I am proposing a new formalism that would cover the varied processes involved in emergence in complex systems, namely, that of self-transcending constructions (STC). As a new formalism for emergence, it is offered as a replacement for the idea of self-organization. I show how the latter has served to mislead rather than enlighten what actually goes on in emergence. Self-transcending constructions are many and varied but the prototype I am using is derived from the anti-diagonal construction that was critical to the set theoretical investigations of Georg Cantor as well as the limitative theorems in mathematical logic achieved by Gödel and Turing. In fact, the anti-diagonal construction is implicated in several important approaches in the study of emergence, namely, Ian Stewart’s and Jack Cohen’s so-called Existence Theorem for Emergence, Charles Bennet’s construct of logical depth, John Holland’s call for a new mathematics for emergence, Walter Fontana’s and Leo Buss’s work on artificial life by way of proof theory and others. Self-transcending constructions will be interpreted along the lines of the special “logic” of creative processes. This logic follows a scheme of following and negating. Several examples of this creative logic are offered. Finally, a few suggestions are presented on the application of the idea of self-transcending constructions for workplace innovation.
The construction of emergent order

In the diverse fields making-up the study of complex systems, one of the most exciting areas of research has to do with the emergence of new patterns and structures with new properties, phenomena identified according to the following characteristics (Goldstein, 1999): radically novel, i.e., neither predictable nor deducible from lower level components or antecedent conditions; dynamical, i.e., arising over time; coherent, i.e., possessing relatively enduring wholeness; and ostensive, i.e., exhibiting themselves only as the system evolves. These same characteristics, though, have rendered the concept of emergence enigmatic from within classical perspectives on causal and deterministic processes, a dilemma exacerbated by the general lack in the sciences of not only suitable constructs for investigating structure and pattern but of any processes capable of generating new structures and patterns.

One construct has achieved pre-eminence in accounts of emergence, namely, self-organization, an idea connoting inner-driven and spontaneous processes. The “self” of “self-organization” alludes to such descriptors as “innate,” “inherent,” “automatic,” “unplanned,” and “natural.” Perhaps nowhere have these self- undertones of self-organization been more enthusiastically received as an apotheosis of scientific and philosophical import than by Kauffman’s (1993) notion of “order for free,” a phrase specifically crafted for the purpose of drawing biological and metaphysical implications far beyond the electronic networks where he first observed “self-organizing” emergence. To be sure, there’s no doubt that the inner-directed connotations of “self-organization” have supplied a much needed corrective to the hoary, but still lingering, presumption that the onset of novel order in a system requires an imposition from outside. Hence, an important theoretical advantage stemming from appeals to self-organization has been a call of attention to whatever internal dynamics may be involved in the emergence of new order instead of just stubbornly insisting it must have a source external to the system.

In my opinion, however, the setting-up of this too close of an alliance between emergence and self-organization has led to a misunderstanding of how emergent order actually comes about in each instance when it does. In contrast, I argue that a careful inspection of research into emergence reveals that the emergence of new order is more appropriately conceived as constructed and not self-organized per se, albeit according to a special type of construction which I have termed self-transcending construction (STC) (see Goldstein, 2001, 2002, 2003). It needs to be pointed out that the way “construction” is being used here does not entail there being a “constructor” as such (see below for more on the specific sense of “construction” I will be using). Understanding emergent order as constructed in this special sense results in several very different implications than those currently emanating from the association of emergence with self-organization.

In this paper I hope to demonstrate why approaching emergence from a constructional, and not self-organizational, point of view is more in line with
the facts of emergence. Next, I will lay-out the unique “logic” of the self-transcending constructional activity involved with emergence, a “logic” closely related to the way creative processes in general are able to generate radically original patterns and properties. Then, I will offer a few suggestions on how this new approach to emergence can be appropriated in conceiving and practicing organizational innovation.

**Beyond self-organization and “order for free”**

To support my contention that emergence in complex systems is more accurately thought of as constructed rather than self-organized, I offer two representatives from contemporary research into the emergence of new order: first, the coherent order observed in putatively self-organizing physical systems; and, second, the order emerging in that species of artificial life to which Kauffman (1993) has devoted his attention. The first instance of emergent order to be examined concerns the laser, a phenomenon of coherent order which the Synergetics School founded by the German physicist Hermann Haken has put forward as an exemplar, even emblem, of self-organization. A closer scrutiny, however, of how lasers are actually constructed in the laboratory reveals that the coherence characterizing laser light is expedited only through the most strenuous of non-internal and non-spontaneous laboratory constraints including, among others (see Haken, 1981; Nicolis and Prigogine, 1989; and, Strogatz, 2003):

- Because atoms generate light only when they fall to their lowest energy or ground state, laser light requires a large investment of energy from outside the system in order to keep lifting them up, or as Strogatz (2003, p. 12) puts it, “[a]n injection of energy inverts the population, in the sense that it hoists a large fraction of the atoms up to a higher energy level than their preferred spot in the ground”;
- In order to intensify and channel the light beams so as to make them coherent, a “resonant cavity” must be constructed, e.g., a long glass tube filled by an appropriate gas or a solid such as a ruby rod;
- In order to further focus the light rays in the laser, mirrors are constructed at both ends of the resonant cavity with one mirror being slight less than 100% reflective so that light can escape at this end.

The extent of these constraining factors (and this is only a partial list) makes it puzzling to me why laser light was ever thought in the first place as self-organized as such rather than constructed through stringent laboratory-induced constraints. Here, it might be argued that lasers are simply not a good example of self-organization precisely because of the many constraining operations required to bring them about. Yet, similar utilizations of numerous constraints and other external shaping factors can be found throughout the literature on what are spoken of as self-organizing systems. To point to just two salient
examples: Haken (1981) has achieved notoriety for describing the coherent order of self-organizing systems as an “enslavement” of system variables to an order parameter driving the system; and, Prigogine (Lissack, 2000) once qualified what he meant by the “self-” of “self-organization” through the caveat of “constrained situated dependentness” a far cry indeed from the usual associations of self-organization!

To be sure, the idea of constraints as such need not entail a strictly external imposition of order and thus preclude the possibility that self-organizing processes are indeed at work in the systems studied by Haken and Prigogine. In this context, Juarrero (1999) has pointed out that one meaning of a constraint has to do with the relational properties parts acquire by virtue of being unified into coherent wholes, that is, an orderly context that embeds and thereby constrains the components of a system. She gives the example of how the tibia’s connection to the knee constrains the movement possibilities of the lower leg. Moreover, constraints need not only serve to reduce a system’s degrees of freedom since, as Juarrero suggests, constraints can also open up a system to new possibilities by moving it away from pure chance, e.g., the fixed alphabet of English simultaneously constrains and opens up possibilities for what words can be meaningfully constructed.

Consequently, the issue stemming from over-emphasizing self-organization as the key to emergence is not the presence of constraints as such, but rather the driving of a conceptual wedge between spontaneous, inner-directed processes and those otherwise constructional in nature. In effect, this conceptual wedge has served to associate self-organization with what is natural while construction has become, by contrast, allied with what is unnatural, i.e., artifice, design, intentionality, purpose, and similar ideas. In point of fact, though, construction can be as natural as self-organization is supposed to be, a fact attested by such natural phenomena, to mention just a few, as bone growth, turtle shells, beaver dams, bird nests, hurricanes, ant hills, termite cones, protein assemblies, and so forth. Indeed, in evolutionary biological literature more and more references can be found to naturally occurring constructional activities as such.

Furthermore, the notion of construction was tied directly to emergence right at the beginning of contemporary neo-emergentist research when the Nobel Prize winning solid state physicist Philip Anderson (1972) offered his Constructionist Hypothesis as a response to the arch reductionism rampant among particle physicists. This Hypothesis proposed that although it might be possible to reduce nature to certain simple, fundamental laws, this did not then entail a similar ability for re-constructing the universe from these simple laws since each new level of complexity involved the emergence of entirely new properties and laws not appearing at the lower levels. Each new level of complexity accordingly can be said to exhibit the construction of new structures with new properties that transcend lower level constructional characteristics and dynamics. Moreover, the construction of each new level does not necessarily imply a intentional designer or constructor behind the constructional activities since construction as such can arise in countless ways as lower level
parts are constrained by each other and their environments and interact in relation to each other to generate even more constructional constraints.

The second example I offer to support my point about the limited applicability of self-organization for understanding emergence concerns Kauffman’s above mentioned “order for free,” his appellation for the patterns emerging in his electronic Boolean networks. Kauffman coined this phrase to indicate that the emergent order exhibited in his networks rules had to arise in a self-organizing fashion from their inner dynamics since the rules governing the operation of the networks were assigned randomly. That is, for Kauffman, it was the random nature of this assignation of rules that guaranteed that the resulting order was the outcome of self-organization since randomness entailed there was no pre-set design as one would find, for example, in an intentional construction.

However, as Kauffman himself has admitted, “...if the network has more than $K = 2$ inputs per light bulb, then certain biases in the Boolean rules, captured by the $P$ parameter, can be adjusted to ensure order” (103; my emphases). “Biases” here refer to just those “canalyzing” rules, i.e., the “or” and the “and” rules, which serve to generate and propagate redundant order through the networks, in other words, the operation of constraining factors in the senses described above. It is important to emphasize that it was only the biased rules which channeled the electric current to generate redundant order. To be sure, the identification of this bias as a bias had to wait until afterwards because the rules were assigned randomly. But the important point to note is that whether the biases were known before hand or only afterwards, the emergent order only ensued when the biased rules were operative. This means it was the built-in bias of the rules that constructed the ensuing order, not some “free,” supposedly spontaneous self-organizing activity of the network.

An analogy can push my point home. Consider an unexpectedly long run of sevens during initial “come-out” dice rolls in the game of craps. A pit boss in a casino who observed such a redundant (and hence orderly) pattern would not surmise it was the result of some sort of mysterious “order for free” or a spontaneous, self-organizing phenomenon but, instead, had to be due to loaded dice even though ahead of the event the pit boss didn’t know the dice were so biased. To load dice means to construct a bias in them towards exhibiting specific orderly patterns when tossed. Such a construction might involve building a die with different weights on each side. Such a constructed difference in weights would bias a roll of such loaded dice. Similarly, in Kauffman’s networks, the order which did emerge was constructed to emerge even though Kauffman might not have known until afterwards which specific biases in the rules were instrumental in constructing the propagating order. Again we see that the emergence of order was not due to what a self-organizational picture would have it but rather Kauffman’s “order for free” was not actually “free” but came with the high cost of having been constructed to be so ordered by the built-in constraint of a biased Boolean rule. To be sure, the random assignation of such biased constraints would mean that each time the network was run, new
patterns of emergent order would ensue at different times and show different patterns. This corresponds to how in the highly constrained constructed emergent order of Benard cells, the exact directionality of each hexagonal convection cell cannot be predicted (see Nicolis and Prigogine, 1989).

**Constructing emergent order**

What I’m claiming in effect is that in being truer to the facts of what actually happens in the case of emergence, a constructional perspective comes with the benefit of calling attention to all of the varied resources for the emergence of new order previously occluded by conceiving emergence purely in terms of self-organization. Since emergent order does not just emerge spontaneously “for free” but comes from somewhere and by means of constructional operations, explanatory attention can now be directed at just these sources of order and how it is that seminal order is transmuted during processes of emergence. An analogy is the construction of a dam by a beaver where the sources of the construction may include the topography of the creek bed and bank, the available sticks, twigs, and leaves, the beaver’s ability to manipulate the former, and so forth. Another example is how the internal organization of a cell is constructed out of a complex interaction of self-regulatory feedback loops, protein folding, multimolecular modulization, and other spatial and temporal constraining operations in tandem with genetic information (see Moss, 2003).

It is also critical to note that construction in this sense doesn’t necessarily entail an external constructor but rather can arise out of the interaction of elements which are already ordered to some nascent extent. Self-organization as such may still play an important role but it is no longer over-emphasized as the key to emergence.

Conceiving emergent phenomena as constructed implies the presence of requisite constructional resources and constructional “costs” including such factors as (see Goldstein, Forthcoming):

- Already present, nascent order as well as ordering generating operations, e.g., the ordering action of those canalizing Boolean rules which establish and then propagate order in Kauffman’s networks;
- Ordering constraints, e.g., the stringent laboratory conditions and manipulations discerned in the production of lasers recounted above;
- “Containers,” e.g., in Benard convection, the actual physical container of the liquid plays a critical role in shaping the emerging - the distance separating two neighboring currents is on the order of the vertical height of the container (Berge, et al., 1984) and instabilities in the thermal boundaries of liquid systems similar to the Benard system lead to more complicated kinds of convection (Weiss, 1987);
- Amplification and recombination strategies which serve to expand and complexify the nascent order, e.g., the presence of strong nonlinearities,
the incorporation of random events, or recombination processes along the line of Holland’s (1994) genetic operators.

Furthermore, if emergence is to amount to something more than ordinary change, it must come to terms with how the production of radically novel outcomes can be brought about since whether of the computational, physical, or organizational variety, emergence refers to a radical, not ordinary novelty, a property of innovation I have tried to capture with the phrase self-transcending to indicate a transcending of the antecedent framework (or self) out of which emergent phenomenon emerge (see Goldstein, 2002, 2003). Furthermore, by adding a constructional perspective, according to the remarks above on construction, to this necessity for self-transcendence, the result is the expression “self-transcending constructions” (STC), a construct which puts the focus on the special potency that processes of emergence must possess in order to effectuate in self-transcending novelty.

**Self-transcending constructions**

In arriving at the idea of self-transcending constructions as a replacement for self-organization as the key to emergence, I have been guided by several clues which demand some adumbration in order to give a fuller sense of the richness of this new construct. The first clue came from the proto-emergentist thinker Oliver Reiser (1935; p. 63) who had made the unusual suggestion of conceiving emergent phenomena as similar to transfinite sets, “Just as assertions about the properties of finite classes cannot be made to apply to transfinite aggregates, so in a similar way, the peculiar non-additive properties of an emergent whole (gestalt) cannot be predicated of the constituent parts.” Reiser was here appealing to the German mathematician Georg Cantor’s theorems on transfinite sets (“aggregates” was Reiser’s translation of the German Menge which today is usually translated as “set”) as an analogy to how emergent phenomena similarly transcended any piecemeal addition of the properties of the components from which they are generated. Cantor had proved his transfinite sets possessed this unique non-piecemeal property through the utilization of a particular mathematical construction called diagonalization (or more precisely anti-diagonalization as we shall soon go over). As there is not space here to detail how Cantor’s argument proceeded (see Goldstein, 2002, and Simmons, 1990, for a logical formalism for anti-diagonalization), it must suffice to say that his anti-diagonal construction was constructed out of a antecedent elements while at the same time transcending the each element at every point. It was precisely this simultaneous operation which lent transfinite sets their unique, radically novel quality.

Investigating further, I came across a derogatory evaluation of Cantor’s anti-diagonal construction as being a type of “self-transcending construction” by the Austrian philosopher of mathematics Felix Kaufmann (1978; p. 136) who
asserted, “...no construction can ever lead beyond the domain determined by the principle underlying it”. Although Kaufmann clearly meant this expression in a derisory sense, it struck me that it was exactly such “self-transcending constructions” which were representative of processes capable of the emergence of the radically novel since, like emergence is supposed to be about, self-transcend the antecedent domains on which they operate. To be sure, I’m not claiming that emergence consists in the type of mathematical operation in which Cantor’s construction consisted but, rather, the latter provides a transparent way to conceive how radically novel outcomes can be constructed.

Reiser’s was not the end of allusions to Cantor’s anti-diagonal construction as I also discovered the latter was implicated in the physicist Charles Bennet’s (1986) idea of logical depth which he had devised as an improvement to algorithmic complexity as a metric for complex systems. It turns out that logical depth uses a version of the same Cantorian anti-diagonal argument used in the proof of transfinite sets. Whereas deterministic programs cannot quickly transform “shallow” objects into “deep” ones and probabilistic computations can only do so with low probability, Bennet’s “deep” metric comes about by first generating a complete list of all “shallow” N-Bit strings and then outputting the first N-bit string not on the list. For Bennet, the Cantorian-like computational construction of logical depth serves to introduce a richness of structure possessing a greater capacity for doing justice to the real complexity of complex systems, including the complexity exhibited in emergence.

The Cantorian anti-diagonal, self-transcending construction showed up yet again, but this time more indirectly in Jack Cohen’s and Ian Stewart’s (1994) so-called Existence “Theorem” for Emergence which applies a Turing-like conjecture on the non-computability of emergent phenomena in terms of their “lower” level or antecedent conditions. Turing’s non-computability theorem was itself inspired by Gödel’s limitation theorems, and the proofs of both Gödel’s and Turing’s theorems employed a variant of the same Cantorian anti-diagonal method we have been discussing. Hence, Cohen and Stewart were proving the existence of emergence by indirect appeal to Cantor’s self-transcending construction.

Furthermore, Gödel’s and Turing’s theorems, and therefore by implication their Cantorian self-transcending constructional core were also seminal to yet another hint in the direction of emergence de Lorenzana’s (1993) and Rosen’s (1996) respective appeals to limitative theorems in order to argue that emergence was essentially non-formalizable. Thus, according to Rosen (p. 212), “(M,R)-systems [his term for emergent biological systems] are inherently unformalizable as mathematical systems. That means: not only do they have noncomputable models, but any model of them that is computable is not itself an (M,R)-system, and hence misses all of its biology.” Although Rosen was here using the term “model” in its mathematical logical sense, what he was saying here can be interpreted as the claim that emergent systems would always transcend any particular formal coding scheme adopted to represent them. Rosen’s appeal, however, to Turing noncomputability in the case of emergence could
be said to rest on the nature of emergent phenomena in self-transcending that from which they emerge - in other words, emergent phenomena are not reducible in a formal manner to their antecedent or lower level components.

Yet, in contrast to Rosen’s recourse to a Turing (or Gődelian) based claim for the purported non-formalizability of emergence, I contend this same appeal to the arguments of Gődel and Turing can be turned inside-out, so to speak, in order to yield the opposite conclusion. But to see how, it is first necessary to say a few words about what Gődel’s and Turing’s limitative theorems actually demonstrated concerning formalizability. Relevant in this regard is Webb’s (1980) compelling argument that the work of Gödel and Turing demonstrated how Cantorian anti-diagonalization was itself formalizable by the very codings, including self-referential schemes, that were used in their respective proofs. Hofstadter (1979; 1985) has offered an understanding of Gődel’s and Turing’s theorems along the same lines, a paradoxical sounding “mechanization” of creativity but with “mechanization” here referring to the sort of formalism found in Turing’s idea of computation. The upshot of both Webb’s and Hofstadter’s interpretations is that the limitative theorems of Gödel and Turing can be understood as actual formalizations of Cantor’s anti-diagonal construction. But, since Cantor’s anti-diagonal constructional method can be considered an example of a “self-transcending construction,” I can draw the implication that what I mean by a STC is a generalized formalization of the self-transcending generation of radically novel outcomes, that is, a generalization of what’s involved with processes of emergence. In other words, rather than suggesting that emergence is not formalizable, what an appeal to the work of Gődel and Turing instead reveals is that emergence is precisely formalizable through the use of the self-transcending constructions like those at the Cantorian core of Gődel’s and Turing’s limitative theorems.

Such an interpretation of Cantor’s anti-diagonal construction as a possible framework for formalizing emergence is further supported from several additional sources. Thus, Holland (1994) has called for a new mathematics for emergence that involves a change in cardinality which is exactly what Cantor’s construction accomplished since his anti-diagonalization can generate transfinite sets of higher and higher cardinality. There is also the “object construction” thesis of Fontana and Buss (1994) for the emergent phenomena observed in artificial life. In their scheme for understanding emergence they rely on proof theory in mathematical logic which itself emanates out of the work of Gődel and Turing. Similarly, Crutchfield’s (1993) “calculi of emergence” for artificial life involves a cognate transcendental leap in innovation classes or sets. Finally, there is Piaget’s (1971) suggestion for a Cantorian-like constructional process in the development of novel insights. At the heart of all these seemingly disparate indications is Cantor’s anti-diagonal construction, a construction serving as a prototype for what I’m calling a self-transcending construction:
The creative process of following and negating

Following-up on these hints, I made a closer inspection of Cantor’s anti-diagonal method and found in it a surprisingly transparent way for not only how to conceptualize how radically novel outcomes can be generated but also how this generation can be formalized. Moreover, I discovered an added advantage in the fact that self-transcending constructions, as Cantor demonstrated with his anti-diagonal construction, can be applied repeatedly in order to produce ever more radically novel outcomes. However, Cantor’s proof method as well as both the various elaborations of it and the later use of it by mathematicians in the twentieth century remain enshrouded in the obscure language of mathematical logic which does not easily offer itself as a way to provide insight outside of its own arcana. Hence, I found it was still necessary to try to get a less obscure handle on what precisely is going on with the “logic” of the processes operative in STCs which enable them to generate radical novelty.

A way to address this issue came from an entirely different quarter (albeit close to Piaget’s suggestion mentioned above), namely, the study of creative process since creativity is, by definition, that set of processes, methods, procedures, and inspirations that have to do with the coming about of the radically original, or, what in the workplace is usually referred to under the term “innovation.” The “logic” of creativity consequently presents itself as a way to probe even deeper into how self-transcending constructions can bring about radically novel emergent phenomena. Indeed, it has not been an uncommon terminological move among those interested in emergence to characterize the processes involved in it through appeal to the term “creative.” This is evident in such expressions for emergence (see Goldstein, 1999; and, Forthcoming) as
“creative evolution” (Bergson), “creative synthesis” (C. L. Morgan), a general theory of creativity (Whitehead), even Prigogine’s and his followers’ description of the self-organizing emergence of new order as a creative process.

Yet, it seems odd to me that not one of these appeals to the term “creative” went so far as to actually consider creative process itself whereas that is precisely what the study of creativity has been all about whether scientifically, mathematically, philosophically, culturally, or artistically. 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 (see the use of “emergent cognition” in Fauconnier and Turner, 2002; and in Finke, Ward, and Smith, 1996).

Of course, it is neither the case that creative processes require sudden leaps nor are they confined to the creation of art. Rather, creativity is a pervasive element of everyday life, showing up in decision-making, problem-solving, cooking, setting up a home, decorating a room, coordinating a wardrobe, getting a job done efficiently and effectively, as well as music appreciation and music making, creating a television show, directing a movie, coming up with an advertising campaign, devising a new product and its packaging and marketing, designing a business, and innumerable other manifestations of bringing about something that wasn’t there before. Moreover, creativity is a phenomenon that can be nurtured and encouraged so as to demonstrate a blend of intentional construction and spontaneous inspiration.

An important aspect of the unique “logic” of creative process can be thought of as a simultaneous following and negating, a logic that is connotated in the very phrase “self-transcending constructions” through its suggestion that emergent novelty both comes out of, while simultaneously transcending, antecedent conditions. This is in line with the creativity researcher Albert Rothenberg’s (1990) point 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. This indeed was critical to Cantor’s proof of transfinite sets mentioned above since the anti-diagonal construction both followed and negated at each step that from which it was constructed. Likewise, Baughman and Mumford (1995) have emphasized that it is extant and not new knowledge which is then used to generate new knowledge by being combined in uniquely novel ways. They cite research which demonstrates how such recombination operations contrast with mechanically-run, inductive searches for rote associations between static features. Thus, when subjects were asked to discern common features among different elements, a typical inductive/abstractive procedure, creativity diminished whereas it increased when searching for
atypical features or when mundane features were eliminated as a basis for constructing a new category. Similarly, Weisberg (1998) has pointed out that the degree of originality and quality of an art product is correlated to how much the created product departs from a simple rearrangement of what already has been done by radically modifying it. Thus, whereas Picasso’s notorious painting Guernica could be interpreted as a rearrangement of an earlier work Minotauromachy, his Les Demoiselles d’Avignon of 1907 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.

The logic behind recombinatory creative strategies is to take antecedent arrangements, follow, at least initially, this extant arrangement, and then change or negate aspects of it as the creative process proceeds. It is important to note that “negation” here does not denote on a change to an exact opposite, e.g., white becoming black. Instead, negating white can be a change to any color not-white, i.e., red, blue, yellow, tan, and all colors in between as well, of course, black. Unless there is a 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. This can be seen in another example of the creative logic of following and negating, namely the film Bound written and directed by the same Wachowski brothers of The Matrix fame. In Bound, it’s as if every conventional plot device were followed and then simultaneously negated. Thus, instead of such a conventional plot as a “made man” working for the mob who gets involved in a nefarious criminal enterprise accompanied, of course, by the appropriate, sizzling gun molls, the main characters in Bound are two women who fall for each other and attempt to rob the mob itself! Moreover, rather than an expected protagonist in the form of a recently released male convict, one of the women herself is an ex-con! This creative logic of following and negating continues on up to the film’s “happy ending” when the two women ride off into the sunset together.

It is important to note that 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. For example, in Rothenberg’s (1990) research into creative process, art work rated as the highest quality was demonstrated to result from the projection onto a screen of two slides of quite disparate imagery onto the same physical space of the screen like a lamination of the two slides on top of the other. The following side of following and negating here consisted in the holding together of the oppositions, that is, a continuity of tension between the oppositions whereby one group of images continues to “negate” the imagery in the other. Similarly, the following aspect of the creative logic may be consti-
tuated by an ongoing, tacit background against which the foreground supplies the negation, e.g., in musical compositions where themes, once they have been introduced, recede into the background yet allusions to them, in the form of variations as well as smaller scale versions of the original, may consistently remind the listener of the original theme(s). Indeed, if this sort of following wasn’t taking place there wouldn’t be a sense of the musical piece having coherence. The famous conductor Daniel Barenboim (Said and Barenboim, 2002) bears this out in remarks to the effect that music-making partakes of paradox by somehow keeping extremes essentially linked. As Finke, Ward, and Smith (1996) have emphasized in their studies of emergent cognition, creativity reflects a balance between novelty and connectivity to previous ideas. This fits with Atlan’s (1974) interpretation of self-organizing physical systems as needing to be redundant enough in order to sustain themselves under the constant bombardment of that “noise” which adds novelty into the system.

**Self-transcending construction, innovation, and the “transformational imperative”**

In earlier days of applying the idea of self-organization to organizations, there was a general sense that innovation would inevitably result from the mere dismantling of command and control managerial hierarchies (I myself was inclined in this direction, see Goldstein, 1994). As stated above, however, although such a dismantling may be one of the important ingredients involved in the facilitation of innovation, self-organization by itself is not sufficient for accounting for the emergence of radically new patterns, structures, and properties. Instead, other constructional resources and “constraints” along the lines of self-transcending constructional resources are also necessary, processes in concordance with the above described logic of following and negating. The point being made here corresponds to a similar one made by the creativity researcher David Feldman (1994) concerning Piaget’s ultimately unsuccessful struggle to develop an adequate theory of creativity despite the limitations of his two epistemological presumptions, viz., assimilation and accommodation within a stable world, assumptions stemming from a Chomskian, neo-nativist view that qualitative change in thinking simply did not occur. By contrast, Feldman has called for a “transformational imperative” in which creative processes resulting from a complex interaction between persons, the social milieu, and the environment, produce what Feldman has called the “crafted world” of innovative constructions. The obviousness of the novelty in the created, constructed, and crafted world in which we live undermines that failure of the imagination on the part of arch reductionists which disables them from conceiving the very possibility of something radically novel coming along at all.

Understanding the emergence of new order in terms of self-transcending constructions can also can supplant those earlier metaphysics of emergence offered by such philosophers as Whitehead (1978) which, founded on an expe-
rientialist basis, failed to take into consideration the actual creative construction of created objects and instead focused on structures common to mundane experience (see Goldstein, Forthcoming). Since self-transcending constructions are essentially about the coming into being of the radically novel, they can consequently formalize how what is radically original can originate through creative process, thereby, indicating what’s involved in that which transcends mundane, repetitive experience.

Furthermore, self-transcending constructions are “free” acts of construction—not free in the sense of Kauffman’s “order-for-free” mentioned above—but rather “free” in the sense of not being opposed by some countervailing force such as entropy has often been understood to be (misunderstood in my opinion). Of course, STCs must operate under constraints just as the construction of a skyscraper must contend with the force of gravity, the durability of building materials, and so forth. But what indeed is free about them is the impetus to construct and create even if there is no constructor behind them. It is only when emergence is conceived as operating against a force opposed to the building-up of order, e.g., the classical understanding of the Second Law, that it is then necessary to posit an impetus or motive force behind it pushing for the building-up of new order.

Emergence, according to the construct of self-transcending constructions, is always a local event occurring in a great variety of circumstances, an event neither rare nor everywhere. Moreover, understood as employing self-transcending constructions, emergence can include the whole panoply of constructional resources, constructional operations, seminal order and structure and form, the constructional principles of self-/cross-referential mechanisms, and so forth, all the things that entail that the actual construction of emergent order is not free but costly. Similarly, although innovation is a “free” act, it must utilize what is present but do so in such a manner that the order that is currently present is transformed in ways not previously conceivable.

References


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