

Determinism and Randomness Always and Only Coexist

 Posted on 21 February 2012 by [cjf](#)

It may be that the presumed dichotomy between determinism and randomness is superficial and illusory. [Determinism](#) is the world view that events result from an unalterable causal chain. It models the world as a clock whose behavior can be inferred by scientific investigation. [Stochasticity](#) or [randomness](#) is the world view that uncertainty pervades experience. It models the world as a dice game with unpredictable behavior.

Many thinkers including [Einstein](#), [Buckminster Fuller](#), and [D’Arcy Wentworth Thompson](#) have argued in support of the traditional deterministic world view[1]. However, Quantum mechanics, machine learning, and behavioral economics are three prominent areas which have helped realign modern thinking to apprehend that [randomness and uncertainty may be fundamental and pervasive](#). [Leonard Mlodinow in a 2008 book goes further and argues that randomness rules our lives](#).

In preparing for and [discussing randomness at a recent meetup of the Ben Franklin Thinking Society](#), I started to gravitate to the hypothesis that uncertainty and determinism may be like inside and outside or concave and convex. They may be both real, both partially right and partially wrong, both revelatory and misleading. It may be that each perspective is a “tuning in” to only part of a reality that is *both-neither*[2].

The principle of functions states that a function can always and only coexist with another function as demonstrated experimentally in all systems as the outside-inside, convex-concave, clockwise-counterclockwise, tension-compression couples.

— R. Buckminster Fuller, Synergetics [226.01](#)

Here are several ways to see the dual and co-occurrent qualities of the stochastic and deterministic models or world views.

In a deterministic model of the world, the fixed set of laws that govern everything apply to every quanta of energy or their constituents. So computing the state of the world requires applying these fixed laws to each such quanta from some initial state and iterating through each [picosecond](#) of time. Clearly, this is computationally infeasible except for the computer known as *Universe* itself. So any effective simulation or calculation will entail estimates and approximations, that is, randomness. Unwittingly, randomness imposes itself into the system!

Conversely, in a stochastic model the relationships between data are given by frequencies with respect to their [sample space](#), the set of possible outcomes. What could be more deterministic than the elementary counting of frequencies? Indeed [probability](#) is basically a form of advanced counting in ratios. Deterministic indeed!

Now consider [measurement](#). The basis of a scientific model involves measurable parameters. Data are measurements. Science has determined that all measurements involve uncertainty. MIT physicist [Walter Lewin](#) puts it emphatically: “any measurement that you make without any knowledge of the uncertainty is meaningless!” Measurement theory is built upon the [law of error](#) which is a principle of the science of randomness. Hard data acquires its validity and persuasiveness from the science of chance!

The key to understanding measurement is understanding the nature of the variation in data caused by random error.

— [Leonard Mlodinow](#)

On the other hand, the law of error is a central principle in [statistics](#), the science of inferring probabilities from observed data. Such inference is the gold standard of scientific truth. The techniques of scientific inference are based on the mathematics of randomness. Like all mathematics, the theory is definite, rigorous, and repeatably verified by logic, proof and experiment. The sciences of probability and statistics are rigorous and deterministic like all mathematics!

Even in a fundamentally deterministic world, our understanding, decision-making, strategies, predictions, measurements, and designs are predicated upon uncertainty and randomness. To be effective we must be cognizant of these lingering unavoidable uncertainties.

Conversely, even in a fundamentally uncertain world ruled by randomness, pattern and order emerge and can be identified. To be effective we can and should seek the design and structure permeating through the apparent randomness.

From these considerations, I conclude that randomness and determinism always and only coexist. They are inseparable. Each provides a spectacular, incisive perspective on reality. The careful thinker or practitioner should be facile in using both types of models to get a more wholistic, more complete picture of the world in which we find ourselves. This is evidence that *both-neither* should be our guiding principle in seeking truth!

Do you find the argument compelling? Is it sound? Can you help me improve it? Do you see other ways in which these two models interpenetrate and interaccommodate? How do you see the interrelationship between determinism and randomness?

To better develop my understanding of a more complete set of models (beyond superficial determinism vs. stochasticity), I am excited about [Scott E. Page](#)'s new and just started on-line video course on [Model Thinking](#). I think we need many diverse models to sharpen our thinking and uncover subtleties in the complex systems and theories upon which our civilization is built. I am looking forward to wrapping my head around the 21 or so models in this course. You can register for the Model Thinking course by filling out the form at <http://www.modelthinker-class.org/>.

So if you want to be out there helping to change the world in useful ways, it's really really helpful to have some understanding of models.

— Scott E. Page

Finally, here are three good audio-visual resources that explore issues of randomness further:

- [Radiolab's exquisite podcast on Stochasticity](#).
- [World Science Festival: The Illusion of Certainty: Risk, Probability, and Chance](#).
- [Persi Diaconis' talk "On Coincidences" \(scroll down near the bottom where the 1998 lectures live or search for Diaconis\)](#).

[1] [Click here to read my previous essay on randomness where arguments for determinism are discussed](#).

[2] Credit to [Tom Miller](#) for the wonderful expression *both-neither*.

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3 Responses to “Determinism and Randomness Always and Only Coexist”

1. [Todd Walton](#) on 21 February 2012 at 5:11 pm



CJ: This was a wonderfully concise elucidation of that part of the spectrum, so to speak, that we're able to see/intuit/guess about, as Bucky might say. Myriad (as in thousands of) life experiences suggest to my wholly subjective self that randomness is an illusion fostered by our perceptive limitations, but I dunno. This is a very good think piece, as the media peeps would say. Kudos.

[Reply](#)

2. **Don Briddell** on 22 February 2012 at 12:22 am

CJ,



You've chosen a classic discussion.

The universe has a constant called “Planck's constant” that allows for determinacy in any equation involving mass and energy. It says there is a discrete amount of

energy below which energy cannot found. This says our universe has a fixed unit energy. Chalk one up for determinism. The universe it seems is a series of fractal iterations that builds from the Planck scale to all other scales. This is what my work with Fieldstructures is telling me and it is suspected by others I've run across, particularly those working in astrophysics who see fractal relationships in the cosmos. While I see determinism in physics, I see what is being called "randomness" to be the metaphysics of our world experience.

So what is metaphysics and why is it appear to be the joker in the court of heaven? To understand metaphysics, really understand it, is not possible with a word discussion, or even thought word concepts. By definition, metaphysics is non-physical, does not refer to field objects (things of any kind). Metaphysics is the field and physics are field objects. You cannot know a field by a study of field objects. If you could physics would have the unified field theory by now. It doesn't have it, because it is using field objects to study fields, which is like studying a knot to understand the string. That which is knotness has nothing causal to do with stringness. The knot can disappear but not the string.

We experience knotness (physics) from our encounter with field objects and we experience metaphysics from the field. The field is not a locality. Field objects are localities. Fields are totalities. That makes field objects subject to the dynamics of a field. Since field objects are unaware of, or unable to function as, a field, they experience what seems like randomness, arbitrariness, unpredictability, probabilities, etc. This is because a field object is not acting from the perspective of the field, so what happens in the world seems chaotic and random.

There is a solution to this dichotomy. It's called "Multiple Certainties" and replaces "Uncertainty" with determinism that allows for multiple choices, but with each one correct. This can be modeled with Fieldstructures.

Don

[Reply](#)

3. [Tom Miller](#) on 23 February 2012 at 1:53 pm
CJ,

I am so glad that both/neither has proved valuable to your explorations.



You explained the both but did you explain what is the neither state? To me that is the key to understanding these duality puzzles. Joe Clinton has convinced me that looking for singularities is short-sighted and the idea of 'deeply-congruent-dualities' are what we have defined as singularities. It is my basic assumption that there is never just one way or one 'thing', like you said earlier, the reliability of natural structures grows out of a diversity of options.

We have an original couple and they produce an off-spring. What produced the original couple? What is the opposite of an off-spring, an on-spring? Some kind of 'pre-existence-condition', a set of 'unforgettable bits of useful information' that allow any cycle of growth to start-all-over-again structurally?

Fuller has his Isotropic Vector Matrix as the answer to this question. The key word is matrix from the Latin word for womb. The minimum definition of matrix is that which gives order and form to something. Maybe a more contemporary name would be the Initial Growth Matrix.

The great thing about the study of geometry is the ‘neither’ state between thoughts and things is structure. The study of all of the big-picture-interconnectedness inside this Initial Growth Matrix gives us a way to think about how structure came into existence and by extension, how thoughts and things started as well. That is why New Tools Lab defines and measures basic geometry as an origin myth.

We are pioneering the use of the science-art-math hybrid of ‘scientific folklore’. This technique uses the powerful cross-referencing abilities of scientific method and repeatable experimentation to develop a body of hard scientific data on which you can build an origin myth. Instead of saying this data shows you a ‘what is’ that is always true, we tell a story that shows the model-dependent-realistic interconnectedness among the parts in the story but leaves it to the observer to decide, using their own experience, what is important to remember from the story-myth.

How Did Structure Begin? Myth

Our “On-Spring” is the field that Don Briddell talks about. It is ‘oneness’, a kind of interconnectedness beyond the wildest reaches of the human imagination. No time, no size, no measure and most important no choice because no ‘alternative’ can exist in ‘all-knowing-1-ness’. “On-Spring” has a deep ‘yearning’ to choose so ‘it’ all-knowingly-forgets enough of its 1-ness to create a field of limitations and doubt. Only an awareness like us, full of limitations and doubt, can have the ability to choose.

Why are we here? We are here to develop our ‘choosing abilities’ in a field of doubt and limitations. More specifically relative to contributing to the bottom-up structural reform of our planet, we are here to develop each of our unique useful-choice-self-innovation techniques. This is a method of exploration that sets up a learning environment around any critical path organization of effort that constantly offers opportunities to learn how to ‘do-more-by-using-less’. Even doubt has its limitations.

There is a ‘Thread of Structural Wisdom’ that connects our everyday life to this ‘genealogy of initial growth’ we call the Initial Growth Matrix. This imaginary thread is so small that it is always less than the smallest measurement. It is the ‘thinnest-thickness-possible’. This Thread of Structural Wisdom is where “On-Spring” exists in our lives and maybe we feel it as our intuition and/or instinctual drives. The raw material of our existence is this ‘persistence of memory’. The primordial first-tool On-Spring embedded in this structural memory is a ‘passion for learning’. This could be is the deeply-congruent-duality that gives the possibility of structural order to any location.

Basic geometry begins when we tie a knot in the Thread of Structural Wisdom creating a cut-off-knot bellybutton. Inside this knot is an all-purpose-center-of-everything, the first ‘something-definite-location’ in a field of doubt and limitations. All we have to do is choose what will be our first sphere, our me-ball.

The radius of that sphere is our scale number and BLAM! the Initial Growth Matrix bursts out in-all-directions-all-at-once tuned to our special case time and size.

Karl Popper had great insight into what does science tell us. Scientific method and repeatable experimentation tells what is 'less-not-true' than anything else that currently exists. We still know so little about the nature of our total scheme of things that searching for truth-like substances that are useful in solving problems is a much more realistic assumption than the Greek ideal of the search for absolute truth that is always true. Maybe that is the essence of the order/randomness puzzle.

If Fuller is right and thoughts have a shape and thinking has a geometry then knowledge has a technology and structure has a language. What do we mean when we say we 'know' something? We mean we remember learning something in the past. There is a structural technology embedded in the matrix that allows each observer to explore how they remember and what are the assumptions that define what is important to remember. Maybe this is the context for the exploration of order/randomness.

Finally, Fuller gives us the physical models to explore this geometry of thinking. His theory of the Closest Packing of Spheres made of ping pong balls defines the first cycle of growth of the matrix because on the third outside layer of balls there is enough space to accommodate 8 new centers. This is a rational, logically-consistent and comprehensive model of the first limit of influence of a center. Whether it really is 'what is' is not important. It is a good push-off start location to begin to explore from a generally accepted structural constant. The quantum is our chosen sphere and any measuring system of structural order must have a simple quantum relativity meaning all measurements (linear, angular, volume) are relative to one sphere with a particular radius. This version of the matrix speaks a 'sphere-speak' language.

Fuller's other great advance in geometrical structural order is his interconnected Tetra-Volume tuning of all-volumes inside the matrix. This is a useful-choice-self-innovation in the development of structural language evolving 'tetra-speak'. Define the edge of the tetra as the maximum reach structurally of any center expressed as a linear measurement in the ping pong ball matrix. The volume inside that 6 radii length tetra is 1 tetravolume (TV). This allows us to explore the modular, self-organizing abilities of big-picture-whole-system volumes. The quantum is this maximum-length-tetra and it tunes the simple quantum relativity of any rational volume inside the matrix.

Wow, I started with the intention of a quick rely and all of this poured out of me. I guess I felt safe in this environment to let it flow. I have no idea if I was able to communicate a single thing coherently.

tom miller

[Reply](#)