EMERGENCE, CREATIVITY, AND THE LOGIC OF FOLLOWING AND NEGATING

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ABSTRACT

The characteristics of emergence connect it to the study of creative processes and vice versa. But both fields are also connected by a unique kind of "logic" having to do with how radically novel outcomes are generated. Because innovation is fundamentally about bringing about the novel - the "nova" inside "innovation" – research into the logic of emergence and creative process cannot but shed light on innovation as well. To explicate this logic, the paper links emergence to emergent cognition.

KEY WORDS: Emergence, Creativity, Logic of following and negating, frames of reference

CREATIVE PROCESS AND EMERGENCE

In his book *Young Men and Fire*, the celebrated author Norman Maclean (1993) recounted a flash of remarkable creativity on the part of a supervisor of young smoke jumpers who parachuted into the Montana Rockies during August of 1949. The supervisor, R. Wagner Dodge, realizing that the jumpers were trapped by a "blow-up" fire, had the inspiration to gather the two young men who were within earshot onto a small region of knee high grass and then, incredible as it sounds, to light another fire in the grass! It was this smaller fire, in fact, which saved all three of their lives, a tactic that later became known as an "escape fire" since the dangerous conflagration burned the knee-high grass on which the three stood and then veered off seeking more available fuel elsewhere. Although the three received superficial leg burns, they survived while the rest of the unfortunate smoke jumpers perished.

It turns out that customary methods for fighting forest fires would not have been much help that fateful day since there was neither enough retardant chemicals nor enough time to dig the appropriate ditches. Only those close to Dodge were fortunate to benefit from his bold transgression of the old adage that you can't fight fire with fire! Dodge's sudden insight was a *creative* "leap," a *transcendence* of previous frames of reference although, to be sure, Dodge's pre-existing experience and knowhow were essential. As a transcendence of previous rules, Dodge's escape fire would today fall within the purview of that branch of the study of creative processes known as *emergent* cognition, the term "emergent" here stemming from the parallel study of *emergence* in complex systems, a sub-field within the gamut of disciplines generally labeled "complexity theory." Emergence refers to the sudden arising of new patterns and structures possessing new properties. I (Goldstein, 1999) have identified four characteristics of emergent phenomena: *radically novel* meaning they are neither predictable nor deducible from antecedent conditions; *dynamical* meaning

they arise over time; *coherent* meaning they exhibit relatively enduring integration; and *ostensive* meaning they only show themselves as the system evolves. Examples given by emergentists include (to name just a few) new patterns in certain chemical reactions, new socio-technical structures in organizations, novel mathematical structures called attractors, life-like patterns in computational artificial life, and new traits arising during the course of evolution.

The characteristics of emergence connect it to the study of creative processes and vice versa. But both fields are also connected by a unique kind of "logic" having to do with how radically novel outcomes are generated (Goldstein, 2001; 2002). Because innovation is fundamentally about bringing about the novel - the "nova" inside "innovation" – research into the logic of emergence and creative process cannot but shed light on innovation as well. To explicate this logic, I will start with some remarks on the study of emergence and then shift attention to research into emergent cognition.
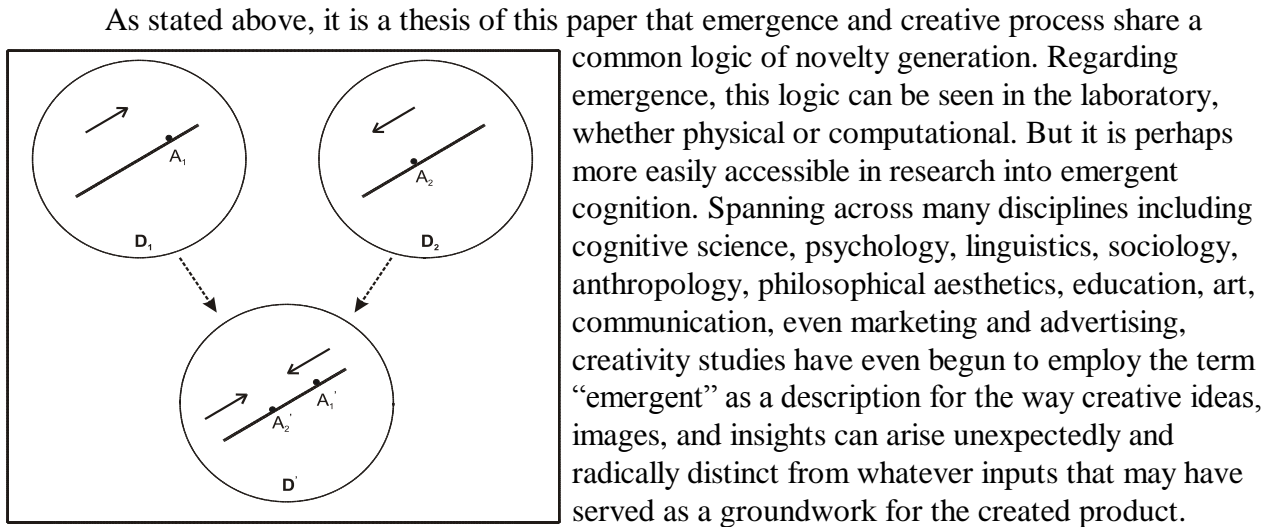
BEYOND SELF-ORGANIZATION

It is first necessary to clear up a misunderstanding that has plagued research in this area. This concerns the typical understanding of emergence as the result of processes of *self-organization,* a term that suggests spontaneity and the inner-driven onset of new order. Although these connotations of self-organization have provided a corrective to the outdated belief that novel order in a system can only come about through the imposition of external order, a careful inspection of research in complexity theory reveals that the emergence of new order is more appropriately *constructed* rather than self-organized as such (Goldstein 2003). An example is that much touted emblem of self-organization, the laser with its property of ultra-focused coherence (see Haken, 1981). In actuality, though, laser light hardly comes about either spontaneously or through inner direction. On the contrary, it requires the most stringent of laboratory manipulations and constraints (see a list of these in Strogatz, 2003). An examination of other examples of self-organization reveals a similar constructional nature of emergent phenomena (see, e.g., Nicolis, 1989).

If the doctrine of emergence is to amount to something significantly different than ordinary change in a system, it needs to involve *radically* novel outcomes rather the difference accompanying any kind of construction. That is, these *constructional* operations must be operations with a capacity that differentiates them from ordinary constructions. I (Goldstein, 2003) have elsewhere termed these unique kinds of constructions "self-transcending constructions" (stc's) since they transcend the lower level and antecedent conditions from which they are constructed. Self-transcending constructions operate on already extant order and creatively transform it along the way into radically novel outcomes. There are several sources of this pre-existing order which are processed by stc's:

1. The already present nascent order in a system, i.e., the way it is functioning right now;
2. The multifarious constraints currently in place, e.g., the geographical layout, the actual buildings, the already extant work groups, the constraints of money, time, goals, and so forth;
3. Operations of recombining and manipulating the above;
4. Supplemental means for introducing novelty such as randomization and negation, i.e., changing the rules.

The actual "mechanics" of self-transcending constructions will become clearer as we go over emergent cognition research.

EMERGENT CREATIVE COGNITION

As stated above, it is a thesis of this paper that emergence and creative process share a common logic of novelty generation. Regarding emergence, this logic can be seen in the laboratory, whether physical or computational. But it is perhaps more easily accessible in research into emergent cognition. Spanning across many disciplines including cognitive science, psychology, linguistics, sociology, anthropology, philosophical aesthetics, education, art, communication, even marketing and advertising, creativity studies have even begun to employ the term "emergent" as a description for the way creative ideas, images, and insights can arise unexpectedly and radically distinct from whatever inputs that may have served as a groundwork for the created product.

One such approach is that of Gilles Fauconnier and Mark Turner (2002) who have developed a theory of creativity based on a process of "conceptual blending" whereby cognition moves among "mental spaces" that map concepts according to such elements as points of view, presuppositions, beliefs, analogies, counterfactuals and so on. The result of conceptual blending is an emergent structure of cognition, "emergent" because it is not present in the original input mental spaces, but instead is composed of elements not present in the earlier spaces, and is not predictable from the inputs alone. Fauconnier and Turner offer the following riddle to show how conceptual blending can work to generate an emergent structure. A Buddhist Monk walks up a mountain, reaches the top at sunset, meditates at the top for several days, and then at dawn walks back to the foot of the mountain, reaching it at sunset. The Riddle: is there a place on the path that the monk occupies at the same hour of the day on the two separate journeys. To answer the riddle involves a conceptual blending of two separate mental spaces that need to be brought into one. In the following diagram the first circle represents the mental space D_1 of the monk going up the path and the circle to the right another mental space D_2 of the reverse trip on a subsequent day.

The third circle below is a blending of the upper two, an emergent cognition containing the answer which is that there is indeed a spot where the monk's path would cross.

Another research program in creative cognition also uses the term "emergent" to refer to cognitions whose properties are neither predictable nor deducible from the intentional combinatory constructions themselves. Thus, R. Finke and his associates (1996) explored how cognitive processes do not have to be limited to *single* concepts like pets or fish but rather can include a compounding of single concepts into *emergent* combinations such as *pet fish* whose unique

properties can lead to a reframing of the limiting associations of "pet" as warm and cuddly and of "fish" as cold-blooded. An emergent combination may also wind-up as an *ambiguous* concept whose very ambiguity can stimulate rather than stifle creativity. For instance, the lack of an unambiguous single meaning for the compound term "computer dog" leads to a search for and possible discovery of *emergent* features that are not typical of either computers or dogs. What exactly is a "computer dog?" Is it a real dog with mathematical abilities? A computer simulation of a dog? A robotic dog? A new term for a persistent computer hacker? Or is it a hot dog prepared by some futuristic "replication" device from *Star Trek*? Notice the sequence: an intentional mental construction is built-up by combining two previously unrelated frames of reference; then there is process of cognition inspired by the new combination; finally, there is the emergence of new features, ideas, or images. The emergence of novelty in this case, therefore, follows a constructional method (here it is cognitive construction) but also allows a "space" for the introduction of the novelty inspired by the construction.

Cognitive research has probed further into exactly how a combination of previous knowledge structures or components can bring about emergent features in the imagination where they were not initially present. In this regard, the creativity researchers T. Ward working with his colleagues (1995) suggested to subjects that they imagine a creature with the heads and legs of an ostrich but with the body of a lion. Obviously a lion and an ostrich are highly discrepant animals so, accordingly, their amalgamation into one creature would spark creative thinking along the lines of how such an imaginary creature might walk, jump, eat, hunt, mate, and so forth. Exploration of the possibilities of such a hybrid then could bring-out new and unanticipated properties which, may, in turn, lead to genuine discoveries, at least in the realm of the imagination. In this context, S. Smith, et. al.(1995) have asked how images formed according to already acquired information could ever engender new insights. The answer is that it is in the *new* combination of what was previously not thought combinable, that is, previous categories pertaining to the isolated information about each of the separate items are transcended and novelty can emerge. So we can see another element of the logic of novelty generation, namely, imaginative exercises involving the combinatory construction of discrepant images.

Similar emergent creativity has been investigated but in a different direction by Albert Rothenberg (1979) with his notion of a "homospatial" thinking on the art of art students. To stimulate their creativity, the students were shown two slides at the same time, the two slides either of harmonious or discordant imagery and either placed side-by-side or superimposed. It was found that the greatest artistic originality and quality was the result of *superimposed, discordant* pictures, i.e., *homospatial* imagery. It was precisely those pictures with the most drastic disjunction of content, mood, colors, patterns, themes, and so forth and which were contained in the same space that stimulated the most creative outcomes. Moreover, the resulting drawings did not display a "melting pot" composite as in a synthesis but included the discrete differences of the original pictures in such a manner that these differences interacted to enhance the novelty of the art work.

Emergent creativity is also found in architectural and engineering design. According to one of the main proponents of this approach, John Gero (1992), an emergent property in a design is one which was not represented explicitly but shows itself through the discovery of a revised description, or structure. For instance, in designs for steel braces, the representation of the problem is considered

a space containing a range of design solutions that can be described geometrically and evaluated according to fitness functions derived from the structural constraints and requirements imposed by the architect's layout of the building. Then these designs are allowed to evolve computationally involving "crossover" types of recombinations as well as random mutations of the designs. The result are "emergent" designs which of course will require further manipulation and evaluation by the actual human designers.

Creative constructional techniques paralleling emergent cognition are also evident in the creation of poetry. In this regard, the poet and poetry scholar Mary Kinzie (1999) describes several grammatical and syntactical constructions where the juxtaposition of contrasting images or ideas serves a critical poetical function. It is worthwhile going into these in some detail since they clearly exhibit the logic of creative novelty. One such device, even called "juxtaposition," involves the placing of contrasting images side by side, often in a manner which appears as a *non sequitur.* An example can be found in the following lines from W. H. Auden's poem "The Fall of Rome":

In a Lonely field the rain
Lashes an abandoned train;
Outlaws fill the mountain caves.

Kinzie points out that the apparent discontinuity between the first two and the third lines leads to the consideration that the post-industrial debris of the first two lines suggests the aberrant social behavior of the last.

In a similar fashion, the poetical structure of "antithesis" consists of words possessing sharply different meanings in neighboring phrases, e.g., the prophet Isaiah declares, "they shall beat their swords into ploughshares and their spears into pruning hooks" (Isaiah 2:4). In the poetical structure termed a "mixed trope," metaphoric construction can be taken to such an extent that the vehicle itself vies for attention with the sense it intends. An example is in *Antony and Cleopatra* when Enobarbus, dying of grief for having abandoned his general Antony, asks the moon to:

Throw my heart
Against the flint and hardness of my fault,
Which, being dried with grief, will break to powder,
And finish all fowl thought.(Antony and Cleopatra IV: ix).

Here the dynamics of "flint," "hardness," "dried," and "powder" take over from the original intention of describing the state of his heart. In another poetic construction where contrast is critical, that of the technique of "tension," the elements of poetical style work against one another, e.g., line versus syntax. An example of the latter is Emily Dickinson stanza # 660:

And though the Woe you have Today
Be larger – as the Sea
Exceeds its Unremembered Drop –
They're Water – equally –

The poetic structure of Haiku, whether produced in its homeland of Japan or elsewhere also exhibits surprising emergent shifts. Here are three examples of famed Japanese Haiku masters (from Hass, 1994):

It's not like anything
they compare it to–
the summer moon. (Bashō)
Even in Kyoto–
hearing the cuckoo's cry –
I long for Kyoto. (Bashō)

In this world
we walk on the roof of hell
gazing at flowers. (Issa)

A couple of haiku from modern Western writers illustrate a similar theme of the juxtaposition of opposites (van den Heuvel, 1999);

not seeing
the room is white
until that red apple. (Anita Virgil)

Sunrise:
I forget my side
of the argument. (George Swede)

These examples of poetic constructions reveal how crucial it is for perspectives, images, and directions to shift not only for the sake of capturing the readers' attention, but to depict just how complex are those experiences which inspire poetic expression.

THE SPECIAL LOGIC OF EMERGENCE AND CREATIVE PROCESS

The above examples from emergent cognition, artistic productions, emergent design, and poetic composition are all linked by a unique kind of logic of novelty generation, one that I have called "anacoluthian" from the grammatical term "anacoluthon" which refers to a grammatical expression that changes midstream (from the Greek "ana" for "not" or "changed" and "coluthon" for "path"). Similarly, an anacoluthian logic points to how both emergence and creative processes are *creative*, that is, how they enable the coming into being of the radically novel. In this regard, anacoluthian processes are *constructional* in nature involving the building and building up of something, but as in their literary meaning these are a special type of constructions, ones that involve the *passing* from one *construction* to another before the former is completed. Being in accord with this kind of logic insures that processes and operations possess the sort of potency to produce novelty. This is a crucial point since how could genuine novelty come about if the processes involved in its generation merely followed a logic of conventions. Anacoluthian processes are the origin of

originality for they mix things up so much so that unpredictable, non-deducible and irreducible novelty results through a paradoxical-sounding simultaneous continuing *and* undermining of extant rules, routines, and procedures.

The continuing of those rules will henceforth be termed "following" and the undermining will be termed "negating." To be sure, the negating aspect of this anacoluthian logic will include some measure of destruction in the sense of violating those rules underlying the pre-existing patterns. However, it is important to note that negating here does not denote a change to an exact opposite, e.g., white becoming black. Instead, negating white can be a change to any color that is not-white, i.e., red, blue, yellow, tan, and all colors in between as well as, of course, black. Unless there is both a following of the past pattern and then a negation of that very pattern, the creative product will either seem to appear like magic out of the blue or will not suggest enough of a transgression to allow for radically novel outcomes.

The following four examples of creative products illustrate the logic of following and negating at work in creative processes and emergence. The first example is the film *Bound* written and directed by the Wachowski brothers before the fame of their *The Matrix*. In *Bound*, it's as if every conventional plot device of a criminal/mob heist movie were followed and then simultaneously negated, which is why it stands out as truly innovative cinema. So, instead of such an established formula as a "made man" freshly out of prison who gets involved in a nefarious criminal enterprise accompanied, of course, by appropriately enticing gun molls, the main characters in *Bound* are two *women, one of whom is an ex-con herself* who *fall for each other* and *rob the mob itself*! This creative logic of following and negating continues on until the last scene where the *two women* ride off into the sunset together.

The second example of the novelty engendering logic of following and negating is the great nineteenth century Brazilian novel *Dom Casmurro* by Machado de Assis. The Brazilian literary critic Joao Adolfo Hansen (1998) describes a host of devices used by the author, just a few of which will be recounted here in order to exhibit the dramatically novel nature of the novel. First there is the juxtaposition of two opposite styles, the "pen of merriment" which is dipped in the "ink for Melancholy." Then there is the curious fact that the narrator is a "dead author" who, already on the other side not only of the mystery discussed in the novel but also of death as well, writes cryptically in a fashion that no doubt was an influence on the equally great Argentinian master of the twentieth century, Jorge Luis Borges: "I managed neither to reconstruct what was there nor what I had been...I myself am missing and that lacuna is all-important." Furthermore, unlike a typical narrator who supposedly is trying to describe events as they unfurl, in *Dom Casmurro*, the narrator calls attention to the narration itself (a postmodernist ploy way ahead of its time). This is not a "suspension of disbelief" but an ironic calling to attention of this very same suspension of belief the reader is expected to possess. There is also an ironic undermining of the very same "respectable" citizens the narrator is describing. In this regard, the reader learns of cheap motivations and disreputable actions which oddly enough turn out to reveal tragic meanings that in turn dignify them. So comedy is used to represent tragedy and what is ridiculous is interpreted as serious. Finally, the whole novelistic enterprise is set-up to be about great love but in actuality is really about obsessive and depraved jealousy.

The third vivid example of anacoluthian operations capable of generating radically novel outcomes can be found in the Surrealist art of René Magritte. In "Empire of Light" Magritte provides what at first sight is a realist painting of an upscale house with the front lights on spreading a reassuring glow at night. But then the viewer realizes that it is really broad daylight as seen by the light blue sky and clouds above. One gets caught up in wondering if it is day or night but then one realizes it is neither since all this consternation of deliberation is about a painting not reality!

Finally, the fourth example is Picasso's chef-d'oeuvre, *Les Demoiselles d'Avignon* of 1907. Whereas his notorious painting *Guernica* could be interpreted as a rearrangement of an earlier work *Minotauromachy*, his *Les Demoiselles d'Avignon* expressed an even more radical restructuring by uprooting all the conventional presumptions at work in representing a typical scene in a brothel. The resulting creative potency of this painting is at the basis of the literary critic George Steiner's (2002) proposal that while the *Demoiselles d'Avignon* used the same, long established brush strokes of tradition, Picasso subverted this very tradition in the very process of painting the picture.

What these four examples demonstrate is the kind of anacoluthian logic that creative processes must adhere to if the result is to be a genuinely novel, emergent outcome. The following aspect of this logic insures that pre-existing patterns are taken into consideration and the negation part of logic guarantees novelty by changing these pre-existing patterns.

An important aspect of the logic of following and negating is that every creation must have familiar aspects or it would not be recognized as departing from the familiar. Thus, while it is necessary that radical newness implies some kind of discontinuity with the past, the novelty that is generated in the creative process must be *at the same time* inextricably tied-up with the past. That is why creativity research reveals that it is *extant* knowledge which is used to generate *new* knowledge by being combined in uniquely novel ways. Indeed, recombination operations stand in contrast to mechanically-run inductive searches. However, the *following* side of the logic of following and negating need not unfold sequentially as in a movie narrative but may instead consist of a *holding* operation whereby negation is continually applied to what it is held against. This can be seen, for example, in Rothenberg's homospatiality where the *following* side of following and negating here consists in the *holding together* where the oppositional imagery of the slides provides an ongoing negation

CONCLUSION

The good news about research into both emergence in complex systems and emergent cognition is that they are both in their infancy. This means that we can look forward to many more intriguing and fruitful insights into creative process and the generation of novelty as these fields mature. In particular, research will hopefully explicate exactly how the wholeness or integrity characterizing emergent phenomena can come about from lower level or antecedent building blocks which may not possess this property of unification. Furthermore, such research may shed light on which conditions foster more constructive and less destructive outcomes from creative and emergent processes.

One of the other exciting aspects of complexity theory to look forward to involves the emphasis on the cross- and multi-disciplinarity making up the field. This kind of cross-fertilization will only grow as more and more disciplines join in and share their insights into the dynamics of complex systems no matter the domain to be explored.

About the Author

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Dr. Goldstein is one of the pioneers in the application of complexity theory to the study of organizations and leadership. His book on that subject, *The Unshackled Organization,* 1994, was hailed by Industry Week as a "fascinating vision." Dr. Goldstein is the author of over 80 scholarly articles and has lectured and given workshops throughout the world at leading businesses and universities.

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