

Towards a SummaTime Psychobiology for Yoga Science

Scott Virden Anderson

1st draft completed 5/31/07 – full moon

Man is the measure of all things.

Protagoras – Pre-Socratic philosopher – 4th Century BC

Summary

The SummaTime Scale (STS) presents as complete a view of subjective time as is possible in current scientific terms. Established findings from various fields of science relevant to our lived experience can be arrayed by characteristic time along the STS. We can thus see one way forward towards a comprehensive psychobiology – a Science that looks across *all* scales of time for “objective correlates of subjective states.” We notice that three distinct realms of experience appear along the length of the STS: a universe of outer phenomena revealed by the senses and their technological extensions, a realm associated with light frequencies “inside the skin,” and a third realm, somehow deep to our experiencing itself. These three realms are here described and explored briefly as domains of time in which many different kinds of processes may occur, including, potentially, many revealed by Yoga that appear excluded from current approaches in Science. Discussion of the deep inner domain suggests that its extremes of “Planckian weirdness” may reveal aspects of our inner selves of particular importance for the future of a complete Yoga Science.

Introduction

Psychobiology is defined in Webster’s as “the study of mental functioning and behavior in relation to other biological processes.”

As Yogis, we regard *all* experience as relating to “modifications of the mind-stuff,” and so we naturally lean toward the broadest possible interpretation of “mental functioning and behavior.”

The aim of this brief paper is to suggest how our psychobiology, thus most broadly understood, might be fruitfully explored in terms of the SummaTime Scale (STS). The STS is simply a logarithmic scale of time past. Readers unfamiliar with its construction should refer to descriptions elsewhere on this site.¹

First, we will consider some examples of psychobiological processes from the scientific literature, translate their characteristic times into the notation of the STS, and plot them along side the STS. This array of findings represents a broad view of “psychobiology” as it is currently commonly understood and practiced in various scientific sub-fields.²

¹ See “A Non-Technical Introduction to the SummaTime Scale” and “The Subjectoscope.”

² For example, biopsychology, psychoneuroimmunology, cognitive neuroscience, mind-body studies, etc...

As we continue, however, we'll discover that there are two other whole “worlds” of phenomena that as Yogis we naturally assume are also an integral part of our “extended psychobiology” – “modifications of *our* mind-stuff – but that are not typically thought of as “part of us” or even as being “on the radar screen” of Science at all.

STS notation*	Rhythm/cycle	Usual units	Notes
2.37 Gs	Average lifespan	75 years	human
233 Ms	embryogenesis	9 months	human
86.4 Ks	Circadian	day	Entrained via RGC/melanopsin
~6.0 Ks	Ultradian	90-120 min	“nasal cycle”
2 - 3 s	Breath	12 – 20 per min	human
1 s	Heartian	~ once / second	human
25 – 250 ms	Brain waves	4 – 40 Hz	delta to gamma
100 ms	Temporal resolution of rods	10 Hz	Vertebrates (G-protein cascade)
50 ms – 50 μs	Acoustic range	20 Hz – 20 KHz	human
300 ns	Diagnostic US	3 MHz	
300 ms – 3 ps	Radio spectrum	3 Hz – 300 GHz	
1.27 – 1.64 fs	R&G cone cells	320 – 700nm	via photopsins
1.40 fs	B cone cells	440 nm	via photopsins
1.66 fs	Retinal rod cells		via rhodopsin
30 as – 30 zs	X-rays	10 – 0.01 nm	

* value 1-999 (as estimate, up to 3 significant digits) x nearest POT prefix³

Table 1. STS notation for some rhythms related to our psychobiology.

The cycles that seem most relevant to our subjective experience “in this moment” (above the Heartian) are here lined up along the STS (along with several medical diagnostic tools):

³ See “STSe POT Prefixes” in Documents section under Technical Yoga Science

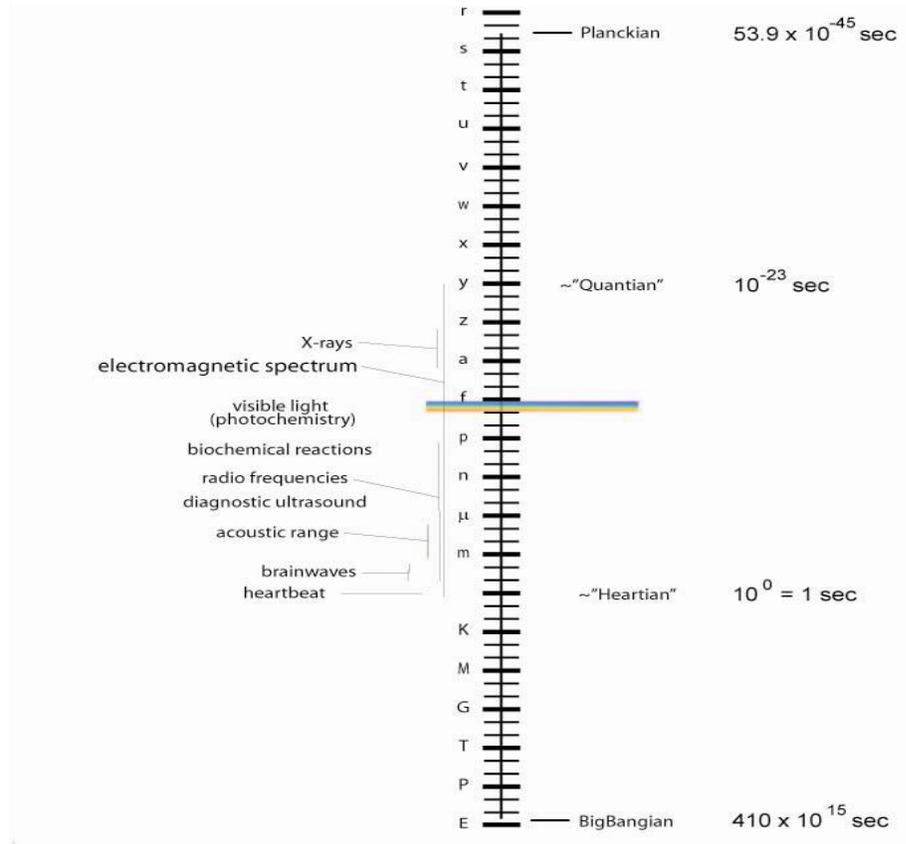


Fig 1. Physiologically relevant phenomena positioned on the STSe
 (This could be re-drawn with the “objective” items listed on the right side of the STS in keeping with the convention established in “The Subjectoscope.”)

Some things to notice at this point:

Psychobiological processes are bunched in the mid range of the STS. It is in this range that we can place the vast majority of existing scientific findings in biology, psychology, and psychobiology in all its many forms (i.e., including the various academic fields that relate to the broad definition being taken here).

Thus, the mechanisms associated with our most immediate bodily-based sensory and mental processes appear to be taking place in the mid-region of the STS. This is “where we live” in terms of frequencies in time.

Interestingly, this time domain also corresponds to that of the electromagnetic spectrum (EMS). Our psychobiology can thus be aligned with the spectrum of electromagnetism. This is not to say that all processes in this domain can be completely described by or “reduced” to electromagnetism – the Sciences of biochemistry, cell biology, and organismal physiology require other descriptive tools that honor their respective levels of organization. However, it remains the case that all phenomena studied in biology can be understood as being composed of processes whose characteristic times can be located in this mid-range time domain of the STS.

For instance, consider a feature central to the vast majority of metazoan (animal) life: a circulatory system consisting of a heart pump, blood vessels, and a liquid blood tissue. A circulatory system involves a number of holarchic levels of organization: tissues composed of cells composed of biomolecules composed of atoms. At each holarchic level we find a host of identifiable processes – be they physiological, cellular, or chemical – each with its own time structures that can be described abstractly in terms of “characteristic times.”

A “characteristic time” is a specific time interval that can be defined technically for any process. It typically refers to an average or mean time for completion of the process – often a cyclical process. Since most processes consist of many sub-processes, there is for any process, a secondary complex set of characteristic times for these sub-processes.

What we propose here is that for biological processes in general, and, most especially the processes taking place in our bodies in each and every moment of life, these characteristic times will all be found to lie, within the time domain that is also spanned by electromagnetism.

Another way to think about this that may appeal to us as Yogis is that all of our subjective experience can be viewed as involving various bio-energy phenomena in the frequency range of light – from ultra-long wave radio waves generated by the heart (at ~1s with a wave length of ~300,000km) to visible light impacting the retina (at ~1fs with a wave length of ~300nm) and perhaps to higher frequencies still.⁴

Thus, all of life “as we know it,” in some basic sense, is taking place in this mid range of the STS. Note that a single human life span reaches back in time into the Gs range, and life itself appeared on the order of Pss ago. However, the focus of analysis with the STS is not how things came to be the way they are, but rather, on how things are now, accessible to our immediate experience.⁵ It is in this perspective of immediate experience that we discover that all life phenomena can be “aligned with light.”

What about the outer time domain?

There is a vast array of phenomena in an “outer” domain extending out from our bodies, into our immediate environment, out to the whole of planet earth, then to the whole of our solar system, our galaxy, and all the way out to the BigBangian at ~410Ps. We experience all these phenomena via the senses and their technological extensions – we do not know them “directly.”

⁴ Although evidence of bio-photo-chemistry involving frequencies beyond the ultraviolet is minimal, further research may yet identify biologically relevant phenomena in this higher frequency range.

⁵ This is the difference between a synchronic view and a diachronic view. Synchronic refers to things that are happening at the same time, diachronic to things that happen over a period of time. This is discussed at greater length in the Subjectoscope paper under Technical Yoga Science in the Documents section.

Note that the Big Bang, according to Science, is something that *is presentable* to our immediate experience: tune your TV to an unused channel and a percentage of the “snow” visible there is due to radio frequency photons of the “Cosmic Background Radiation” present here and now, currently permeating our bodies, “left over” from the Big Bang. In fact, it turns out that these radio-photons from the Big Bang are the most abundant photons in the universe, even right here and now!⁶

Meanwhile, all of our knowledge of an apparently outer world is mediated by our psychobiology – not something that we have direct contact with. Some go so far as to suggest that we (the real “us”) is somehow situated inside the body (somewhere) viewing a sensory projection of the outer world on a data display screen we know as the neocortex.⁷

This “outer world” is thus one that we infer, based on our years of learning how to correlate sensory inputs and motor outputs and to “see structure” in what we experience – a process that Science has revealed is profoundly influenced by culture. It certainly looks like there is a “real world out there,” but we can never really know it directly. The page or screen that you are looking at in this moment is, in psychobiological fact, an image created in your brain that experience has convinced you is an accurate portrayal of biologically (including mentally, linguistically, and culturally) relevant features of your environment. Evolution has gone to great lengths to create such a convincing bio-imaging mechanism for its obvious survival advantage.

When we go to sleep, this “outer world” disappears. However, the brain mechanics associated with visual experience can continue to operate in dreams. Here learning has typically convinced us that visual information in dreams is not correlated with the world of physical motor behavior. On the other hand, as Yogis, we know very well that the dream world is not totally irrelevant either, and may, at least at times, contain useful “information” about features of our life-world, albeit given in more “symbolic” form.

(It may turn out that some Yogis can have direct non-sensory-mediated experience of this outer world, but this does not appear to be typical, and may or may not be important – a good future research topic for Yoga Science).

And, finally what about the vast inner time domain?

This is a region of active exploration by contemporary physicists pushing ahead with a number of Big Science projects aimed at understanding “the fundamental constituents of reality.” For a Yoga Science psychobiology it is a large playground for speculation.

What is going on here? Dozens of books come out each year as physicist try to explain what they are trying to accomplish in their efforts. Experientially, it is hard for us to even imagine the time intervals involved – let alone experience them. Or is it?

⁶ Astronomer Eric Chaisson has a nice discussion of this in his book Cosmic Evolution.

⁷ My current favorite version of this notion is that of David A. Holmes’ Bioluminescent Brain.

Rare Tibetan monks are said to be able to distinguish time intervals as short as $1/30^{\text{th}}$ of a second. But this is barely two orders of magnitude up from the Heartian – still a very long way below the Quantian. As you look at these words, what we are talking about here are time intervals smaller than those between the crests of the shortest individual waves of light in the femto second range (at 10^{-15} seconds). There is no mechanism known to contemporary cognitive neuroscience that would allow any kind of conscious discrimination to be made in such an unimaginably small time interval.

And yet, you are here, seeing these words.

Where (or when) are you?

Perhaps our situation is the one suggested by contemporary “philosopher of mind” Thomas Metzinger. He proposes that we (exact position undefined) are *seeing through a transparent model of the self*.⁸ 99+% of us point to the heart region when asked, “please point to where in the body are ‘you’ located.” It seems reasonable, therefore, to presume that what it is we point to when we identify ourselves is a sense we have developed of ourselves as the result of *living in and experiencing via a body*.

This sense we have of being in a body is based on our years of lived experience interacting with others who are in bodies of their own. This sense of a self in the body is most likely also associated with the full array of bodily processes including all of our psychobiology. As we’ve seen above, that psychobiology includes countless sub-processes at the organ, tissue, cellular, and chemical levels with characteristic times spanning much of the electromagnetic spectrum. However, we do not have any experience we can point to associated with characteristic times any shorter than a wavelength of visible light – if even that, really.

So, it seems fair to say that most of our lived experience is taking place on the STS in only the “outer” regions of even this mid range – the region between the heartbeat and the brain waves. Sound and light are prominent features of experience, but we are not used to any kind of experience taking place in the seemingly infinitesimal time intervals between individual sound waves, let alone individual light waves.

Some Yogis work on “entering the space between thoughts,” but that time interval is likely huge compared to what we are speaking of here – most likely on the order of $1/30^{\text{th}}$ of a second or 30ms.

Yet physics has revealed that these ultra-short time intervals a) exist and b) constitute a vast domain of reality with c) some most peculiar and paradoxical qualities – sometimes referred to these days as “quantum weirdness.” But this weirdness of the quantum level may itself only be an outer weirdness, given that even above (and within) the quantum level lies a vast domain between the Quantian and the Planckian. It seems reasonable at

⁸ Being No One – The Self Model Theory of Subjectivity, MIT Press 2004.

this point to wonder, “if we thought the quantum was weird, what might we find down toward the Planckian?”

What will strike the Yogi as most provocative about the extreme degree of weirdness of the sub-Quantian to Planckian domain is that it may open new avenues for a scientific understanding of a) consciousness itself and b) an array of inner experiences reported by Yogis that have otherwise been difficult to “place” scientifically.

While it seems likely that a substantial range of Yogic experience will be found to correlate with bodily phenomena associated with light and all of its “quantum weirdness,” there are aspects of advanced Yogic experience that may take us into this deepest realm: “being one with everything,” “nondual timelessness,” and “consciousness itself.”

It may turn out that these important features of Yogic experience will be understood in quantum terms as the result of the various efforts underway that are exploring “quantum consciousness.” It may turn out that the deeper sub-quantal domain is only relevant a) in the first instants of time after the Big Bang, b) near black holes, or c) in the super high energy physics of “atom smashers” like the Large Hadron Collider about to come online in Europe. Maybe this deep domain has nothing to do with us in this moment of our lived experience.

However, Yogic intuition suggests that *all of time* is relevant to us in this moment of lived experience – the question becoming, “how exactly?”

The sort of arm chair psychobiology we’re indulging in here can quite readily make sense of the outer domain of STS time inferred back to the BigBang and the middle range of STS time – at least up to visible light. But how shall we make sense of this vast domain of innermost time?

“The yet-to-be-fully explored domain of the ultra-fine structure of our Present Presence” perhaps – “the deep structure of Now?” “Deep *inner* Time.” Perhaps this “abyss of inner time” is the flip side of the discovery nearly 200 years ago of just how old the earth was:

Deep time is a pivotal historic scientific concept... An understanding of geologic history and the concomitant history of life requires a comprehension of time which initially may be more than disconcerting. As Hutton's friend and colleague mathematician John Playfair later remarked upon seeing the strata of the angular unconformity at Siccar Point for the first time with Hutton and James Hall in June, 1788, "the mind seemed to grow giddy by looking so far into the abyss of time." (*Transactions of the Royal Society of Edinburgh*, vol. V, pt. III, 1805 [1])

from wikipedia on “deep time:”

Perhaps in another 200 years we’ll have gotten used to this deep *inner* time. New generations of Yogi-Physicists may take up this exploration and find entirely new ways of understanding our human condition.

Gross, Subtle, and Causal Redux

“The Subjectoscope” suggests that the three domains of time described here can be aligned with the ancient triad familiar to most Yogis of gross, subtle, and causal. The “outer domain” is clearly the world of objects that we access via our senses – “gross by definition,” we might say. It is further suggested above that the “inner domain” can be aligned with light (i.e., electromagnetism) – an alignment that seems appealing given our Yogic intuition of what the “subtle” domain is all about. But when it comes to the causal and “the deep inner domain,” as discussed above, we enter a realm of paradoxes where at this point we have a much harder time “pinning down” our correlations.

Consider traditional Yogic descriptions of the causal domain. It is typically portrayed as the domain we enter nightly in deep sleep, as the domain of “formless mysticism,” and as where the abstract patterns of our karmic personality lie as seeds. Could it be that we don’t need Planckian ultra-weirdness to understand these features of Yogic experience and that “quantum weirdness” may be plenty?

Notice that in the upper reaches of the mid range of the STS – when we move above the range of visible light – there are nine or ten orders of magnitude that are still within the domain of electromagnetism. We’ve seen above that lots of psychobiology can take place in a couple of orders of magnitude – all the various brainwaves span just one order of magnitude and the human acoustic range spans only three. So, could it be that these ten orders of magnitude are where we should be looking for the “causal realm?” There are various hints in this direction:

There is considerable debate currently going on around the fringes of physics concerning the equations of electro-magnetism. The original equations developed by James Clerk Maxwell in the 1880s were in a form that we might now describe as “hyper-complex.” Specifically, Maxwell used a notation developed by William Rowan Hamilton in the 1840s called “the quaternion” which consists of an algebra that uses numbers with one real part and three imaginary parts. This in contrast to the older “complex arithmetic” that uses numbers with one real part and one imaginary part – the “complex numbers” familiar to high-school science and math students of today. Hamilton was ecstatic when he discovered the quaternion – he felt it would be the key to unlock the secrets of a universe with one dimension of time and three of space.

However, Maxwell’s contemporaries found the quaternion notation cumbersome and efforts to simplify Maxwell’s epochal unification of electricity and magnetism began immediately, Maxwell died prematurely, and the simplifications became enshrined in science. What all students of science and engineering have learned since is the simplified “vector notation” form of Maxwell’s equations. The quaternion has been mostly forgotten and the notion that the vector formulation is “fully equivalent” has been cemented in the minds of most scientists – “set in stone,” as they say.

However, it turns out that there are terms in the quaternion formulation that are simply left out of the vector formulation with the assumption that they are irrelevant. This assumption is now being called into question and there is growing suspicion that these left out terms point to important “hidden elements” of electromagnetism. The exploration of these “hidden elements” may open the way toward the Grand Unified Theory – one that unites all the forces of nature into a single theory. These “hidden elements” may also open the way to a deeper understanding of “subtle energy” as known and worked with by Yogis throughout the ages. Thus, it may turn out that these “hidden elements” of electromagnetism describe the features of reality known traditionally as the “causal” as well. One hint in this direction is that the causal is sometimes referred to as “the very subtle.”

If that turns out to be the case, then what do we make of the Quantian to Planckian region – yet another vast domain comprising over 20 orders of magnitude? It may turn out that what has been thought of traditionally as the “realm of the Absolute,” the “nondual domain,” and the “timeless” has within it a vast range of subtle gradations – a sort of “Jacob’s Ladder” that rises in many steps up from the uppermost reaches of our human realm to more and more elevated “angelic” or “godlike” levels toward the Planckian.

The “Field of Mind” diagram developed by Yogi-Scientist Elmer Green in the 1940s (published in various places by ISSSEEM and in his magnum opus The Ozawkie Book of the Dead) has an extensive “transpersonal” range consistent with this interpretation. There are other suggestions in this direction in the literature of Tibetan Buddhism – that there are many “transpersonal levels” that are still within the realm of “samsara” (here interpreted as the entire STS).

The deeper reaches of modern mathematical physics, string theory, and efforts toward Grand Unification seem to be moving us more and more into this domain “beyond light.” Perhaps here we will find that even the expanded and updated quaternion versions of Maxwell’s equations break down and we are forced to move to an even more complex mathematics – perhaps governed by the octonion – numbers with one real part and seven imaginary parts. This algebra has already been explored by mathematicians and perhaps it will yet find future application in this Quantian to Planckian domain. For now we can only suggest that these are perhaps what Kent Palmer calls “research horizons” for Yoga Science into the future.

In any case, the STS seems to be a tool that by expanding and bringing into view these many deeper levels of our potential experience raises interesting and potentially important questions for the future of Yoga Science.