Socionomics and Fibonacci:
THE GOLDEN RATIO GOVERNS LIFE, BEAUTY AND THE UNIVERSE
By Euan Wilson

Sometimes a little review is helpful. This month we take a step back and look at one of the mathematical components of the science of socionomics.

Socionomics goes beyond the what of human events to pursue the deeper question of why. Why does mood wax and wane? Why does history seem to repeat itself in patterns? Why were hemlines higher last year? Part of the explanation is our proposal that fluctuations in social mood exhibit a ratio that also orders our DNA and galaxies.

We speak of course of phi, the Fibonacci, or golden, ratio (1.618 and its inverse .618) and the sequence from which it derives (0, 1, 1, 2, 3, 5 … ). For centuries, scientists have documented the appearance of this ratio and sequence in the human form, flowers, architecture, music, branching systems and so on. Ralph Nelson Elliott’s publisher, investment advisor Charles Collins, first pointed out the connection between the Wave Principle and the Fibonacci sequence, and Elliott published their findings in 1940. Robert Prechter further developed the connection to nature, especially biological systems, in his 1999 book, The Wave Principle of Human Social Behavior (HSB). He noted that the most basic structure of the Wave Principle, five waves followed by three waves, is the minimum number of moves required to accomplish growth with fluctuation. In this sense, then, the Wave Principle is the most efficient model for coincident progress and dynamism.

This month we present new findings that further indicate the ubiquity of the Fibonacci sequence and the golden ratio in the universe. We review some previous observations and make a few conjectures along the way. First, a brief review of the Fibonacci sequence and the golden ratio, phi.

The Fibonacci Sequence and the Golden Ratio
In 1202, Leonardo of Pisa, also known as Leonardo Fibonacci, brought knowledge of the Fibonacci sequence from the Arab world to Europe. The sequence begins with the numbers 0 and 1. After 1, each number is the sum of the preceding two: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, and so on.
Several mathematical properties make the sequence remarkable. The quotients of each successive pair of numbers is a number progressing toward a constant, \( \phi \). \( \phi \) is an irrational number equal to roughly 1.618, and is named for Phidias, architect of the Parthenon.

Expressed as line segments (see Figure 2), any two adjacent Fibonacci numbers show the same ratio of the smaller segment (b) to the larger (a) as the larger segment (a) to the whole (a+b).

![Figure 2](Image)

Note that any additive sequence begun with any two numbers (that is, not only 0 and 1) will yield successive quotients that converge toward \( \phi \). For example, -1 and 8 begin the sequence -1, 8, 7, 15, 22, 37, 59, 98, 157, 255, 412, 667, 1079, etc., and 1079/669 = 1.618. Thus, \( \phi \) is a mathematical constant of all such sequences.

**Logarithmic Functions Govern Efficient Natural Designs**

The Fibonacci sequence and the shapes associated with it grow according to logarithmic functions. These functions, spirals in particular, are found throughout nature.

The fastest animal on earth is the Peregrine Falcon, which dives at over 200 miles per hour to capture its prey. It plummets not straight down but in a spiral, widening by a constant factor. In a paper published in 2000, Dr. Vance A. Tucker of Duke University points out that to maintain constant vision of its prey, a straight-diving bird would have to cock its head to the side. He observes:

> Although the spiral path is longer than the straight path, a mathematical model for an ‘ideal falcon’ shows that the falcon could reach the prey more quickly along the spiral path because the speed advantage of a straight head more than compensates for the longer path.¹

By employing a logarithmic spiral instead, the bird maintains top flying speed, shortest time of descent and the ability to constantly view its target.

Logarithmic spirals govern a realm far greater than the falcon’s: the structure of many galaxies.

In plants, logarithmic spirals frequently express themselves with Fibonacci numbers, creating golden spirals. One example is the pineapple. The fruit’s outer surface comprises hexagonal sections arranged in five, eight, 13 and 21 spirals of increasing steepness. HSB discussed similar spirals in branch and root patterns.

But perhaps the best-known example of logarithmic spirals that conform to Fibonacci expression is in sunflowers:

In order to optimize [seed packing], it is necessary to choose the most irrational number there is, that is to say, the one the least well approximated by a fraction. This number is exactly the golden mean \( [\phi] \). The corresponding angle, the golden angle, is 137.5 degrees. (It is obtained by multiplying the non-whole part of the golden mean by 360 degrees and, since one obtains an angle greater than 180 degrees, by taking its complement). With this angle, one obtains the optimal filling, that is, the same spacing between all the seeds.

This angle has to be chosen very precisely: variations of 1/10 of a degree destroy completely the...
optimization. When the angle is exactly the golden mean, and only this one, two families of spirals (one in each direction) are then visible: their numbers correspond to the numerator and denominator of 2 consecutive numbers in the Fibonacci sequence, which is proved to converge toward the Golden Mean value of 1.6180339... (in the picture we have 21/34, the 7th and 8th terms of the Fibonacci sequence). 2

Fibonacci Discovered at the Quantum Level

Fibonacci is present in quantum physics. A recent paper by Drs. Alan Tennant and Radu Coldea announced the discovery of the phi constant in cobalt niobate. Properly applied magnetic fields transform the material into a new state, called quantum critical, where:

... the chain of atoms acts like a nanoscale guitar string. Dr. Radu Coldea explains: “Here the tension comes from the interaction between spins causing them to magnetically resonate. For these interactions we found a series (scale) of resonant notes: The first two notes show a perfect relationship with each other. Their frequencies (pitch) are in the ratio of 1.618 ... which is the golden ratio famous from art and architecture.” Radu Coldea is convinced that this is no coincidence. “It reflects a beautiful property of the quantum system—a hidden symmetry. Actually quite a special one called E8 by mathematicians, and this is its first observation in a material,” he explains. 3

By detecting phi in atomic particles, we know more about how they behave despite being unable to observe them visually. As Dr. Tennant explained, “Such discoveries are leading physicists to speculate that the quantum, atomic scale world may have its own underlying order. Similar surprises may await researchers in other materials in the quantum critical state.”

New Discoveries of Fibonacci in the Human Body

Artists, anatomists and others have long observed Fibonacci relationships in the grand designs of the human body. Consider “Vitruvian Man” (Figure 3), Leonardo da Vinci’s famous 1487 drawing in which the artist showed multiple Fibonacci relationships.

Modern research suggests that in the human body, Fibonacci ratios correspond to health. Yosh Jefferson’s 1996 paper “Unraveling the Mystery of Facial Beauty and its Biologic Significance” found that individuals with “long” faces—or faces whose lengths are greater than a phi relationship to their widths—tend to have problems breathing through their noses. Their too-long and too-narrow sinus cavities inhibit airflow, leading to excessive snoring and, in some cases, sleep apnea.

Conversely, Jefferson notes that people with shorter-than-phi faces tend to experience pain as the result of a “crowded jaw.”

HSB notes studies that show the “muses of the left ventricle of the heart are made up of a series of spirals that repeatedly contract to a point that is approximately 62 percent of the long axis from the aortic valve to the apex.” More recent research by Drs. Hanno Ulmera, Cecily Kelleherb, and Martin W. Danser uncovered Fibonacci relationships in blood pressures and related them to human health. This 2009 study tracked 160,000 people over 20 years and found that:

Although the systolic:diastolic blood pressure ratio in the whole population was 1.6235, the mean ratio was 1.6180 in the participants who lived beyond the 20 year observation period, and 1.7459 in those who did not. This finding suggests that blood pressure values in healthy individuals, but not in those at risk, exhibit the golden ratio. 4

Fibonacci relationships are present at the tiniest level in the human body as well. As noted in HSB, the width of a DNA strand versus the length of a full turn of the DNA spiral comes surprisingly close to phi.

Early evidence suggests that brain waves exhibit Fibonacci proportions as well. Adult human brains, while conscious, exhibit two main forms of waves. Alpha waves occur when a person is in a very relaxed state; these patterns are relatively smooth and regular. Beta waves occur when a person is actively thinking; they oscillate more dramatically. Most experts agree that Alphas fluctuate between about 7 and 13 hertz per second and Betas between about 12 and 30. 7/13 is close to phi (.618), and 12/30 is close to the square of...
phi (.382). Scientific understanding of these waves is still unfolding; we would not be surprised to see these ratios even more closely approach phi and phi squared as scientists quantify them further.

**Humans Appreciate Fibonacci Forms**

Humans find beauty in forms that reflect the golden ratio and Fibonacci numbers. Consider the circle, pentagon and pentagram in Figure 4.

Three aspects of this graphic appeal to the human mind. First is its radial symmetry: Any one-fifth pie piece from the vertices is congruent with any other fifth. Second is its bilateral symmetry: A line drawn straight across from any vertex will bisect the graphic perfectly. Third is that the lines within the circle are in golden ratio to one another: A is 1.618034 times as long as B; the same is true for B:C and C:D.

The golden rectangle (Figure 5) is similarly appealing. The long side of the rectangular perimeter exhibits a phi relationship to the short side; likewise the long and short sides of all the rectangles pictured within.

Each expansion of the golden rectangle involves the addition of an increasingly larger perfect square. Draw a curve from each square’s corner to its opposite, and the golden spiral results.

The same spiral results from the pentagram’s golden triangles, as shown in Figure 6.

Dr. Adrian Bejan of Duke University recently proposed that to perceive beauty in Fibonacci shapes is an evolutionary adaptation. He described his “constructal theory” in a December 2009 interview:

The natural design that connects vision and cognition is a theory that flowing systems—from airways in the lungs to the formation of river deltas—evolve in time so that they flow more and more easily.

“When you look at what so many people have been drawing and building, you see these proportions everywhere,” Bejan said.  

Bejan notes that the faster a human can view a situation and categorize it as threatening or not, the greater its chances of survival:

Shapes that resemble the golden ratio facilitate the scanning of images and their transmission through vi-
sion organs to the brain. Animals are wired to feel better and better when they are helped and so they feel pleasure when they find food or shelter or a mate. When we see the proportions in the golden ratio, we are helped. We feel pleasure and we call it beauty.  

Humans, through evolution, may thereby have come to understand that Fibonacci relationships are orderly, healthy and safe. In our minds they are “beautiful,” and we desire to linger in their presence. They calm us. Perhaps this evolved response causes us to abide in safe behaviors and places.

In an attempt to understand better what humans define as “beautiful” in art, Drs. Cinzia Di Dio, Emiliano Macaluso and Giacomo Rizzolatti of the University of Parma used fMRI technology to scan the brains of subjects who were shown works of art that contain Fibonacci proportion and then distorted images of the same works. What they found speaks both to the Fibonacci- and emotion-rooted foundations of socionomics. From their findings, published in the Public Library of Science:

In terms of brain activations, this comparison showed that the presence of the “golden ratio” in the original material activated specific sets of cortical neurons as well as (crucially) the insula, a structure mediating emotions. This response was particularly apparent when participants were only required to observe the stimuli; that is, when the brain reacted most spontaneously to the images presented. The “subjective” perspective was evaluated by contrasting beautiful vs. ugly sculptures, this time as judged by each participant who decided whether or not the sculpture was aesthetic. The images judged to be beautiful selectively activated the right amygdala, a structure that responds to learned incoming information laden with emotional value.

Many fine musical instruments exhibit the golden ratio. For centuries, luthiers have crafted the world’s best violins, including the famed Stradivarius, to precise Fibonacci dimensions. More recently, Jody Espina designed phi into his highly regarded saxophone mouthpiece. He calls the mouthpiece the JodyJazz DV (DV for da Vinci). He explained:

Every measurement was analyzed with phi in mind and used when applicable. This included the length of the bore, the width of the shank walls, the beak of the mcp [mouthpiece], the depth of the bore at the facing and others. The amount of harmonics in the sound, and therefore the projection of the mouthpiece, is huge. This eliminates the annoying shrillness that is associated with loud, bright mouthpieces.

The acclaim for these mouthpieces is nearly universal, with accolades from top jazz review magazines like JazzTimes, Downbeat, Music Trade, and Jazz Improv.

Why Phi?

Growth and organization in nature and fluctuations in social mood all unfold according to Fibonacci regulated patterns. In HSB, Prechter wrote:

Why do the brain and nervous system’s innermost forms and functions exhibit Fibonacci proportions? It may be for the same reason that collective human interaction produces punctuated progress in the form of 5-3: Nature prefers the most efficient path. The Fibonacci-based style of collective human action that results from interaction may also be a “special efficiency” of nature, just as its inner structure and processes may be. In the case of the Wave Principle though, its goal is not the efficiency of an individual’s biology but efficiency in the progress of the species.

Prechter also pointed out that the tendency of human groups to exhibit phi in decision-making is particularly evident in times of uncertainty. This inclination may reflect the unconscious herding impulse. Herding can be a useful default when facing a potential threat in the wild but it is almost always a significant detriment when making decisions about modern financial markets:

Throughout the herding process … the conviction of the rightness of stock valuation at each price level is powerful, emotional and impervious to argument.

Such powerful, unconscious conviction helps one escape from a predator, but it is not conducive to rational thought in a financial setting.
**Fibonacci and the Golden Ratio Govern Social Mood**

In “The Second Coming,” William Butler Yeats used the falcon’s spiral descent as a metaphor for what the poet feared was a fast-approaching and inescapable doom. In the aftermath of WWI, he wrote,

*Turning and turning in the widening gyre*
*The falcon cannot hear the falconer;*
*Things fall apart; the centre cannot hold;*
*Mere anarchy is loosed upon the world.*

The poem succinctly expresses our point about social mood: Its fluctuations are relentless, and we cannot alter them.

Our natural affinity for Fibonacci forms, rooted in the herding impulse, generally enhances our survival and informs our aesthetics. Idealized Elliott waves reflect the Fibonacci sequence. The golden ratio is manifest in our brain waves and in our bodies. Evolution mandates that we appreciate the forms that follow Fibonacci guidelines, and in the aggregate we can’t help but participate in Fibonacci based, social-mood fluctuations. Nevertheless, individuals who understand social mood and take appropriate action will thrive far better than those who do not.

Philip Davis once said, “One of the endlessly alluring aspects of mathematics is that its thorniest paradoxes have a way of blooming into beautiful theories.” The same is true of social theories. To a layman, the stock market and human history appear at best to be somewhat organized chaos. But as R.N. Elliott, Robert Prechter and others have delved steadily deeper into patterned social behavior, we have found what we believe to be a profoundly organized order with fearsome, yet beautiful, intricacies.

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**CITATIONS**


