or top down thinking. One way of visualising the design thinking process is in terms of convergent thinking as expounded by Nicholas Roukes [3], or in terms of the exploratory processes of cognitive creativity as outlined in the 'Genoplore' model by Ronald Finke, Steven Smith and Thomas Ward [4]. The creative thinking processes more commonly attuned to the fine arts in Finke, Smith and Ward's, reasoning's are the generative processes. Scott Kaufman highlights the benefits and necessity of the both aspects of the genoplore model. The generative or (divergent [3]) thinking processes are necessary for generating a variety of potentially useful ideas [5]. The distinction that I see between the categories of the genoplore model is that the generative stage need not produce anything of use, it is necessary for pure novelty, distant combinatorial associations and analogical mapping.

The generative stage is fresh and exciting, it is as disruptive as dada. In myself and in my disciplines I see the necessity for both art and design, it makes sense that divergence and convergence or generation and exploration are necessary states to each other. The cycle of generation and exploration are evidence of the brains dynamic and iterative systems.

There is potential in the generative model, I believe, to introduce the concept of the exaptation and the spandrel. It is the role of the arts to challenge and to find exceptions to rules and to introduce new creative pathways as thrilling as surrealism or as dangerous as dada. It is also 'commonly' the role of design to search through possibilities and potentials raised by generative process for function, limitation and 'usefulness', to evaluate from different perspectives or within different contexts, and to interpret from the perspective of the problem to be solved [4].

Kaufman, in his summary of recent neuroscientific studies in creativity makes it clear that the theme emerging from these studies is that, creative cognition relies on both cognitive control and associative chaos [5].

I support Kaufman in his statement that Creative Cognition is 'controlled chaos', because it incorporates both elements of the creative process. The underlying point to be re-iterated if you will excuse the pun, is that the fundamental principles of chaos theory show it as enabling a deeper sense of order, an organisation of higher orders of complexity, a dance between order and disorder, or as John Casti defines chaos theory, 'the science of surprise' [6]. Having introduced the dualistic notions of chaos and control, generation and exploration, divergence and convergence, and offered some thoughts on the dynamics of creativity in physical and psychological systems, it is essential to seek out what is 'surprising' about chaos and in turn its effect on creativity and in particular creative thinking.

If we were to place our mindset, for a moment, outside of our normal physical realm and pretend we had no place and no understanding of what creativity and evolution was, we may see why surprise is a fundamental necessity for the creative act. If we imagine a world founded solely upon adaptive pro-

cesses, we would soon find wherever we looked, evidence of systems that go nowhere, not truly evolving, but stagnant and tending toward entropy. This clockwork universe may function reasonably efficiently and on the surface it may indeed look like our own, but delve a little deeper and it would soon reveal its shallow resemblance. It would appear as a copy of what we know frozen in a moment, it would function in the sense of Nietzsche's hell of eternal recurrence, but it cannot move forward, as it is not a good place to solve problems, and anything resembling creativity within this mechanistic realm would behave far too predictably to quickly adapt to unforeseen circumstances were they ever to eventuate.

Lowcre builds an image of creative evolution from quantum uncertainty to the evolution of complex biological life with the suggestion that the creative possibilities arising from simple combinatory potential accelerate to the highest level of physical creativity in terms of DNA mutation. The prophetic view of this high level of adaptation, and mutation in organisms and particularly humans is that the stage is reached where "the universe consciously reflects upon itself and what it has created. If we regard ourselves as a living part of the universe, through us the universe has found a way to optimize or willfully change a new combination into something else or use it yet in another combination" [1]. This statement may seem 'new ageist' but it is simply an ontological position and the conceptual defence is intriguing when the standpoint is the basic question; what is creativity and how did it arise?

Lowcre's position, that we as humans are reflective of greater creative processes, is an elegant and sensitive placement of the human in a much grander context. This also gives rise to the notion that creativity and consciousness are fundamentally linked.

It seems apparent that any claims that involve complexity, chaos theory and fractals involve the discussion of greater interconnected parts and is never simplistic. This idea that creativity involves chaos and is dynamic and unpredictable, is supported by, amongst others, Margaret Boden who proposes the view that "unpredictability is at the essence of creativity, but cautions that is not enough, that at the heart of creativity lie constraints: the very opposite of unpredictability. Constraints and unpredictability, familiarity and surprise are somehow combined in original thinking says Boden" [7].

The terminology may change from author to author but the two part notion of creativity is a common theme, the question remains though what do we do with this knowledge concerning creativity in art and design. Carl Bovill who published, fractal geometry in architecture and design is credited by his editor Arthur Loeb as being articulate and systematic with espousing the balance between the predictable and the surprise in art and design [8]. Bovill points out that "without the expected there can be no surprise" [8]. It is the potential links between cognition and practice that will be explored later and other architectural theoreticians offer insight as to how this may take place.

Neural Patterns

Richard Taylor, as one of the contributing authors to Organic Creativity and the Physics Within, states that fractal search turns out to be more efficient than the randomness physics exploits in finding novel combinations [9]. The reasoning given is cited in a book chapter by Fairbanks and Taylor on the fractal analysis of a number of search patterns, from human perception to albatross navigation. They conclude; "when searching for the appropriate problem to be solved, or for out-of-category information to be used in solving that problem, a number of search processes in nature have been shown to follow fractal patterns" [9].

In support of the human use of fractal search processes, there is some evidence for perceptual and cognitive search paths that possess fractal structure, that it demonstrates complexity. And if we are looking for the structural correlations between how the brain searches and associates new perceptions with memory, the hierarchical levels of the pattern recognition process offer clues as to the fractal branches and links required for complex perception and reasoning. It could be said that the patterns of neural processes, in this case the search and recognition processes, mirror the structural connections of the neurons themselves.

This proposition has support from some unlikely areas. Nikos Salingaros, a mathematician and architectural theoretician make the claim with Terry Mitiken and Hing Sing Yu, that, "we subconsciously use as a template the ordered complexity of our own mind so as to extend our consciousness outside our own body" [10]. The idea of fractal structure of and within the brain is raised by Salingaros and Taylor as a proposal to extend to areas such as human creativity and aesthetics. The proposal is supported by neuro-scientific studies which speak of biological hierarchy of structural pattern within the brain in much the same way that fractal structure is discussed. David Alexander and Gordon Globus state that the brain is a structured system of hierarchically organized modules. These interacting modules communicate with one another, and in turn these modules contain sub modules which communicate among themselves [11]. This "pattern is repeated at several different levels of scales, culminating in what is a molecular and biochemical fractal of interacting and communication systems" [11].

The proposal again is that if the structures of the brain are complex and fractal in their nature and in their interactions, might not the cognitive processes exhibit similar complex and fractal properties. Alexander and Globus's key points to be raised however are in the particularities of the neural systems as described by 'edge of chaos dynamics', they explain

> complex systems are positioned at the edge of chaos. And that a system poised at the edge of chaos is neither too ordered and thus unchanging, nor too chaotic and so incoherent [11].

Positioning the system at the edge of chaos enables it to have access to either regime. At any given scale of neural organization, the neural system is poised at the edge of chaos. The system shifts subtly either side of the edge of chaos to utilize more ordered or more chaotic regimes and to take advantage of the rich dynamics to be found in the narrow transition between the regimes [11].

E, Harth, as referenced in Alexander and Globus's chapter, likens the shift between ordered and chaotic states in brain tissue to laminar and turbulent flow in fluids [12]. Laminar flow is observed to be predictable and linear, turbulence is unpredictable and satisfies the chief tenet of chaos theory which is sensitivity to initial conditions. Harth points out that in neural systems, the underlying fluctuations in turbulent flow are highly structured perturbations that carry meaning, and are filtered up through numerous scales of neural organisation [12].

Alexander and Globus conclude that the various scales of neural organization are interactive and interanimating each

other with chaos and order, and that in this recursive vision of the brain, the scales are inseparable, the part and whole indivisible [11].

There is much speculation supported by growing evidence that the brains structure can be seen as self-similar and fractal [13][14]. There is support amongst researchers that our neural systems are complex and function at the edge of chaos, and there is argument that our perceptual and cognitive systems mirror the iterative and recursive complexity of the biological structures. The leap I intend to make now, with the aid of architectural theory and pattern language is through a circuitous path back to my earlier proposition: that we must begin to entertain the notion that our ideas of creativity and aesthetic organisation are entwined, and informed by physical systems.

Infinite Pattern

Returning now to Salingaros, who instigates the theory that the built environment reflects structures in human thought, in that it is created by human minds, he, Mikiten and Yu suppose that "fractal structures in nature influenced the development of neuronal mechanisms in evolution that could encode and decode these structures automatically. If true, it is reasonable to suppose that the mind, which uses these mental mechanisms, seeks to shape its environment according to the same rules for structural connectivity" [10].

In an earlier paper 'The Structure of Pattern Languages' Salingaros discusses the language that links patterns together and how it contains useful connective information that helps both to validate the patterns and to apply them [15]. Rather than differentiate between patterns of varying types and classes, as stylistic concerns, I wish to draw attention to the connections and underlying commonalities between patterns of thought and application of pattern as Salingaros has done in defence of the importance of what he believes Christopher Alexander has contributed.

In 'A Pattern Language' [16] Christopher Alexander provides the language (syntax and grammar) to inform the architectural design process and facilitate a human connection with the built environment. For each 'pattern' Alexander describes a recurrent problem in the built environment and then describes the core of the solution to that problem. Each pattern represents a rule governing one working piece of a complex system, no pattern exists as an isolated entity, and all are linked hierarchically in scales. Alexander developed his pattern language as a response to the disconnections observed in contemporary architecture between the human and the product of the human, but warns any user of the language that it is not meant to be fully prescriptive, but rather instructional and adaptable.

Alexander's pattern language has correlation to the neural processes described previously. What is particularly of note is how Alexander's theories of pattern languages have influenced software engineering, computer science and interaction design to name only a few disciplines, thus verifying the strengths of using pattern language and pointing to its inherent connections to internal patterns.

It supports and fosters creativity, perhaps because it is as branched as neural structures. Anyone utilising the language can start the process from any part of the problem that is understood, and work toward unknown parts. This is where it mirrors cognitive process, Salingaros concludes his paper by stating that patterns provide a necessary foundation for any design solution to connect with human beings [15], my addition to that argument is that patterns connect to patterns, the patterns of action, of physical process, have reference to the patterns of perception and interrogation. Whatever the language we create is, inclusive of its own grammatical rules, it is the connection to memory and association that is more important to us for its recursive dialogue than the product of using that language.

If we are responsive to our creative processes, the aesthetics of what we do, what we make, whether it be artwork, design object, furniture or building it will have reference to our own processes of thought. Alexander himself speaks of this point quite eloquently in the 'Nature of Order' when he makes the introduction to complexity, "all the well-ordered complex systems that we know in the world and that we view as highly successful, are generated structures" [17]. Christopher Alexander speaks of generation as intrinsic to us as humans and our place within complex biological systems. In general he says, a complex object (or system) may only be successful if it is generated, and flows from living process [17].

Through a circuitous set of associative processes we have again arrived at the concept of generative processes. I would like to conclude that for creativity to flourish and be attuned to physical and psychological processes we permit chaos. Granted we must be aware of and responsive to processes in tension, we may prepare constraints as in the rules of pattern language, but we must be open to responsive dialogue between generative and exploratory modes of thought. Our creative processes require a balance between the expected and the surprise in art and design. There is however a great creative challenge and that I believe is a commitment to the continuing development and critique of grammatical systems in art and design that are better informed by patterns identified in our neurology. I would like to believe that the study of creativity and aesthetics has much to be informed by research into the dynamic processes of chaos and complexity.

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