

CHAOS, COMPLEXITY, SELF-ORGANIZATION AND US

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Changes in the weather. Cardiac arrhythmias. Traffic flow patterns. Urban development and decay. Epidemics. The behavior of people in groups. Any idea what holds all of these ideas together? The answer is chaos and complexity. Although the roots of chaos theory go back to Poincaré, a multidisciplinary interest in chaos, complexity and self-organizing systems did not take off until the 1970's. Now, at the Santa Fe Institute in New Mexico, and at other centers around the world, scientists, economists, urban planners, sociologists and psychologists are developing theories, theorems, and practical applications for these concepts, all of which focus on the study of change in natural systems – including change in individual human beings, relationships, and groups.

The theories behind the study of complexity, however, are not that easy to discuss. One writer in the field has described the process of defining chaos theory as similar to trying to grasp gelatin: “It’s easy to see that there is some substance there, that the substance has some specific form, and that it appears solid. When one tries to actually pick some up, however, it quickly becomes a challenge to manage and is transformed into a very different substance than it appeared while sitting on the plate” (Chamberlain as quoted in McClure, 1998, p.1).

Many people have a rudimentary idea about what chaos theory refers to from media attempts to present the material. The most well known image is that of the butterfly effect, referring to the idea that the flapping of a butterfly’s wings in Brazil can affect the course of a tornado in Texas. Since Edward Lorenz’s original discovery of this effect via his meteorological analyses in 1961, other people have noted the phenomenon in how a few grains of pollen set off an attack of hay fever, a rumor causes the stock market to fall, and a fast-spreading grievance ignites a prison riot (Briggs & Peat, 1999). In chaos lingo, this has become known as “sensitive dependence on initial conditions”,

expressing an understanding that even minute differences in input can quickly manifest as an overwhelming difference in output. Lorenz also noted that “crisis points”, critical turning points exist everywhere in natural systems.

As it turns out, systems considered to be chaotic aren't really chaotic at all – they are just not as predictable as the cause-and-effect kind of ideas associated with linear dynamics. Linear systems work within clear, definable limits and things “add up” to form a predictable outcome – add together certain causes, perform an equation, and you get a predictable result. The statistics we use in psychology and elsewhere, derive from the study of linear systems. So do the ideas of what a clock is, and how the universe is like a clock – including the people in it. If we can just discover all the rules for clocks, we will also have all the rules for people. And if we can figure out how to control clocks, we can probably discover not only how to control the weather but how to control people as well.

The only problem is that linear systems exist more in theory than in practice. Living systems and forces of nature are nonlinear, regardless of whether we talk about the weather, planetary systems, a cell or a therapy group. A nonlinear system means you cannot quantify outcome based on additive equations. As a result, cause and effect are not necessarily functionally related. In linear systems, output is proportional to input. In nonlinear systems this is not the case – a little bit of input can produce an enormous change in output – or not. In linear systems change can be predicted by what has happened in the past. In nonlinear systems, change is discontinuous, with sudden unpredictable jumps, more like the change in a horse's gait from walking, to trotting to galloping – sudden transitions resulting from dramatic reorganization (McClure, 1998). This nonlinear idea is extremely inconvenient for researchers who depend on changing one variable at a time, measuring it, and discovering causality. Up to a point, this methodology can be helpful, and lead to significant advances. But when we need to look at actual situations that occur in messy and complicated real life situations, rather than in highly controlled laboratory settings, we run into trouble. All kinds of unpredictable things happen when you get joint interactions between systems. These things that happen, although unpredictable are quite frequently, not chaotic at all, but well organized. For an example there is none better than the function of the exceedingly complex human brain.

Formally, the focus of chaos theory is on the manner in which simple systems give rise to very complicated unpredictable behavior, while complexity theory focuses on how systems consisting of many elements can lead to well-organized and predictable behavior. Self-organization is a notion that holds that new levels of form, organization and complexity often arise out of the interchanges between organisms and their contexts – order “for free”. As an example, groups of neurons self-organize into a pattern of firing in response to changes in experience (Masterpasqua & Perna, 1997). Taken together, they represent the “science of change”. Relational therapists will note the continuity with general systems theory. One psychologist in this new field has stated that general systems theory focuses on stability while chaos theory explores how systems change (McClure, 1998). Others propose that chaos and complexity are the basis for a postmodern self. In contrast to the modern man who could objectively discover the machine-like workings of the universe, a self-contained individual able to uncover the one Truth, the post-modern self is an open system, dependent on context, always in a state of becoming, actively integrating new information and exchanging that information with a changing environment (Masterpasqua and Perna, 1998).

When a complex, nonlinear system becomes stressed or “perturbed”, the system becomes unstable. The further the system gets from equilibrium the more unstable it becomes. Human beings, and human organizations experience such a phenomenon as anxiety, fear, and stress. The system may make changes to reestablish equilibrium, but these changes will be first-order changes – linear, gradual, segmental, predictable, moderate and incremental. If these adjustments fail to work and the system does not restabilize, the continued perturbation will propel movement toward a “bifurcation” – a decision point, a critical choice, Robert Frost’s “two paths” diverging in a wood. There may be many possible options at each fork in the road and the consequence is that the future becomes unpredictable, although not random. Like entering the vortex of a tornado, the system experiences this movement as chaotic and, in human terms, terrifying while inside the cone, but from outside, we can see that the vortex has form and boundaries. Hence chaos is not really chaos, exactly. In fact, the possibilities of movement within the vortex will be constrained by previous decisions that have led to this turning point, and by other aspects of both internal and external reality, but within the field of

choice within the cone, anything can happen. As one psychologist has said, “history circumscribes the choices” with which systems are presented (McClure, 1998, p.20).

At a certain point, the bifurcation occurs, one fork is chosen, and that fork leads to “second order change” which is described as turbulent, chaotic, nonlinear, sudden, dramatic, transformative, and unpredictable (McClure, 1998). “Attractors” lie ahead along the path within the vortex of change, drawing the choice along trajectories, a bit like magnets. In a chaotic system, the attractors are called “strange attractors” and represent the process that unfolds through the complex interactions between elements in a system. These strange attractors, acting like magnets, constrain the system to lie within certain ranges. The system orbits around these strange attractors but never in exactly the same way so that although a pattern can be seen from a distance, close-up the behavior of the system is unpredictable for any specific repetition.

The patterns that strange attractors give rise to are never repeated exactly within the system but even so, there is a form. These forms when made into visual images on a computer create beautiful, rhythmic patterns that look like infinity symbols, sinuous mandalas, fireworks (Chamberlain, 1998). Like fractals, their geometric cousins, strange attractors demonstrate a crystalline, convoluted ornateness that is associated with the field of chaos (Moran, 1995). “Chaos is a science of pattern, not predictability” (Chamberlain, 1995, p.268.). A new self-organization is the result of the transit through this chaotic, turbulent process, one that may lead to increased complexity or to regression/disintegration: to life or to death. The change of a caterpillar into a butterfly is an example of second-order, transformative change.

Since psychotherapy at its core is about change, even more than it is about stabilization, it should not come as a surprise that people interested in the social sciences and in the study of psychotherapeutic change should become fascinated by the metaphors and the science that are the underpinnings of chaos/complexity theory. In our language, “sensitive dependence on initial conditions” is chaos code for “childhood”. We know intimately about the power of applying stress to a system, while watching that system – individual, family or group – attempt to restabilize itself using tried and true methods, or defenses, only to become overwhelmed and enter a period of chaos out of which may or may not come positive change and growth. There has long been

a tension in the mental health field generally, and the psychiatric field in particular, between those who favor doing whatever it takes to stabilize a patient – drugs, restraint, punishment – and those who see strategic and creative possibilities within the chaos, i.e. R. D. Laing, Joseph Berke, etc. Many psychotherapists would agree that the proper role for therapy is to be a safe container for the chaos of the patient’s experience, validating the importance of letting change occur, despite the disruptions that may attend the process, alternating between provoking enough anxiety to propel the person, family, or group into the vortex of change while soothing anxiety that is threatening to overwhelm the system, forcing it into regressive solutions.

McClure (1998) has written an entire book devoted to understanding the process of group therapy through the lens of chaos theory. In it he postulates that the stages of group therapy map out the process of chaotic transformation that can occur in a group if there is effective group leadership that does not seek to control and limit the group transit through the period of conflict and chaos. He sees groups that become regressive and even destructive as those that have been unable to evolve and develop, to self-organize out of the chaotic transition in a healthy way. Brabender (1997) also focuses on group treatment and explores the connections between Lewin’s field theory, Agazarian’s systems-centered thinking, the group analytic school originated by Foulkes, and chaos/complexity concepts.

Several authors have written about the process of family treatment from the perspective of chaos theory. Hudgens (1998) and Chamberlain (1995) use chaos theory as a model for the dynamics of dysfunctional families, viewing the “attractor” phenomenon in terms of what draws the family together and then looking at the therapist as a “strange attractor” who can pull the individual family members and the entire family towards new patterns of communication and interaction.

But arguably, some of the most interesting ideas come out of stepping back and applying chaos/complexity theory to a larger worldview. The potential relevance to all areas of human endeavor are startling, and carry for many of us enormous hope that there is something beyond the fragmented, reductionistic, exploitative view of human nature that currently confronts us from every angle. It forces us to evaluate many of the underpinnings of our present mechanistic, scientific viewpoint. The chaos concepts ask us to suspend, or at least be willing to play with the

notions that behavior is predictable, that observation can be objective, that behavior is replicable, that output is proportional to input, that chaos is destructive and even avoidable, that anything can be understood in isolation from anything else ((Chamberlain, 1998). In place of a mechanistic view of the universe, we are encouraged to see the playful interdependency of all being, best represented by the trickster image that has played such a vital role in all cultures throughout time, demonstrating how creativity can overcome the odds, bend the rules, think and move “outside the box”. It is time for such a change. In the 22nd century movie version of 21st century history, just as our linear and reductionistic solutions to the complex problems of corporate globalization fail to save the planet from threatened extinction, the human species discovers – or rediscovers – the power of subtle change, of dynamic, unpredictable, creative self-organization. We come to recognize that all life is truly and irrevocably interconnected and that our salvation lies in giving up the struggle for control and turning ourselves over to loving life in each other and the world around us.

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