

“*Constructive Skepticism*” Volume 3 – Notebook #I: *Model Risk*

Chapter 3: From “*Existential Meaning*” to “*Statistical Significance*”

*Mielewczik & Moll*’s paper, reviewed in Chapter 2, moved the discussion about “*Iron in Spinach*” from *Sutton*’s search for a culprit as discussed in Chapter 1 to the development of an analytical framework to discover the presence of “*Willful Ignorance, Error & Deceit*”. This framework has two components: The first component addresses the presence of functionality that researchers can measure. The second component addresses the presence of preferences held by the “*Decision-Maker*”.

This chapter continues the development of this framework with the addition of “*Tools, Checklists & Processes*” that include “*Statistical Significance*” [Finding a meaningful answer to the measurement problem] and “*Practical Significance*” [Finding a meaningful answer to the preference problem]. Problems develop because “*Measurements, Functionality & Form*” obey the rationality of “*Small Worlds*” subject to “*Axioms, Assumptions & Hypotheses*”, but “*Decisions, Preferences & Desires*” follow the irrational exuberance of a “*Large World*” subject to “*Arbitrariness, Randomness & Chaos*”. Fortunately, we have “*Tools, Checklists & Processes*” to manage the resulting “*Willful Ignorance, Error & Deceit*”. This chapter presents the development of these “*Tools, Checklists & Processes*” starting from first principles.

**Rodolfo LLinás**

This review of first principles starts with **Rodolfo LLinás**, and his 2001 book titled “*I of the Vortex: From Neurons to Self*”. Born in Bogota, Columbia, **LLinás** became a medical doctor in 1959. He earned his first Ph.D. on the circuit analysis of the visual system using multivalued logic in 1965, from the Australian National University. His second Ph.D. focused on the physiology of the cerebellar cortex.

Starting in 1976, he became the Chairman of the Department of Physiology and Neuroscience at the School of Medicine of New York University. His autobiography shows the development of a step by step understanding of what “*Brains*” do. This begins with the electrophysiology of single neurons in the 1960s, moving up to the behavior of groups of neurons in the 1980s, and culminating with the functional architecture of the “*Brain*” based on experiments based on magnetoencephalography in the 1990s.

**LLinás** uses the example of the “*Sea Squirt*”, a living creature that eats its own brain when, in the unique course of its life-cycle, it transitions from a mobile, animal-like creature to a sessile, plant-like creature:

- “*The lesson here is quite clear: the evolutionary development of a nervous system is an exclusive property of actively moving creatures.*”, and

- “*The nervous system has evolved to provide a plan, one composed of goal-oriented, mostly short-lived predictions verified by moment-to-moment sensory input.*”

“*Brains*” support the development of internal, mind-maps of the external environment in order to navigate it. The survival value that comes from the ability to perform “*Motions*” justifies the evolutionary expense that comes with the development of a “*Brain*” that makes “*Predictions*”.

**Llinás** showed that the ability to make “*Predictions*” starts at the level of individual neurons with differences in slow vs. fast responses to stimulation, and that our brain does not work as a continuous processor because the computational overhead would overcome its capacity. Instead, the brain makes “*Predictions*” across several, nested mind-maps with different scales of sampling time, and motor output. Thus, **Llinás** sees the mind as a self-referential, closed-system emulator of reality with built-in ancestral pre-sets.

“*Mindness*” & “*Brains*” evolved to manage “*Motions*” between moving individuals & their “*Task Environment*”. Consciousness appears intrinsic to shared evolution, and memory appears to come from individual adaptation. Our “*Sense of Self*” develops in the measure of the centralization of “*Predictions*” in the “*Brain*”.

This led to his description of the functional architecture of the “*Brain*” as follows:

- Sensory “*Perceptions*”,
- Amplification of “*Perceptions*” (Emotions provide context for “*Predictions*”),
- Goal-oriented “*Predictions*” (Short-lived, transient decisions), and
- Guided “*Motions*”.

**Llinás** sees “*Brains*” as capable & understandable rather than complex & mysterious. He developed this view from an understanding of electrical engineering, and mathematical models of biological oscillations & resonance, and the empirical study of the electric potentials of neurons, leading to the discovery of internal & continuous frequency oscillations that enabled the mapping and the interpretation of the functional architecture of the “*Brain*”.

Looking for first principles with **Rodolfo Llinás**, we learned that physical timing difference between fast and slow neurons started an evolutionary developmental cascade. The end-result of this developmental cascade turned into the functional architecture of the brain, summarized as follows:

- “*Brains*” exist to manage “*Motions*” through “*Predictions*”.

This functional architecture of the brain turns us into goal-driven individuals, as we make “*Predictions*” about many things, including “*Directions*” [Ours, and the other movers’ around us] in order to manage our own “*Motions*”.

### **Viktor Frankl**

This search for first principles continues with the work of **Viktor E. Frankl**. Born in Vienna in 1905, **Frankl** became a doctor of neurology. Based on his personal knowledge of, and disagreement with **Alfred Adler** and **Sigmund Freud**, he developed a distinctive view of psychology based on “*Meaning*” instead of “*Power*” (**Adler**), or “*Desire*” (**Freud**).

Caught in the Holocaust during WWII, he survived, and was 40 years old when the war ended. His background in psychology, and experience of the concentration camps led him to continue the development of his own school of psychology, Logotherapy, in ways that resonated deeply with leaders, and readers at the time. His writing, starting with his first book published in German in 1946, and titled “*A Psychologist Experiences the Concentration Camp*” with its English translation first published in 1959, and titled “*Man’s Search for Meaning*” continues to resonate deeply with readers.

**Frankl** touched something foundational in the human experience, and turned it into healing from “*Meaning*”. **Frankl** saw that what we now know as **LLinás**’ goal-oriented functional architecture for the brain makes us seek “*Existential Meaning*”. We need goals to orient ourselves, so that “*Brains*” can do what they do: Managing “*Motions*” through “*Predictions*”.

Thus, “*Brains*” rewards us, and to the foundational core of our being, for finding hard-to-see patterns in the chaos of life. This creates a structural problem for Model Risk in research papers. We live to find, and we survive by finding meaningful patterns in the “*Arbitrariness, Randomness & Chaos*” of life.

This means that what we want to see can turn into runaway “*Decisions, Preferences & Desires*”. Fortunately, we can use this same goal-oriented drive to turn patterns against themselves. “*Small Worlds*” models based on formalized measurements reduce the scope of our foundational drive to see patterns in the “*Large World*”.

However, these models reduce our vision to statistical patterns from the “*Small Worlds*”, at the cost of accepting limiting “*Axioms, Assumptions & Hypotheses*”, a form of “*Willful Ignorance, Error & Deceit*”. Managing “*Motions*” with “*Predictions*”, and making good decisions as a “*Prudent Exchange of Risks*” based on research results derived from such models require a clear view of the limitations created by the “*Axioms, Assumptions & Hypotheses*”.

**Viktor Frankl** simplifies the analysis of the clinical ambiguity associated with the “*Decision-Maker*” by making a distinction between “*Decent*” people and people that are not. “*Decent*” people know that the “*Ends*” do not justify the “*Means*”. People that are not “*Decent*” believe that the “*Ends*” justify the “*Means*”.

Making good individual, business & investment decisions recognizes that the “*Ends*” do not justify the “*Means*” because some means will destroy the value of the best of intentions. **Frankl**’s distinction applies to model measurements as well as “*Decision-Makers*”. In the case of models, making good decisions recognizes that proving the presence of a desired “*Effect*” does not justify the use of statistical “*Tools*” in ignorance, or violation of their “*Axioms, Assumptions & Hypotheses*”.

This application of **Frankl**’s criterion of decency to models brings us from “*Existential Meaning*” to “*Statistical Meaning*”: At what point, in a decent model, does a pattern rise above the level of random noise to become a statistically meaningful pattern?

### **Richard Prum**

At what point, in a runaway preference for subjective “*Meaning*” does the noise of “*Randomness*” start to sound like a objective melody? **Richard O. Prum**, an evolutionary ornithologist at Yale University, explains how he measured changes in such subjective preferences by tracing the evolution of bird ornaments, e.g. song, plumage, and behavior, over time to show that species and ornaments co-evolve, a process of adaptation by Natural Selection complemented by a process of Aesthetic Evolution. The process of subjective Aesthetic Evolution complements the process of physical Natural Selection, and refers to **Charles Darwin**’s 1871 book titled “*The Descent of Man and Selection in Relation to Sex*”.

In his 2017 book titled “*The Evolution of Beauty, How Darwin’s Forgotten Theory of Mate Choice Shapes the Animal World – and Us*”, Prum explains why, and how the scientific community has focused on the physical process of Natural Selection at the expense of the subjective process of Aesthetic Evolution. He also explains why the subjective process of Aesthetic Evolution experiences a resurgence, and how it applies to domains of knowledge other than ornithology: From one generation of birds to another, Aesthetic Evolution reinforces a subjective, arbitrary choice that eventually becomes detached from its original intrinsic value.

The form of beauty in ornithology, the physicality of the birds’ ornaments, may have started as an honest display of evolutionary advantage. This theory has the name of Natural Selection. However, **Prum** shows that the subsequent desire for these ornaments shaped them as a subjective, and arbitrary runaway process. This theory has the name of Aesthetic Evolution.

Using the example of the Great Argus (A type of pheasant) and its extreme ornaments, **Prum** points out that the exuberance of subjective experience - the “*Desire*” for meaning from arbitrary subjective choices - can run wild, and its impact on evolution from Natural Selection – the “*Form*” of adaptive physical change – can run away to maladaptive extremes before it hit the brick wall of extinction. **Prum** helps us see the connections, and differences between the “*Measurements, Functionality & Form*” and the “*Decisions, Preferences & Desire*”.

**Prum** brings up many interesting points in this book, but one seems particularly relevant for the field of finance. He starts with the observation that Natural Selection works on the basis of direct functional costs: One reproduces or not. He then continues with the description of the physical degeneracy that develops at the level of the species such as the Club-winged Manakin because the increasing cost of their maladaptive aesthetic choices (akin to debt financing) are deferred to the next generation. This deferral of maintenance costs to the next generation causes the population to degenerate further over time, and with no visible checks-and-balance, or self-correcting mechanisms, other than evolutionary collapse or financial bankruptcy.

**Prum** also makes the general observation that when opportunities for choice develop, preferences follow, and over time arbitrary signals communicate no other information besides their presence. Model Risk from runaway ideas, similarly to risk from Aesthetic Evolution comes from maladaptive subjective preferences. His theory of Aesthetic Evolution creates a useful analogy that one can apply to other domain of knowledge, such as financial planning and portfolio management. Aesthetic Evolution explains subjective, arbitrary, and potentially harmful runaway beliefs such as “*Spinach*”, and ideologies.

**Prum** then asks the important question: How can we stop this runaway process? Fortunately, humans, unlike the Club-winged Manakins can turn the subjective, arbitrary, and random power of Aesthetic Evolution on itself with quantitative “*Methods*” designed to limit the power of such flights of fancy. Statisticians have developed “*Methods*” such as Hypothesis Testing to ensure model decency.

Prum’s view of such “*Methods*” develops from asking two other questions:

- First: Who should bear the burden of proof: Should the assumption of an honest signal from Natural Selection bear the burden of proof, or should the burden of proof rest with an assumption of randomness from Aesthetic Evolution?
- Second: What is the nature of the burden of proof: Should the assumption of an honest signal from Natural Selection, or should random signaling from Aesthetic Evolution become the “*Null Model*” for hypothesis testing?

He points out that, in his field, one should always start by testing subjective, arbitrary signaling from Aesthetic Evolution as the “*Null Model*” before testing for the presence of an “*Effect*” from Natural Selection. Many research papers do not take this first step, and instead assume the presence of “*Effects*” from Natural Selection. This creates a structural bias from research design.

Many research designs do not test for the “*Null Model*” with the relevant random hypothesis but instead assume the presence of a non-random “*Effect*” as their default view of the world. These research designs become artificially protected from invalidation through “*Statistical Significance*”, because they preordain the presence of an “*Effect*”. Any negative results just means that the researcher did not work hard enough, and do not get published.

Thus, **Prum** believes out that a good research design in his field would start with trying to reject Aesthetic Evolution as the “*Null Model*” [The hypothesis of the presence of arbitrary Aesthetic Evolution as the driver for changes in bird ornaments]. However, such a rejection would not prove the presence of a specific “*Effect*” [The hypothesis of the presence of Natural Selection as the driver for changes in bird ornaments]. The proof of a specific “*Effect*” would have come from testing a specific cause-and-effect theory.

**Prum** calls his observations a “*Null Model*” Revolution, and gives examples of fields where it happened. He also shows how these “*Null Model*” Revolutions proved fruitful for these “*Domains of Knowledge*”. If we took his “*Null Model*” Revolution to the financial industry, the equivalent of Aesthetic Evolution as the fruitful “*Null Model*” would likely become **Ergodicity Economics**’ “*Noisy Growth*” model where prices move as a random and intrinsic behavior of a growth rate instead of external causes.

The next chapter will detail the development of hypothesis testing, and how it started in 1925. It will explore how its double-negative logic [We can only reject the “*Null Hypothesis*”], its assumptions and matching need for user-selected critical values and test distribution, as well as its reliance on user calculated test statistics make its valid use the exception rather than the rule. These foundational problems have become a driving source of “*Spinach*” since the second half of the 20<sup>th</sup> Century because software-driven, mechanical applications as a short-cut solution to its complexity have led to a pervasive problem of reproducibility of results, and recommendations in the Social Sciences.