The Fractal Nature of Energetic Models of Medicine

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"The human perception system has evolved over millions of years in a natural fractal environment. Only recently by evolutionary time scales have we found ourselves in a primarily Euclidean environment of straight lines and few spatial scales".

- Richard Voss[1]

Human perception is strongly influenced by immediate environment. In turn, cognition is strongly influenced by perception; therefore, the models and concepts of humans are strongly influenced by their environments. For many centuries, Western culture has removed itself from nature, while many other cultures live very closely to nature. These different settings have a significant impact on perception, which in turn strongly impacts human concepts and modeling. It is proposed that energetic models of medicine (Native American shamanism, Chinese medicine, Ayurvedic medicine, traditional African medicine, etc) derive from the human mind that is permeated in nature. Nature is primarily of fractal dimensions and processes, therefore, the energetic models of medicine are suggested to be fractal-like in their approach to human health and disease.

Look around you. Yes, now, in this moment. How many straight lines do you see? Are you in some sort of rectangular box, a house or workplace building? Notice the flat, straight rectangular objects; walls, desks, tables, counters, even furniture. In whatever indoor environment you may find yourself, this is the rule rather than the exception. Most humans currently live in boxes; structures that are rectangular or square.

This is of great significance to how we perceive the world around us. Psychologists tell us that our immediate environment affects our perception. Our perception is influenced by where we live, the structure in which we live and of course, how we live. Psychologists further suggest that environmental influences go beyond perception to directly impact our behavior and cognition.[2, 3] Much of the influence on the building of our "cognitive maps", the way we structure

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and store knowledge, comes directly from our immediate environments.[4, 5]

In essence, what psychology reveals is that the ability to think is grounded in our perceptual experience. Even when more complex reasoning and tasks require us to use symbolic abstractions, our cognitive processes retain their connection to perception.[6] Moreover, we find that our perceptual world informs our abstract concepts and models of reality.[7, 8] And of course, in a circular manner, this comes back to our environmental backdrop; our perception is influenced by what we see.

Now consider how many years of life you have lived in a "box". Do you ever wonder how your perception would be different if you had grown up in a round structure, or better yet, outside where straight lines are rare and everything is in a curved, irregular form – a non-linear form?

If perception is influenced by what we see around us, and in turn we imprint on our surroundings, building our cognitive maps, models and abstractions on our environments, then the psyche is hostage to its environment. However, we rarely recognize that we are perceptual prisoners of our surroundings. As Maturana and Varela[9] put it, "We do not see that we do not see."

If we compare the interior of buildings (or even the external environments of cities) to that of nature, we see a notable difference. Straight lines are the exception rather than the rule, and the curves of mother nature are ubiquitous. The forms of trees, plants and animals are not made of straight lines. The way that plants grow and animals move is not linear, but rather non-linear. Intriguingly, what we see are fractals; a fingerprint of the complexity of nature.

Table I. Characteristics of Fractals

Self-similarity Fractals show similar shapes on all scales
Scaling Quantification is dependent on measurement resolution

The fractal character of the natural world

Fractals are geometrical forms, irregular and uneven, that reflect the dynamic rhythm of complex systems. Fractals are seen as the geometrical "footprints" of dynamical systems in complexity theory modeling. While complexity theory reveals a story about the evolution of dynamical systems over time, fractal geometry records the patterns of their movement in space. Fractals reflect the irregularity of nature, its energy, its dynamical changes and transformations. In contrast to the smoothness of artificial lines, fractals consist of patterns that recur on finer and finer scales, scale-invariant shapes of immense complexity.[10]

The non-linearity of fractals have two distinct properties; self-similarity and scaling. The self-similarity is demonstrated by fractals showing similar shapes on all scales. Scaling refers to the fact that quantification is dependent on measurement resolution. In other words, if one asks how long is the coast line of California, a fractal answer is, it depends. Different answers would be had by using a satellite photo, an aerial fly-over, a three-hundred-foot measuring tape or a ruler. Measurement is dependent on the clarity of the perceiver.

Briggs[11] points out that fractals are common – in trees, mountains, the winding of a coastline, the branching structures of plants and the scattering of autumn leaves. We may not recognize the fractal shapes of clouds, lightening and snowflakes, but nevertheless, fractals are a common theme, permeating our consciousness when we find ourselves surrounded by nature. It seems nature dances to the tune of complex dynamical systems and this is seen from one-cell organisms to galaxies.[12] The imprints of mother nature's fractal steps have provided a novel view of the secrets of nature's movements.[11] However, so complex were these patterns that they have only recently been observed due to the number-crunching

power of computers. Once recognized, the fractal signatures of the creative processes of nature's self-organizing systems awed scientists and artists alike.

As this view of fractal shapes emerged, their astonishing beauty revealed a distinguishing characteristic of life; the emergence of a hidden order out of the complexities of material foundations. Long overdue, this unique perspective united biology with physics, allowing scientists to see nature as a single, dynamic unfolding system.[13] Accordingly, the concept of emergence moved from being relegated to mysticism to a scientific phenomenon. Importantly, by their non-linear mathematics, fractals defy reductionist logic.

Table 2. Characteristics of Energetic Medicine

Self-similarity
Reflection of the whole in each part
eye ear hand foot tongue pulse
Scaling
Expression of similar patterns in all parts of the human system What expresses in the body expresses in the spirit, mind, emotions

Where linear systems are logical, incremental and predictable, and can be described by linear mathematical equations, non-linear systems can change radically through positive feedback. Non-linear systems are non-linear because they are so embedded with positive feedback loops that minute influences can cause a folding and refolding of feedback in the system that may have drastic effects. As a result, small perturbations having extraordinary outcomes as in the classic metaphor of a butterfly flapping its wings causing a hurricane thousands of miles away. These systems can go from order to chaos to order, depending on the inputs from the environment. In other words, a complex system is so sensitive to its environment that it cannot be seen separately from its environment.[11, 14] Fractals are an image of this movement.

Benoit Mandelbrot coined the term fractal in 1975. By 1980, there were just a handful of academic papers that used the term. However, by 1990 there were 5,000 papers a year with the word fractal in the title. The fingerprints of nature's complex dynamical systems permeate the minds of those who would surround themselves in a natural environment. The immensity of this infusion is the subject of increasing exploration.

The influence of nature's fractals on the psyche of humans

The human mind seems to have an affinity for fractal forms.[10, 15] Taylor *et al*.[10] found that participants in visual perception tests displayed a preference for fractals. Aks and Sprott[15] found a similar preference for fractal forms and postulated that this may be due to the continuous visual exposure of our ancestors to natural environments. Richard Voss [1] supported this view when he stated, "The human perception system has evolved over millions of years in a natural fractal environment. Only recently by evolutionary time scales have we found ourselves in a primarily Euclidean environment of straight lines and few spatial scales".

So one can not help but ask the question, how are those cultures that have been steeped in a natural environment different than ours? Will their constructs and models of the world reveal differences between minds infused in linear environments versus non-linear environments? After all, if we are influenced as profoundly by our environments as psychologists suggest we are, it follows that this would be quite notable in cultural perspectives.

Ancient humans were infused in an environment

rich in fractal shapes and processes,[1] their psyches imprinted on these patterns. In this way, their perception was profoundly swayed towards non-linear patterns, thus influencing their cognitive processes. As a result, their constructs and models were informed by their non-linear environments and non-reductionist perspectives. And, of course, these models and constructs should therefore reflect their fractal-rich environments.

The intriguing study by Taylor *et al*.[10] demonstrated not just a preference for fractal images over non-fractal images, but also that non-fractal images added futher stress to participants asked to do mentally challenging tasks. Moreover, they found that a fractal image actually dampened the stress response due to these demanding tasks and improved recovery time between tasks. Of great interest to neuroscientists, when Mandelbrot first introduced the concept of fractal geometry, he hypothesized that the fractal and Euclidean shapes might be processed in different regions of the brain due to their differing visual qualities.

Perhaps this has something to do with different perceptions of peoples raised in nature and those raised in cities. Lesmoir-Gordon *et al.*[16] points out that ethnographers now recognize that traditional African societies are subconsciously modeled on fractal forms. The branching of streets and the recursive rectangular enclosures and circular dwellings of traditional African villages reveal clear fractal patterning. Additionally, much of what is associated with the non-Western cultures – humility in dealing with nature, the richness and diversity of life, the generation of complexity from simplicity, the quest to understand the whole to understand a part – are intrinsic in many other culture's worldviews.[14] This may be due to humans imprinting (or even a form of entrainment) on fractal forms.

The theology of these non-Western cultures also reflect the chaotic fractal patterning of nature. In Buddhism and Sufism, self-looping contradictory statements consume the minds of students in order to transport them to the edge of chaos and then to enlightenment, through a self-reorganization of the psyche. Thus, the teacher perturbs the mind to stimulate the mind's understanding of truth and falsehood, while continually folding back on each other.[14]

Notably, the theme of self-organization that runs throughout complexity theory is the opposite of the hierarchical systems that proceed from top to bottom.

In complex systems, structures originate from the bottom up, leading to an emerging order where the structure of the higher level presents as a new quality of the system.[17] This reveals an interesting potential for political reorganization, and brings to mind the bottom-up formation of the first democratic culture ever formed in Greece.

The fractal nature of energetic models of medicine

Additionally, an area of significance to all cultures is health. In the west, we have created a model dependent on quantification; in the traditional healthcare systems of non-Western cultures, health models are largely qualitative. These models are often referred to as "energetic" models of medicine. Those cultures in close contact with nature developed a model of the human system inspired by the fractal phenomena of their surroundings.

The biomedical model associated with Western culture has been largely free of 'qualities' ever since Galileo banned such input from the field of science itself.[18] Alfred North Whitehead expresses the quantitative focus of Western science in general when he suggested that the hunt for measurable elements

Table 3. The Similarities of Energetic Models of Medicine

Fractals	Energetic Models of Medicine
Self-similarity	Self-similarity
Scaling	Scaling

among phenomena, and the search for relations between these measures of physical quantities, has been the essence of modern scientific procedure.[19] A medical system that is concerned only with quantity and based exclusively on measurement is inherently unable to deal with experience, quality, or values. Moreover, by default, quantitative models are inadequate for understanding perception, since perception is a central aspect of our inner world and therefore, an experience.[18]

The non-linearity of energetic models of medicine, on the other hand, make room for quality, soul, perception, spirit and human experience. In true fractal form, energetic models of medicine emphasize the repeating nature of human processes and relationships. For example, the energetic pattern of the human system is believed to be repeated in all parts of that system; the reflection of the whole in each part is actively utilized diagnostically. The pulse, tongue, eye, etc., are seen as reflecting the dominant pattern of both the physiology and psychology of the system. Energetic models of medicine also make use of scaling. What expresses in the body is also seen to express in the different levels of being – the emotions, the mind and the spirit.

Energetic models of healthcare have arisen not from the primitive minds of native cultures, but from the native mind that is non-linearly oriented. As such, these "alternative" medical models are beginning to catch the attention of scientists as they recognize that these models cannot be explained in linear terms. Looking at shamanism from a linear perspective is like trying to explain cyberspace to a person from the 1940s. There is little frame of reference to provide insight into such paradigms.

It does seem that Western biomedical models are catching up to non-linear systems of medicine: The application of complexity theory and non-linear dynamics to problems in biology has resulted in a growing body of advancements.[20] Bassingthwaighte *et al.* [21] suggest that capturing the richness of physiological structure and function in a single model presents one of the major challenges of modern biology, and fractals offer the hope of doing just this. They suggest that through the phenomenological description of bodily processes, fractals provide insight into physiological mechanisms. For example, Bahrami *et al.*[20] have demonstrated that the brain functions as a complex, non-linear system. Using the fractal dimension of the electroencephalographic signal in a manic episode of bipolar patients (type I) they were able to draw, for the first time, a clear objective distinction between normal and abnormal mood and associated brain states. This breakthrough is based on the same non-linear mathematical equations that give rise to fractals.

Cerruti *et al*.[22] found that non-linear algorithms of physiological signaling, despite the greater methodological and computational complexity, performed better than linear algorithms. They found enhanced physiological insights and clinical viewpoints from non-linear algorithms. Weng *et al*.[23] suggest that since the origins of many human diseases, including cancer, diabetes and neural disorders, are found in physiological signaling, better insights into this complex process are likely to result in enhanced treatments. Weng goes on to predict, true to fractal form, that understanding complex signaling networks will facilitate an improved elucidation of molecular interactions of humans and their environments.

What is of interest as science 'discovers' ancient reasoning is that such modeling and subsequent per-

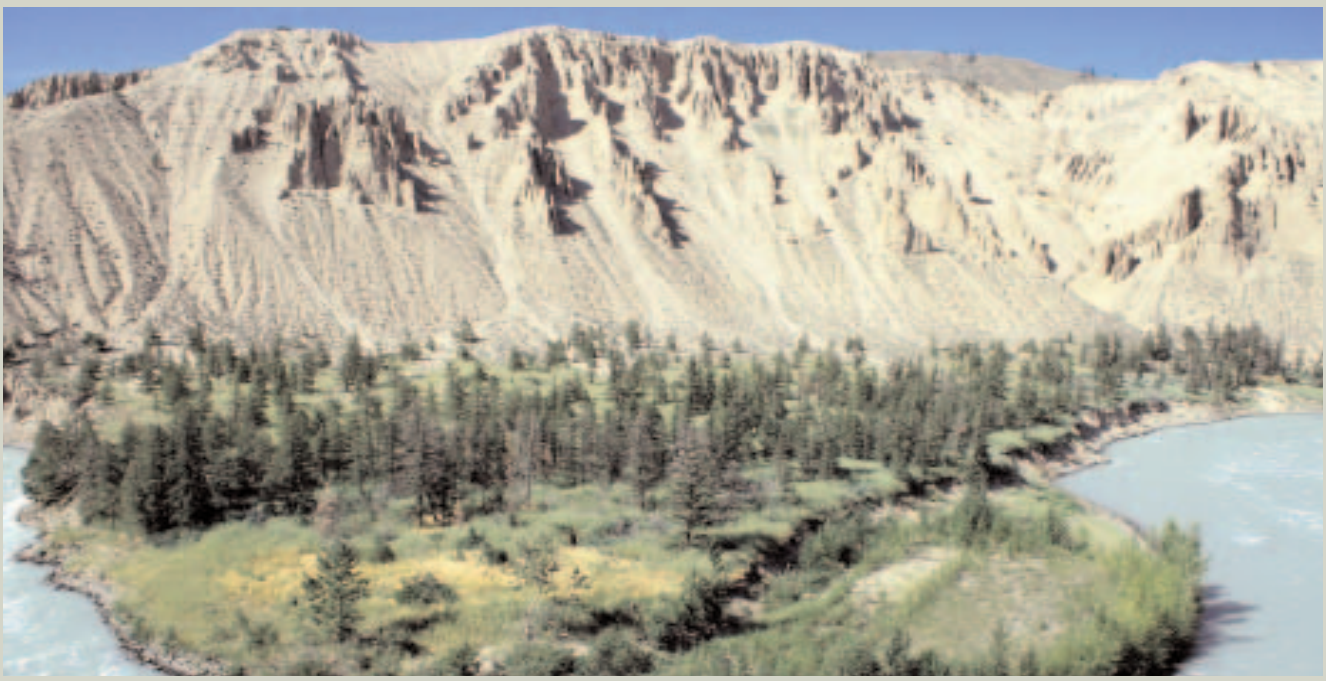

Table 4. Biomedicine Discovers FractalCharacteristics

From Bassingthwaighte *et al*.[21]

Self-similarity
DNA
Ion channels
Linings of intestine and placenta
Branching patterns of neural dendrites and vessels
Binding of ligands to enzymes
Scaling
Diameter of bronchial passages
Length of transport pathway through the junctions between pulmonary endothelial cells
Time course of chemical reactions
Clearance curves measuring decay of substance in plasma

spectives have been around for at least 5000 years in systems of philosophy and medicine such as Native American shamanism, Chinese medicine and Ayurvedic medicine. As humans seek further understanding of their condition - their politics, their social order, their family structure, their health, and themselves - they are finding that the same system-level laws governing for instance, cell biology, represent a pattern common to complex systems and networks in general.[24]

The “noble savage” in his non-linear cognition has always recognized, and indeed, been respectful of life as one self-repairing ordered system. Yet scientists have just arrived to recognizing biology as one huge interactive, evolving ecosystem which demonstrates self-organized criticality.[25] With such a perspective, hopefully, we may now avoid the oversimplification that is typical of reductionist linear modeling. In such oversimplifications we cannot see such important non-linear phenomena such as entrainment, modulations, on-off modes of responses, variable gains, threshold and saturation characteristics, etc.[22]

Through the understanding of complex processes and expanded perspectives that go beyond the dogmatic scientific perspective of prediction and control of nature, we are realizing a relationship of participation in natural processes.[13] Complexity theory and her beautiful fractals, in bringing together scientists of all disciplines, allows us to see the creative fabric of natural processes as a single dynamical interactive dance of all species.[13] We are seeing that we are all cut from the same fabric. But perhaps most importantly, complexity theory and her fractals are giving us a respect for native values, a more profound view of our universe, and of our place in it.

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