

Creativity and Chaos in Waking and Dreaming States

Stanley Krippner, Ruth Richards and Frederick David Abraham

ABSTRACT

Dynamics of creative mental activity are examined in waking and dreaming processes which manifest beyond normative waking consciousness. Some consider such phenomena to be pathological or meaningless. Alternatively they may be viewed in new and healthier ways, in the context of adaptive mental controls, using nonlinear dynamical/chaos theory. The first example involves the innovativeness reported with mild mood elevation in bipolar mood disorders, linked to a *compensatory advantage* model of everyday creativity. With adequate controls, such mood elevation may open adaptive creative mental possibilities (in fact, for all of us). Tension between divergent and convergent thinking—as noted by J.P. Guilford, and common to many models of creative process—can further “edge of chaos” states and raise the odds of bifurcation to new and creative chaotic attractors. The second example involves *REM sleep and dream phenomena*, where the self-organizing brain coordinates the dream’s component parts to generate unusual dream narratives. However fanciful, such divergent and condensed dream content may lead to creative insights and adaptive narratives (there are famous examples) in the light of day, when interpreted or further developed, by bringing convergent processing to divergent processing. In each case, one finds the abnormal is not necessarily pathological—and sometimes can be usefully exceptional. One consequence of a dynamical view and these examples is the need, in all of us, for greater openness to experience, and acceptance of a greater divergence of expression and behavior (vs. conformity) in ourselves, our culture, and our world.

Key Words: creativity, dreams, chaos, bifurcations, bipolar disorders, mood elevation, “edge of chaos,” rem sleep, divergent production, convergent production

NeuroQuantology 2012; 2: 164-176

“The clown, the trickster, or shape changer becomes the personification of chaos for cultures all over the world...the trickster is also identified as the bringer of culture, the creator of order, a shaman or “super-shaman”....who defies convention, subverts the system, breaks down the power structure, and gives birth to new ideas.”

J. Briggs & F.D. Peat (1999), *Seven Life Lessons of Chaos*

Introduction

Many Asian, African, Native American and other indigenous traditions have used creative imagination to enrich and enhance everyday life, with original contributions sometimes seen as gifts from deities or spirits who used humans as their “channels.” These insights could come in nighttime dreams or daytime visions and were thought to represent divine truth. In some of these societies or contexts, individuals who produced something

unprecedented (such as a mask or weapon) might be hailed as heroes, but in others, they might be censured for breaking with tradition (Freeman, 2003; Kilborne, 1990; Krippner, 2000; Norbu, 2002; Richards, 1998). Not everyone was validated for presenting “divergent” ideas, which could challenge convention and the status quo.

The English word “creativity” is a social construct that has been linked with the concept of origin itself (from the Latin *creare*, ‘to make’, and the ecclesiastical Latin *creator* or ‘Creator’). Some researchers and theorists focus on creative *products*, requiring that they be of social value or have attained some other type of consensual validation if they are to be called “creative.” Others emphasize three other “P’s of creativity,” namely the *process* by which the products (artwork, technology, concepts,

Corresponding author: Stanley Krippner

Address: Stanley Krippner, Ph.D. serves as a professor at Saybrook University in San Francisco, California. Ruth Richards also serves as a professor at Saybrook University, and is a lecturer in the Department of Psychiatry with Harvard Medical School. Frederick David Abraham is the founder of the Blueberry Brain Institute and serves as faculty with Silliman University.

✉ skrippner@saybrook.edu

Received May 10, 2012. Accepted June 6, 2012.

eISSN 1303-5150



etc.) come into being, the milieu in which they emerge, called the *press* of the environment, or qualities of the creative *person* such as unique achievements, abilities, and/or attitudes of a creator—or a consortium (Pritzker and Runco, 1999; Rhodes, 1961).

In each of these perspectives, there can be levels of accomplishment, utility, or originality, implying that some persons or groups can be more or less creative than others. The concept of *everyday creativity* (Richards, 2007) directs attention to creative outcomes in a vast variety of activities in everyday life, as long as criteria of (a) *originality* and (b) *meaningfulness* are met. Examples are accomplishments in office management, child-rearing, home repairs, food preparation, teaching, or community service. One need also note a “dark side of creativity” characterizing the all-too-frequent acts that are innovative but destructive (McLaren, 1999). On the other end of “everyday creativity” are *self-actualizing* forms described by humanistic psychologists (Maslow, 1968) with implications for our higher human development. Creativity does not necessarily carry either positive or negative social value. What it offers is uniqueness—and it is up to us how to find it, and how to use it.

From a Western standpoint, “creativity” as *process* is a term that can be used to describe bringing something new into being by becoming sensitive to gaps in human knowledge, identifying these deficiencies, searching for their solutions, making guesses as to a potential solution, testing one’s hypotheses, and communicating the final results. This paper was written through a Western lens, while keeping in mind that creative idea generation and dream reports, and the innovations which result, are honored and valued in varied contemporary cultures that take different approaches to their cultivation and use (*e.g.*, Korea, many Native American tribes, and various countries in the Middle East).

Creativity from the Perspective of Chaos Theory

The creative process is imperfectly understood, and not always the same. It may occur in a planned sequence or spontaneously, and/or may be intentional or largely unconscious. Yet creative *insight*, or the “Aha!”

moment, is one frequent feature, and an important aspect here (Richards, 1996, 2010; Runco and Pritzker, 1999), as well as what happens during the preceding periods of *incubation*. Below, we take several concepts from nonlinear dynamics in an attempt to illuminate aspects of the creative *process* and also *person*, relevant to generating a creative product in a given environment, from the perspective of Western science.

(a) During waking states, evidence suggests there are healthy benefits for creativity even in the context of mental health problems such as bipolar disorders, as well as for people in the general population.

“Everyday creativity,” the originality of everyday life, is defined (after Frank Barron, 1969) using only two criteria: *originality* and *meaningfulness*. There needs to be novelty, and the outcome needs to communicate to others. Such creativity was likely adaptive in the course of human evolution and remains so (Abraham, 2007; Arons, 2007). It is similar to what evolutionary biologists such as Dobzhansky (1962), have termed our human “phenotypic plasticity,” and hence as a fundamental survival feature (Richards, *et al.*, 1988; Richards, 2010), underlying our flexible improvisations and ability to adapt to ever-changing environments.

The Lifetime Creativity Scales (LCS) of Ruth Richards, Dennis Kinney, and associates (Kinney *et al.*, in press; Richards, Kinney, Lunde, and Benet, 1988) adopted Barron’s (1969) definition, and became the first truly broad-based general measures of real-life everyday creativity at work and at leisure. The scales are based on self-report and in-depth interviews, taking a particularly valid approach (Kinney *et al.*, in press). They allowed a different kind of study, one focused broadly on the general population. The research revealed a paradoxical effect, and also one with evolutionary implications: the finding of unusually healthy benefits from a genetically influenced mental health *risk*. This phenomenon had, in fact, been predicted (Kinney and Matthyse, 1978; Richards, 1981).

Here, instead of choosing a few eminent creative people, and looking at their mental health—this, a specialized population—the research sampled from *everyone* carrying a particular diagnosis and assessed their



everyday creativity (Richards, 1998); this poses a different question, with implications for literally millions of everyday people. In so doing, the LCS not only addressed everyday creative *products*, but also the originality in creative *process*, or in the way an activity was conducted, not just what was done. One can do many tasks in an innovative way or alternatively a conventional way (e.g., teaching a class, repairing a car, fixing a meal, writing a report at the office). One participant, for instance, was a skilled auto mechanic, who invented his own tools.

Generally, the LCS makes norm-referenced assessments of how people manifest their *everyday creativity* or their “originality of everyday life” across a broad range of activities at work and at leisure. The scales look at “peak” creativity and “extent” of creativity (re: quality and quantity); these are typically highly correlated. The scales show high interrater reliability and multiple indications of construct validity (Kinney, *et al.*, in press; Richards *et al.*, 1988). They allow comparisons among people in unselected populations, such that one need not study only creators who are writers, or artists, or entrepreneurs, or are homogeneous in any creative way. One can select individuals on other variables (such as psychopathology, or attention deficit issues, or home schooling, or rebelliousness) and see where their “originality of everyday life” happens to come out—viewed as a broad-based, real-life outcome variable. In fact, the LCS and the surprising mental health findings that resulted (as below) even led to a feature in the Tuesday “Science Times” section of *The New York Times* (Goleman, 1988).

(b) Creativity may be pathologized and misunderstood because of its assumed links with pathology or “abnormalities”—even when this creativity serves a healthy purpose. Furthermore, creativity is sometimes pathologized or stereotyped for people without a diagnosis—for example, the unkempt inventor, the absentminded professor, the antisocial artist—and these stereotypes may include young people whose nonconformity is not always understood or appreciated.

The above approach to everyday creativity permitted a new look at the age-old question of whether *everyday creativity* is enhanced in

people with a diagnosis of bipolar spectrum mood disorders or who carry familial risk (Richards *et al.*, 1988). Previous research had too often focused only on celebrated or eminent people (Jamison, 1993). The new “everyday” answer was more positive than in those previous studies. Richards, Kinney *et al.* (1988) used a model for *compensatory advantage*, somewhat similar to sickle cell anemia, where the homozygous individual can be severely ill, yet the more numerous and heterozygous carriers may show a mild anemia at best. Meanwhile, these carriers manifest a *compensatory advantage*: resistance to malaria. A result is the continuation of sickle cell anemia in the global gene pool.

Might there be a *compensatory advantage*, as well, for the strongly familial spectrum of bipolar disorders? These risks have a strong genetic component—although the genetic model is likely more complex than that for sickle cell anemia. Despite causing great pain and human suffering, these mood disorders have remained stable in the population over time and geographic region. An advantage based on milder, and perhaps healthy, manifestations, could help explain this persistence through adaptive advantage (Gartner, 2005; Goodwin and Jamison, 1990; Kinney and Richards, 2007; Richards, 1981, 2010; Richards *et al.*, 1988).

Richards and associates (Richards, Kinney *et al.*, 1988; see also Richards and Kinney, 1990; Richards *et al.*, 1992) compared more severe and moderate bipolar spectrum disorders (bipolar I and cyclothymia), along with persons showing psychiatric “normalcy” despite a family history of bipolar disorder, to control subjects without a mood disorder, and including a subgroup of “normal” controls. Richards and Kinney (1990) also asked people diagnosed with bipolar spectrum disorders for their preferred mental states while creating—here a *state* measure, in addition to the ongoing *trait* (or diagnostic) measure.

In fact, the data did support this *compensatory advantage* related to bipolar family risk. Everyday creativity was highest for individuals who were (1) relatively better functioning on the bipolar “spectrum” (e.g., cyclothymia, more than for full bipolar disorder—that is, on the diagnostic, or *trait* variables). Beyond that, the *psychiatrically normal* relatives also tended to share the creative advantage, compared to general



controls and even normal controls. The *compensatory advantage* was therefore not necessarily about pain and suffering. As for (2) the preferred mood *state*, the most preferred condition was during mild mood elevation (the *state* characteristic). This was not about “the sicker the better.” Other findings have supported this research (Akiskal and Akiskal, 1988; Fodor, 1999; Schuldberg, 1990).

Here, then, is creativity linked with the more healthy outcomes. Why might creativity in this mental health context (or in general) sometimes be considered unhealthy and even harmful? Why is something supposed to be *wrong* with the creator? Can dynamical systems thinking help at all here?

Krippner (1994) noted how the ontology of the mind exhibits bifurcations characteristics of nonlinear dynamical systems, and F.D. Abraham (1995) proposed ways in which nonlinear dynamical features can explain aspects of cognition. Zausner (2011) has applied chaos theory to her own creative work in the arts. Furthermore, investigators and scholars have questioned whether moments of creative insight, the “Aha” moment in creative process, might involve bifurcations and “edge of chaos” reconfigurations of mental possibilities (Abraham, 1996; Briggs and Peat, 1999; Richards, 1996, 2000; 2001; Schuldberg, 1999, 2007; Zausner, 1996). Animal models (Skarda and Freeman, 1987) provide evidence, for example, that with novel odors and the olfactory bulb, far-from-equilibrium mental systems may rapidly generate new attractors related to novel stimuli.

Might such a mechanism facilitate the birth of new and original mental attractors during creative periods, for any of us? Might this happen even more readily for persons with a personal or family history of bipolar disorder, during mild mood states that enhance rich associations, depth of emotional experience, and energy and motivation to create (Richards, 1981; Kinney and Richards, 2007)? Might creativity then get categorized as psychopathological, along with certain creators? Remember there are “many roads to creativity” (Richards, 1998), yet might we *all*, when creative for whatever reason, also get pathologized a bit?

Creative persons often show what Kris (1952) called “regression in the service of the ego,” a loosening of generative functions and

possibilities while still possessing control functions to manage the results. There is, to be sure, some looseness and idiosyncrasy in the mix. We suggest such creative process may be further understood using dynamic models of brain function including “*edge of chaos*” phenomena, at least at the metaphorical level (Moran, 2009) and perhaps even as a psychoneurological descriptor (Rossi, 2004).

(d) In view of these possibilities, society might do better to value innovative “divergence” rather than assume that deviations from what is “normal” are invariably “pathological.”

Goertzel (1995a and b) suggested that the psyche can manifest highly patterned strange attractors—we can think of these as dynamic branching figures in phase space—for associative memory, for example. Included can be hierarchies of attractors—where clusters of ideas form further self-similar clusters, leading to rich possibilities for access. Hardy (1998) refers to these as networks of meaning. Gruber and Davis (1988) use a developmental approach with multicomponent systems comprising networks, both within the mind, and among separate individuals. Such hierarchies are also consistent with categories and interrelationships among factors (such as units, relations, and systems) in early creativity researcher J. P. Guilford’s multifactorial model of divergent thinking (Richards, 2000; 2001).

Abraham (1996) noted that the balance of forces of *convergence* and *divergence* within one’s psyche may provide necessary conditions for creative cognitive chaos. He suggested, for “creative cognition...that there is a range of optional dimensionality...in the mid-dimensional range. This process is autopoietic, self-organizational” (p. 385). In fact, a balance of *divergent* and *convergent production* abilities, as in the work of Guilford (1968), is well known for creativity (Richards, 2000, 2001). This may also be related to Ernst Kris’s (1952) “regression in the service of the ego.” One must generate novelty within the context of sufficient control and executive functioning, such that creative work can be adapted to real-world needs (Richards, 1998). Human systems don’t remain chaotic indefinitely but tend to self-organize (Guastello, 2009); hence, the creative



instability provides the nudge, then resolves toward adaptive novelty.

As per Abraham (1996), it could follow that, with too little or too much convergent processing, the balance could tip from adaptive creativity to something less useful, for example, toward pathological patterns of thought and behavior, either too loose or too rigid. Similarly, with too little or too much *divergent* consideration of alternatives, the balance could again be upset between convergent and divergent processing. One potentially moves outside the range of mid-dimensional chaos that appears optimal for useful, healthy creativity. The right balance here is critical.

To summarize, aspects of dynamical systems theory may give, at least metaphorically, clarity to understanding creativity: Creative systems may indeed require mid-dimensional chaotic complexity as a necessary (but perhaps not sufficient) condition for healthy creativity. It takes a mix of interactive forces to achieve such conditions. Some converge toward an attractive surface—or hypersurface—or are within it; some diverge, either away from an attractive surface, or within it. The convergent forces must prevail for an attractor to exist. Yet they must not be overwhelming, and need to be balanced by some pull toward divergence, to achieve mid-dimensional chaos—where they may generate conditions for richly productive creativity.

For bifurcations to occur there needs to be movement away from stable attractors to the unstable conditions near and at the bifurcation point (“far from equilibrium”). Intentional systems may achieve this movement through self-control (self-organization, autopoiesis). Of course, external controls can also achieve this movement. The intentional control of system parameters comprises “navigation in parameter space.” “On the edge of chaos” refers to bifurcations from non-chaotic attractors to chaotic ones. Bifurcations from one type of chaotic attractor to another may be important as well, for a bifurcation sequence to other chaotic attractors generating healthy creative solutions.

In other words, the peaking of everyday creativity among so-called “better functioning” individuals with a bipolar diagnosis, and during times of milder mood elevation (e.g.,

cyclothymia, and during mild highs) could represent an optimal balance within the risk for these disorders. Certain advantages (e.g., rich associations, emotional resonance, and higher energy and motivation during mild mood elevation) might peak without loss of the adaptive functions needed to utilize them. In Kris’s (1952) view of creativity, one could have “regression in the service of the ego.” By Barron’s (1969) definition, one could generate creative products that are both *original* and (despite any attendant pathology) *meaningful*.

Further work is needed to understand such a *compensatory advantage*. This may offer hope for people at risk, such as individuals with bipolar disorders and their relatives (Goodwin and Jamison, 2000; Kinney and Richards, 2007; 2010; Goleman, 1988). In general populations, many health benefits of creativity have been documented (Richards, 2010); the best known involve art therapies, writing or imagery, although there are others. It is perhaps not surprising that high creativity could help certain “better functioning” individuals carrying bipolar risk cope resiliently with their lives. Through exercising their creativity, they may emerge healthier than they would have otherwise. It follows that, creative modalities may have particular value in treating mood disorders, and may even be useful for primary prevention (Kinney and Richards, 2007). Once again, creativity carries benefits for the rest of us too, mood disordered or not. Of interest, mild mood elevation carries benefits for creativity in the population at large (Isen *et al.*, 1987).

Yet, health benefits notwithstanding, the pathologizing of creativity, whether “everyday” or “eminent” creativity, occurs a lot. The media is filled with images of creators as odd, absent minded folk who cannot help bumping into walls. In these stereotypes, the “mad scientist” is too busy, or too unconventional, even to comb his or her hair. The link of creativity to mental disorders may be one factor in stereotype production, combined with the misunderstanding that, if creativity is associated with mental health problems, it will therefore be a problem itself—rather than a healthy response (Becker, 1978; Briggs and Peat, 1999; Richards, 1998; 2010).

In addition, there can be social discomfort with “difference.” And within individuals, some people who are uncomfortable with their own unconscious



processes and bizarre thoughts –even thoughts that might have creative potential—may prefer to disown them or unconsciously attribute them to others (Kinney and Richards, 2007; Richards, 2007; 2010). Unfortunately, some teachers see creative youth as problematic, and more compliant youth as the creative ones. This unfortunate stereotype has damaged the self-concept of some vulnerable and talented young people in the schools (Cramond, 2005; Richards, 2010).

Because a response is odd or “abnormal” does not, however, mean it is inevitably harmful or “pathological.” Rather, it may be “usefully exceptional.”

Along those lines, creativity researcher Frank Barron (1969) and colleagues found, for exceptional creators, and particularly for highly recognized creative writers, a paradoxical combination of (1) high ego strength (here denoting a control function, with high adaptation to reality) alongside (2) some high scores on virtually all of the pathology scales of the Minnesota Multiphasic Personality Inventory. Included were scales such as schizophrenia or hypomania. The researchers interpreted this, not as illness, but as an adaptive openness to the irrational and unconscious, including to what some call our “primary process” mind. The creator could pick and choose from this less conscious material. Notably, according to Barron (1969):

“It appears that creative individuals have a remarkable affinity for what in most of us is unconscious and preconscious...to find hints of emerging form in the developmentally more primitive and less reasonable structured aspects of his own mental functioning” (p. 88).

Here then could emerge the usefully “abnormal.” As Barron (1963) put it:

“The creative person is both more primitive and more cultivated, more destructive and more constructive, occasionally crazier and yet adamantly saner, than the average person” (p. 234).

Could this be our chaos- and creativity-generating “trickster” from the opening quote (Briggs & Peat, 1999) of this article, appearing to bring forth new patterns of mind?

Kristeva, in turn, discussed eruptive cognitive moments, this time in the service of *social* as well as individual bifurcation. Chaotic phenomena have been invoked, after

all, to explain varied social and financial changes and disruptions (Briggs and Peat, 1999; Robertson and Combs, 1995; Schuldberg, 2007) as well as personal ones. One of Kristeva’s favorite authors was Bakhtin, whose concept of *carnivalesce* shows similarities to the trickster—this time regarding the trickster’s role in cultural transformation. Sarup (1993) presented some of Kristeva’s ideas:

“If the semiotic is pre-Oedipal, based on primary processes, and is maternally oriented, by contrast, the symbolic is an Oedipalized system, regulated by the secondary processes and the Law of the Father. The symbolic is the domain of positions and proposition. The symbolic is an order superimposed on the semiotic. The symbolic control of the various semiotic processes is, however, tenuous and liable to break down or lapse at certain historically, linguistically and psychically significant moments. It results in an upheaval in the norms of the smooth understandable text. The semiotic overflows its boundaries in those privileged ‘moments’ Kristeva specifies in her triad of subversive forces: madness, holiness, and poetry” (p. 124).

Again, in a broader context, one sees similarities to “regression in the service of the ego” (Kris, 1952), and also to primary and secondary process, where a dynamic of opposing forces generates bifurcations, oddities, and creativity.

(e) Creative personality traits may be useful predictors for the enhanced generation of divergent thought, perhaps because a greater proximity to the “edge of chaos” provides a useful fit with nonlinear dynamic models.

Certain personality traits have been linked with high scores on measures of creativity (Barron, 1969; Barron and Harrington, 1981), traits including Openness to Experience, Tolerance of Ambiguity, and Preference for Complexity. It has been suggested that certain traits, or perhaps related cognitive styles, also might be part of the (evidently healthy) *compensatory advantage* for those at risk for bipolar disorders (Kinney and Richards, 2007).

A dynamical framework may help predict mental events that could accompany such traits as, for example, Openness to



Experience, and how they might sometimes “go a little too far,” producing odd and unusual responses that fit with some of the prevailing biases and stereotypes of the “odd” creator. It is interesting, for example, how responses of first degree relatives of bipolar individuals show a mild degree thought disorder of the same general bipolar type on a measure called the Thought Disorder Index (Holzman *et al.*, 1986), based on ink blot interpretations. Yet these same responses might be considered, instead, both colorful and *creative*, on a test of creative thinking! (Richards, 1998)

How then might cognitive style (or stylistic features linked to personality traits), create conditions that enhance novelty? Howard Gardner (1993), speaking of creativity, proposes that “certain personality characteristics are necessary” (in Abraham, 1996, p. 389). Might these allow bifurcation to more innovative mental modes? Might a stylistic bent such as Openness to Experience, for example, raise the odds for multiple bifurcations? That is to say, might this orientation open the gates to a stronger stream of ideas, and more widely diffuse, which can be picked through later, so the creator can choose the most useful for adaptive creative purposes?

One study (Kaufman, 2009) indicates that people with “faith in intuition” tend to have lower *latent inhibition*, that is, that they lower a gating mechanism that keeps out irrelevant (or seemingly irrelevant) stimuli. Low latent inhibition is related to types of schizophrenia but—taken along with stronger executive functions; it is also related to creativity! Some of these novel associations might be odder than others (Goertzel, 1995a, b). However original, might a few unusual ideas, when the mental gates are lowered, lead a critical observer to *pathologize* a process that should lead to celebration? For example, a person diagnosed with a mild thought disorder might write something viewed as gibberish in a mental hospital; but the same creative product might be viewed as beautiful poetry in a literary venue.

Group brainstorming offers another useful example (e.g., Putman and Paulus, 2009). In our own inner, personal brainstorming (recall Goertzel’s branching structures) perhaps some occasional bizarreness of ideation may emerge. One would welcome this in a group brainstorming session, following the rule that “anything

goes.” Yet it might be easy to dismiss a bizarre thought in a personal reverie, if one were too bound by convention, even though that “crazy idea” could be exactly what a real-life problem situation required.

As in brainstorming, it makes sense to separate idea generation from judgment, first eliciting a broad range of options, and then sorting through them later, to find the one that has the greatest promise. Again, it is important not to *pathologize* difference just because an idea is non-standard—especially when it may be a sign that one is breaking free of the ordinary, and moving toward new possibilities. With the right balance of divergent and convergent processes, one may be on the route to higher creativity—a goal sought and valued by a great many people.

(f) In dreaming, one may see certain of these phenomena in even bolder relief, where our external sensory world and the usual rules of logic are suspended.

The fractals found in Nature can be used as metaphors for the “branching” that characterizes the work of many creative people, even while they are asleep. Here indeed, the “trickster” may be at play, throwing us off from the usual, while opening new worlds.

How, in dynamical terms, does the dreamer depart from the known, to strike a new path, to switch between mental attractors? This switch might be accomplished by any of (a) bifurcations, (b) the resetting of initial conditions, or (c) by jumping boundaries of basins of attraction, this last being facilitated by fractal boundaries between basins (*fractal separatrices*) (FD Abraham, 1995; RH Abraham, 1995).

Dreaming could actually involve all three. During dreaming, the neural networks that comprise the waking circuitry of the brain appear to be less constrained by daytime reality and more open to novel connections (Hartmann, 1999). Stanley Krippner and Allan Combs (2002) have noted that the formal analysis of activity patterns in complex neural networks, such as those found in the dreaming brain, can be carried out in terms of chaotic attractors. They proposed that the dreaming brain (both in rapid eye movement or REM sleep and non-REM sleep) “relaxes” into natural patterns of self-organized activity that often reflect the residual moods, stresses, and



concerns of waking life. During dreaming, the brain is immersed in something like a sensory isolation tank, cut off from the influences of external sensory input. In this situation, patterns of brain activity can slip into forms that are primarily dependent upon internal considerations (Krippner and Combs, 2002).

In Allan Hobson's (2000) terms, during both waking and dreaming there is an *activation* of the brain, a source of that *information* that is evoked during the waking or dreaming process, and a *biochemical modulation* that differs radically in nature, from wakefulness to sleep. Dream experiences are, in part, he says, a product of self-organizing tendencies in the brain during which some randomly evoked informational data are then creatively patterned into a narrative to which meaning can be attributed (Kahn and Hobson, 1993). It thus starts randomly, and human beings impose meaning.

(g) Valuable insights may emerge--including highly "divergent" results; these can be worked through in dreaming, at times, or upon waking where "convergent" processing can more readily occur.

In the creative process, small changes in cognition or behavior can trigger an avalanche of new insights or novel creative products. Krippner and Combs (2002) have suggested this "Butterfly Effect" characterizes many dreams that lead to a creative solution to an ongoing problem. The human brain with its many chaotic patterns of activity is subject to the cascade of a Butterfly Effect. The introduction of "noise" into such a system may normally produce a response too small to be noticed. However, the presence of this "noise" or "vibration" can keep a system in motion, rather than allowing a signal to become stuck.

Termed *stochastic resonance*, a seemingly paradoxical effect has been demonstrated in electronic signals as well as in nerve cells (Moss and Wiesenfeld, 1995). On the other hand, the dreaming trajectories may be more under autopoietic control than those systems attempting to follow a repetitive signal, as in most stochastic resonance. As in more routine processing, there is a problem to be solved, but here divergent trajectories and bifurcations are used to generate a creative solution.

Objects, for instance, on a vibrating tabletop are sometimes seen to "walk" about, especially if the table is not level. In fact, they are following the line of least resistance down the slope of the surface, ordinarily not available to them because of friction with the top of the table. In the present case, one might imagine that the neurochemical stimulation of the higher brain by the lower brain could cause activity there to "slide" in the direction of least resistance, affecting one's dreaming. Here, with the dreaming brain isolated from daytime sensory bombardment and detached by neuromodulatory amnesia from those experiences that immediately precede sleep, chaotic phenomena such as the Butterfly Effect or stochastic resonance can produce a brain state especially responsive to subtle influences such as faint residual memories of emotional residues.

Affect regulation is one of several adaptive functions of dreaming; unpleasant dreams are a way to process a discomfiting emotional experience from waking life by placing it in novel settings, often with strangers playing key roles, especially during REM dreams (McNamara *et al.*, 2005). This highly creative way of managing an *affect load* seems to depend upon chaotic dynamics. When the regulatory dynamics are not functioning properly, this self-regulatory creativity may break down and the result is a nightmare in which the discomfiting experience, often traumatic in nature, can even be repeated over and over in the brain's unsuccessful attempt to restore its self-regulatory functions. There is a bifurcation to a reduced dimensionality

(h) Some scholars see dreaming as no more than random patterns due to random brain activity, rather than an intentional process holding potential meaning.

One of William Shakespeare's characters, in *Romeo and Juliet*, derided dreams as "full of sound and fury, signifying nothing." In more recent times, Frances Crick and Graeme Mitchison (1986) proposed that dreaming performs a housecleaning function for the brain and that their content is "best off forgotten." However, Crick and Mitchison described a neural network that underlies dreaming that other authors (e.g., Hartmann,



1999) have used to propose a more creative function of the dreaming process.

Hobson (Hobson and McCarley, 1977; Hobson *et al.*, 2000) has taken the position that dream content results from random stimulation of cortically-stored memories, but that the dreaming brain “makes the best of a bad bargain,” creatively weaving a narrative from the images. Krippner and Combs’ (2002) model of dreaming as a chaotic, self-organized process attempted to span the chasm between the neurobiology of dreaming and the study of dream content, a task also performed by G. William Domhoff (2003). However, Domhoff took the position that dreaming was an epiphenomenon of sleep while Krippner and Combs (2002) held that it was adaptive in nature, even serving an important role in the evolution of higher vertebrates (also see McNamara, 2004).

For Hobson, dream content is so bizarre that dreaming could be described as a “model psychosis” and “delirium.” Similarly, Crick and Mitchison (1986) wrote about the “bizarre intrusions” that characterize dreams (p.231). Carol S. Uppercut (1993) took a more creative approach to bizarre elements in dreams, stating that “bizarreness is the means by which the dream represents objects, persons, or experiences that cannot ... be isolated from the dreamer’s history in time and space. In the dream state we recreate the diachronic world from the standpoint of its synchronic coherence as established in a unique memory” (Uppercut, 1993, p. 25).

How useful these dreams can sometimes be. Deirdre Barrett (2001) has described a “bizarre” dream reported by the Italian composer, Giuseppe Tartini in which he handed the devil a violin bow. “The Devil played a haunting melody of unearthly beauty. The instant he awoke, Tartini grabbed his violin and tried to reproduce it. All he could remember was the distinctive double-stop trill. Around that marvelous sound, he composed a piece her called *The Devil’s Trill Sonata*” (p. 69). Thus, where one person may see delirium and bizarreness, another person may see creativity.

(i) Although dreaming may have random elements, one can also discover patterns of content for which the meaning has potential social as well as individual significance.



There are multiple Western books on how to derive benefit upon awakening from various types of dreams (Krippner, 1990; Krippner *et al.*, 2003), on how to benefit through lucid awareness during the dream itself (LaBerge and Reinhold, 1990), and how, in waking life, to use altered states derived from dreaming for further knowledge and benefit (Moss, 1996). Across cultures, one may take seriously indeed, the shamanic use of dreams which have led, for example, to successful diagnosis or treatment for client illnesses (Kilborne 1990; Krippner, 1990) or to major transformations in spiritual awareness (Norbu, 2002). Is this truly only content casually impressed on random activity by pattern-making humans?

How might dreams generate meaningful content? During the process of dreaming, random activation within the cortex (primarily the visual-motor areas) can evoke images and memories that connect with an unsolved issue. This may serve as a chaotic attractor. “Branching” can lead to alternative ways of resolving the issue; the resulting dream narrative might favor a particular solution or it might present various alternatives and predispose the dreamer to solve the problem upon awakening. Such a use of dream time is adaptive indeed.

Goertzel’s’ (1995a and b) branching models again help explain this potential dream process. If divergent and convergent processes are at work, it is likely that the more convergent processes occur later, upon waking, to fully understand an insight from dreaming. Many models of the creative process include an “incubation” phase that is followed by “illumination” (Richards, 2010), a time of hidden activity before it comes together. Tartini’s dream could serve as an example since he was hard pressed to produce a new composition and had a creative block for which his devilish dream provided a welcome opening and finally a breakthrough.

Hartmann (1999) encourages dreamers, when they wake, to seek a “central image” in their dream, one that contains vivid imagery and intense affect. This image, he maintains, can serve as the key to unlock the latent meaning of the dream narrative. In Krippner and Combs’ (2002) model, Hartmann’s central image would be a chaotic attractor, and neural networking would draw

associated memories and images toward it to yield a coherent story.

Janice Bayless (2009) has proposed that branching, or bifurcating, can happen more than once, producing a *cascade*, which we have referred to as a bifurcation sequence. These bifurcations and cascades are specialized types of *associative thinking*, in which two associated images have a linking similarity (*chaining*). She used the well-known example of Elias Howe's invention of the lockstitch sewing machine to make her point. While awake, Howe had worked in vain to design a machine that would sew garments, but nothing would work. One night he dreamed that savages had captured him and prodded him with their spears. As they were about to execute him, he noticed that each spear had a hold in the pointed end. He woke up with a start, realizing that what his machine needed was a needle with a hole in the pointed end. The needle and the spears had a similarity of shape—long, narrow, and pointed.

Chaos theory thus adds an important dimension to the understanding of dreams; information is not simply accumulated, as Hobson has maintained. It is also generated, creating connections that were not there before, and the Elias Howe dream is an example because from it he generated a working model for his sewing machine (Bayless, 2009). This dream had social significance since it initiated an industrial paradigm that required fewer workers. Because many of the skilled sewers were slaves, it could perhaps even be said that Howe's dream was an initiator of the death knell to slavery in the United States.

Nighttime dreaming serves as another example of "everyday creativity," as each dream is unique and novel, and can indeed be meaningful, in its interpretation and later use. Because each brain constantly self-organizes data, whether it is awake or asleep, creativity can be seen as part of human potential rather than a phenomenon limited to an isolated circumstance or an elite group of individuals. Such manifestations are of great social significance because they "democratize" creativity, showing that the term need not be limited to a few "creative geniuses." Everyday creativity is, indeed, our birthright as human beings.

(j) These patterns are not only suggestive of immediate value, but of ongoing value because they may well have been adaptive during the course of evolution.

Social psychology rests, in part, on the understanding that evolution selected genetic and genotype-environment patterns that facilitated social interactions (McNamara, 2004). The outcome of such patterns is seen not only in these social interactions per se, but also in relevant thoughts, feelings, and dreams of humans. Indeed, there is evidence that social interactions are more likely to be depicted in dream reports than in one's spontaneous tellings in the waking state. Aggressive social interactions are more characteristic of REM sleep than experiences during NREM sleep or based on reports from waking periods, while dreamer-initiated friendliness is more characteristic of NREM than of REM reports (McNamara *et al.*, 2005). Dreaming permits "downloading" of negative emotions usually depicted symbolically in unusual settings to "work through" the troublesome feelings in general rather than in particular. This process permits the dreamer to awaken refreshed and ready for the new day. If the process fails, the unpleasant experience is dreamed about directly, not symbolically, and in familiar rather than in unfamiliar settings—a phenomenon most apparent in repetitive post-traumatic nightmares.

Processing of social interactions seems often to be performed "off-line" during dreaming. This pattern may be linked to the observation that there is a reciprocal interaction of two neuronal groups, acetylcholine in REM, and norepinephrine and serotonin in non-REM. These specializations suggest that dreams may later exert a regulatory impact on waking social interactions (McNamara *et al.*, 2005).

(k) It is likely that further clarification of nonlinear dynamical processes and the balance between divergent and convergent forces can further reveal the healthy potentials of our creative minds, during both waking and dreaming states.

Reflecting on the dream state, there may be misunderstanding and mislabeling of some dream phenomena that are healthy and



adaptive—whether calling them bizarre and delusional, or random and meaningless. Yet these dreams can represent highly adaptive creative processes, albeit in less conventional forms and ones we dare not overlook.

Dreaming is a complex neurocognitive process with a neurochemistry, a neuroanatomy, and an electrophysiology as complex as waking processes (Pagel, 2009). The authors of this paper take the position that dreams are not, as some claim, an epiphenomenon; indeed, we suspect that dreaming also played an important role in evolution of the nervous system and human behavior. Dreams are not, as some claim, a spandrel, a decorative piece of architecture that serves no structural function; instead, they are central to the organization and architecture and development of the brain. Dreams are not, as still others insist, a nighttime discard that is best off forgotten; rather, dreams can lead to affect regulation, memory consolidation, and even creative problem solving. Parenthetically, Gould and Lowentin (1979) have even proposed an evolutionary significance for ‘spandrels’.

If dreams were simply epiphenomenal images without causal, intentional, or semantic content, then one would not expect to find dream states exhibiting processing specializations. If dreams are nighttime discards, one would not expect the selective emphasis upon social interactions reported in the literature. If dreams are spandrels that randomly reflect only snippets of daytime experience, there would be no reason to expect, for instance, high levels of aggression in either REM or NREM dreams.

Instead, the available evidence points to non-randomness and purpose, with creativity as a hallmark of a healthy mind in dreaming as well as waking. The sometimes bizarre appearances of new ideas, or new dream material should be carefully observed and even honored. Here one finds patterns of information that appear meaningful, socially relevant, and of potential individual, cultural, and evolutionary importance.

One should therefore not assume that dream material is random and meaningless simply because its special rules are not understood. Nor dismiss waking ideation if it is at first hard to understand, or is odd if not frankly bizarre. One may thereby miss patterns of meaning and creativity. As we have said,

the abnormal is not necessarily *pathological*. It may be superbly unique and usefully exceptional. One should at least take a look.

Rather than revealing pathological bizarreness (while awake) or meaningless random activity (while dreaming), our cognitive-affective productions may be showing us their own logic. Moreover, perhaps, if we look ahead, they will even reveal their own forms of beauty—a deep aesthetic based in the infinities of chaotic possibilities in our own minds (Mitina and Abraham, 2003; Richards, 2001). Such phenomena can open us beyond the conventional, to deeper parts of the psyche and onward to benefits and experiences we would otherwise lack.

Zausner (2011) has presented examples of her work that illustrate this deep connection, stating that “archetypes of the creative process link a single mind to the collective unconscious and works of art become self-opening worlds that create an expanded reality” (p.994). For example, while working on a painting, “*The Philosopher’s Stone*,” Zausner had portrayed a child reaching the light after crawling up a winding path in the darkness. But she needed a symbol of transformation as well, one that would counteract the sweetness of the child. Suddenly, she heard an inner voice say, “Wears let a jewel in its head,” a passage that she recognized from Shakespeare’s *As You Like It*. The entire line read, “Sweet are the uses of adversity, which like the toad, ugly and venomous, wears yet a precious jewel in its head.” Zausner painted a toad, a symbol of transformation in several cultures, near the bottom of the painting and the gestalt was complete (pp. 995-996).

Here then is our “trickster,” our inner creative advocate of the new, the surprising and, ultimately, the useful. Further study of waking and dreaming creativity from the perspective of chaos theory may help us understand the underlying mechanisms that can destabilize the known, while opening up the possible and the original, meanwhile providing us the balance and control for useful, adaptive, and sometimes astonishing new understandings.

Note

This article is an expansion of a paper by S. Krippner, R. Richards, and F. Abraham, entitled *Chaos, creativity, dreaming and waking states: Honoring our healthy divergence*, presented in July, 2009 at the Annual Meeting of the Society for Chaos Theory in Psychology and the Life Sciences, Milwaukee, Wisconsin.



References

- Abraham FD. Introduction to Dynamics: A Basic Language, a Basic Metamodeling Strategy. In FD Abraham and AR Gilgen (Eds.), *Chaos theory in psychology*. Westport: CT: Praeger/Greenwood, 1995.
- Abraham FD. Dynamics, Bifurcation, Self-organization, Chaos, Mind, Conflict, Insensitivity to Initial Conditions, Time, Unification, Diversity Free, will, and Social Responsibility. In R Robertson and A Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 155-173). Mahwah, NJ: Erlbaum, 1995.
- Abraham FD. The Dynamics of Creativity and the Courage to be. In W Sulis and A Combs (Eds.), *Nonlinear dynamics in human behavior: Studies of nonlinear phenomena in life sciences*, Vol. 5 (pp. 364-400). Singapore: World Scientific, 1996.
- Abraham FD. Cyborgs, Cyberspace, Cybersexuality: The Evolution of Everyday Creativity. In R Richards (Ed.), *Everyday creativity and new views of human nature* (pp. 241-259). Washington, DC: American Psychological Association, 2007.
- Abraham RH. Erodynamics and the Dischaotic Personality. In FD Abraham and AR Gilgen (Eds.), *Chaos theory in psychology*. Westport: CT: Praeger/Greenwood, 1995.
- Akiskal H and Akiskal K. Reassessing the prevalence of bipolar disorders: Clinical significance and artistic creativity. *Psychiatry and Psychobiology* 1988; 3: 29-36.
- Arons M. Standing up for Humanity: Upright Body, Creative Instability, and Spiritual Balance. In R Richards (Ed.), *Everyday creativity and new views of human nature* (pp. 175-193). Washington, D.C.: American Psychological Association, 2007.
- Bakhtin MM, Holquist M, and Emerson C. *Speech Genres and Other Late Essays*. Austin: University of Texas Press, 1986.
- Barrett D. *The Committee of Sleep*. New York: Crown, 2001.
- Barron F. *Creativity and Psychological Health*. Princeton, NJ: Van Nostrand, 1963.
- Barron F. *Creative Person and Creative Process*. New York: Holt, Rinehart, & Winston, 1969.
- Barron F and Harrington D. Creativity, intelligence, and personality. *Annual Review of Psychology* 1981; 32: 439-476.
- Baylis J. Dreams: Chaotic or ordered? *Dream Network* 2009; 28 (1): 17-19.
- Becker G. *The Mad Genius Controversy: A Study in the Sociology of Deviance*. Beverly Hills, CA: Sage, 1978.
- Briggs J and Peat FD. *Seven Life Lessons of Chaos: Timeless Wisdom from the Science of Change*. New York: HarperCollins, 1999.
- Cramond B. *Fostering Creativity in Gifted Students*. Waco, TX: Prufrock Press, 2005.
- Crick F and Mitchison G. REM sleep and neural nets. *Journal of Mind and Behavior* 1986; 7: 229-250.
- Dobzhansky T. *Mankind Evolving*. New Haven, CT: Yale University Press, 1962.
- Domhoff GW. *The Scientific Study of Dreams: Neural Networks, Cognitive Development, and Content Analysis*. Washington, DC: American Psychological Association, 2003.
- Fodor E. Subclinical inclination toward manic-depression and creative performance on the Remote Associates Test. *Personality and Individual Differences* 1999; 27: 1273-1283.
- Freeman A. *Consciousness: A Guide to the Debates*. Santa Barbara, CA: ABC-CLIO, 2003.
- Gardner H. *Creating Minds*. New York: Basic Books, 1993.
- Gartner, JD. *The Hypomanic Edge: The Link Between (a little) Craziness and (a lot of) Success in America*. New York: Simon & Schuster, 2005.
- Goertzel B. Belief Systems as Attractors. In R Robertson and A Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 123-134). Mahwah, NJ: Erlbaum, 1995a.
- Goertzel B. A Cognitive Law of Motion. In R Robertson and A Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 135-153). Mahwah, NJ: Erlbaum, 1995b.
- Goleman D. (1988 September 13). A new index illuminates the creative life. *New York Times*, pp. C1, C9.
- Goodwin F and Jamison KR. *Manic-depressive Illness*. New York: Oxford University Press, 1990.
- Gould SJ and Lowentin RC. The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptionist programme. *Proceedings of the Royal Society of London B, Biological Sciences*, 205, 581-598, 1979.
- Gruber H, and Davis HE. *Inching Our Way up Mount Olympus: The Evolving Systems Approach to Creative Thinking*. In RJ Sternberg (Ed.), *The nature of creativity* (pp. 243-270). New York: Cambridge University Press, 1988.
- Guastello SJ. Chaos as a psychological construct: Historical roots, principal findings, and current growth directions. *Nonlinear Dynamics, Psychology and Life Sciences* 2009; 13(3): 289-310.
- Guilford JP. *Intelligence, Creativity, and their Educational Implications*. San Diego: Knapp, 1968.
- Hardy C. *Networks of Meaning*. Westport, NY: Praeger, 1998.
- Hartmann E. *Dreams and Nightmares: The New Theory on the Origin and Meaning of Dreams*. New York: Plenum Press, 1999.
- Hobson JA and McCarley R. The brain as a dream state generator: An activation-synthesis hypothesis of the dream process. *American Journal of Psychiatry* 1977; 134: 1335-1348.
- Hobson JA, Pace-Schott EF, and Stickgold R. Dreaming and the brain: Toward a cognitive neuroscience of conscious states. *Behavioral and Brain Sciences* 2000; 23: 793-1121.
- Holzman PS, Shenton ME, and Solovay MR. Quality of thought disorder in differential diagnosis. *Schizophrenia Bulletin* 1986; 12: 360-372.
- Isen A, Daubman K, and Nowicki G. Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology* 1987; 52: 1122-1131.
- Jamison KR. *Touched by Fire: Manic-depressive Illness and The artistic Temperament*. New York: The Free Press, 1993.
- Kahn D and Hobson JA. Self-organization theory of dreaming. *Dreaming* 1993; 3: 151-178.
- Kilborne B. Ancient and Native Peoples' Dreams. In S Krippner (Ed.), *Dreamtime and dreamwork: Decoding the language of the night* (pp. 194-203). New York: Tarcher/Putnam, 1990.
- Kinney D and Matthyse S. Genetic transmission of schizophrenia. *Annual Review of Medicine* 1978; 29: 459-473.
- Kinney D and Richards R. Artistic Creativity and Affective Disorders: Are They Connected? In C Martindale, P Locher, and V Petrov (Eds.), *Evolutionary and neurocognitive approaches to aesthetics, creativity, and the arts* (pp. 225-237). Amityville, NY: Baywood, 2007.
- Kinney DK, Richards R, and Southam M. *Everyday Creativity, Its Assessment, and The Lifetime Creativity Scales*. In MA Runco (Ed.), *Handbook of creativity*. Creskill, N.J.: Hampton Press, in press.
- Krippner S. (Ed.) *Dreamtime and Dreamwork: Decoding the Language of the Night*. New York: Jeremy Tarcher, 1990a.
- Krippner S. *Tribal Shamans and Their Travels into Dreamtime*. In S Krippner (Ed.), *Dreamtime and dreamwork* (pp. 185-193). New York: Jeremy Tarcher, 1990b.



- Krippner S. Humanistic psychology and chaos theory: The third revolution and the third force. *Journal of Humanistic Psychology* 1994;34(3): 48-61.
- Krippner S. The epistemology and technologies of shamanic states of consciousness. *Journal of Consciousness Studies* 2000; 7 (11-12): 93-118.
- Krippner S and Combs A. A systems approach to self-organization in the dreaming brain. *International Journal of Systems and Cybernetics* 2002; 31: 1452-1462.
- Krippner S, Bogzaran F, and de Carvalho AP. *Extraordinary Dreams and How to Work With Them*. Albany, NY: State University of New York Press, 2002.
- Kris E. *Psychoanalytic Explorations in Art*. New York: International Universities Press, 1952.
- Kristeva J. Giotto's joy. In LS Roudiex (Ed. /Trans), *Desire in Language*. New York: Columbia, 1980.
- LaBerge S and Rheingold H. *Exploring the World of Lucid Dreaming*. New York: Ballantine, 1990.
- McLaren RB. The Dark Side of Creativity. In MA Runco and SR Pritzker (Eds.). *Encyclopedia of Creativity* (Vol. 1, pp. 483-491). San Diego, CA: Academic Press, 1999.
- McNamara P. *An Evolutionary Psychology of Sleep and Dreams*. Westport, CT: Praeger, 2004.
- McNamara P, McLaren Smith D, Brown A, and Stickgold RA. "Jekyll and Hyde" within: Aggressive versus friendly interactions in REM and non-REM dreams. *Psychological Science* 2005; 16: 130-136.
- Maslow A. *Toward a Psychology of Being*. New York: Van Nostrand, 1968.
- Mitina O and Abraham FD. The use of fractals for the study of the psychology of perceptions: Psychophysics and personality factors—A brief report. *International Journal of Modern Physics* 2003;14(8): 1-14.
- Moran S. Boundary foundations in creativity research: Boundary vs. organism. *Journal of Creative Behavior* 2009; 43: 1-22.
- Moss R. *Conscious Dreaming: A Spiritual Path for Everyday Life*. New York: Three Rivers Press/Crown Publ, 1996.
- Moss F and Wiesenfl K. The benefits of background noise. *Scientific American* 1995; 271: 66-69.
- Norbu N. *Dream Yoga and the Practice of Natural Light*. Ithaca, NY: Snow Lion, 2002.
- Pagel JE. *The Limits of Dream: A Scientific Exploration of the Mind/brain Interface*. Amsterdam: Elsevier, 2008.
- Putman VL and Paulus PB. Brainstorming, brainstorming rules and decision making. *Journal of Creative Behavior* 2009; 43: 23-39.
- Rhodes M. An analysis of creativity. *Phi Delta Kappan* (1961, April); 305-310.
- Richards R. Relationships between creativity and psychopathology: An evaluation and interpretation of the evidence. *Genetic Psychology Monographs* 1981;103: 251-324.
- Richards R. Does the lone genius ride again? Creativity, chaos, and community. *Journal of Humanistic Psychology* 1996; 36(2): 44-60.
- Richards R. When Illness Yields Creativity. In M Runco and R Richards (Eds.), *Eminent creativity, everyday creativity, and health* (pp.485-540). Greenwich, CT: Ablex, 1998.
- Richards R. Millennium as opportunity: Chaos, creativity, and JP Guilford's Structure-of-Intellect Model. *Creativity Research Journal* 2000-2001; 13 (3&4): 249-265.
- Richards R. A new aesthetic for environmental awareness: Chaos theory, the natural world, and our broader humanistic identity. *Journal of Humanistic Psychology* 2001;41: 59-95.
- Richards R. (Ed.). *Everyday Creativity and New Views of Human Nature*. Washington, DC: American Psychological Association, 2007.
- Richards R. *Everyday Creativity: Process and Way of Life—Four Key Issues*. In J Kaufman and R Sternberg (Eds.), *Cambridge Handbook of Creativity*. New York: Cambridge University Press, 2010.
- Richards R and Kinney D. Mood swings and creativity. *Creativity Research Journal* 1990; 3(3): 202-217.
- Richards R, Kinney D, Daniels H, and Linkins K. Everyday creativity and bipolar and unipolar affective disorder: Preliminary study of personal and family history. *European Psychiatry* 1992; 7, 49-52.
- Richards R, Kinney D, Lunde I, and Benet M. Creativity in manic-depressives, cyclothymes, their normal relatives, and control subjects. *Journal of Abnormal Psychology* 1988; 97: 281-288.
- Robertson R and Combs A. (Eds.). *Chaos Theory in Psychology and the Life Sciences*. Mahwah, NJ: Erlbaum, 1995.
- Rossi E. *A Discourse with our Genes: The Neuroscience of Therapeutic Hypnosis and Psychotherapy*. Benevento, Italy: Editris, 2004.
- Runco MA and Pritzker SR. *Encyclopedia of creativity* (2 vols.). San Diego, CA: Academic Press, 1999.
- Sarup M. *An Introductory Guide to Post-structuralism and Postmodernism* (2nd Ed.). Athens, GA: University of Georgia Press, 1993.
- Schulberg D. Schizotypal and hypomanic traits, creativity, and psychological health. *Creativity Research Journal* 1990; 3: 218-230.
- Schulberg D. Chaos Theory and Creativity. In M Runco and S Pritzker (Eds.), *Encyclopedia of Creativity*, Vol. 1 (pp. 259-272). San Diego: Academic Press, 1999.
- Schulberg D. Living Well Creatively: What's Chaos Got To Do With It? In R Richards (Ed.), *Everyday creativity and new views of human nature* (pp. 55-73). Washington, D.C.: American Psychological Association, 2007.
- Skarda C and Freeman WJ. How brains make chaos in order to make sense of the world. *Behavioral and Brain Sciences* 1987;10: 161-173.
- Zausner T. The Creative Chaos: Speculations on the Connection Between Non-linear Dynamics and the Creative Process. In W. Sulis & A. Combs (Eds.), *Nonlinear dynamics in human behavior: Studies of nonlinear phenomena in life sciences*, Vol. 5 (pp. 343-363). Singapore: World Scientific, 1996.
- Zausner T. Transcending the self through art: Altered states of consciousness and anomalous events during the creative process. *Journal of Consciousness Exploration & Research* 2011; 2: 993-1005.

