RHYTHM ENTRAINMENT: AN INTEGRATIVE THEORY OF INTERCONNECTEDNESS

by

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ABSTRACT

Entrainment is the phenomenon whereby 2 or more independent rhythmic systems synchronize and become bound together. Entrainment can happen with a variety of vibrations, such as sound, light, temperature, atoms, molecules, cells, and moving bodies. It acts as a calibration mechanism that influences perception, attention, and learning. It may relate to the lived sense of interconnectedness and belonging. As a means of knowing rooted in participatory relationship, rhythm entrainment has social, cultural, environmental, behavioral, cognitive, developmental, and transpersonal implications related to consciousness transformation and eco-social sustainability. Many disciplines have researched entrainment, yet investigation reveals little efforts at developing an integrative theory bringing these fields into a transdisciplinary whole. This dissertation articulates rhythm entrainment as a relational means of knowing that includes physical, psychological, and spiritual dimensions. From an integral perspective, rhythm entrainment serves as a fundamental force in nature, an archetypal organizing principle of the psyche, and an absorptive state of experiential flow. It encompasses the theory of harmonic evolution within the natural sciences, the attunement dynamics of intersubjective communication, and the human capability

of spiritual union within the realm of mystical experience. A transdisciplinary, integrative theoretical approach is used. To this end, this study: (a) develops an integrative theory of entrainment as the foundation for a transdisciplinary field of applied rhythm studies; (b) challenges the assumption that entrainment is limited to psychophysical processes and observable, spatiotemporal perceptions; and (c) explores rhythm as an entry point toward the design of an embodied, participatory model of consciousness transformation in everyday life.

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CHAPTER 1: INTRODUCTION AND METHODOLOGY

> In the deepest layers of consciousness, every human being lives in perfect harmony with rhythm. For many of us, awareness of our natural connection with rhythm has disappeared.
> ~ Reinhard Flatischler (2011, p. 7)

Humans are embedded in rhythm, and rhythm is embedded in humanness. There is no movement without rhythm. At the physical level, rhythm is the oscillation of vibration (i.e., measured movement). At the metaphysical level, rhythm is the flow of life (i.e., lived interconnection). Breath cycles, brain waves, heart beats, digestion, sun and moon phases, seasons, work schedules, bird songs, traffic, emotions, hormones, habits, traditions, and archetypes are all expressions of internal, external, and collective life rhythms. Each holds a unique wisdom, or quality, with which anyone can interrelate and through which anyone can be transformed. Such rhythm mindfulness can be a way of identifying, understanding, and navigating qualities of consciousness. The underlying aim of this dissertation is to show that approaching oneself, others, and the world with this sense of rhythmic belonging can help create a space for meaningful relationship to unfold. One way that this dialogue and transformation occurs is through *entrainment*, the phenomenon whereby one moving rhythm synchronizes with, or adjusts toward matching, another moving rhythm.

Entrainment can happen with a variety of rhythmic vibrations, such as sound, light, temperature, atoms, molecules, cells, and moving bodies. When two heart cells beating at slightly different rates come in close proximity, they entrain and begin to beat in unison (Leonard, 2006). Flocks of birds and schools of fish exhibit similar behavior, demonstrating entrainment as a means of collective

consciousness in the animal kingdom (Gaynor, 2002). Entrainment is often researched in fields such as mathematics, engineering, and physics, as well as psychology, biology, neuroscience, musicology, and anthropology. It was first discovered by Christiaan Huygens (1629–1695), a Dutch physicist, astronomer, and inventor, who noticed that the pendulums on different clocks hanging on the same wooden beam would synchronize their rhythms to each other, even if their initial motions began off-sync. In letters to his father, Huygens referred to this phenomenon as "an odd kind of sympathy" (Birch, 1756, p. 19).

As a means of knowing rooted in participatory relationship, rhythm entrainment may have social, cultural, environmental, behavioral, cognitive, developmental, and transpersonal implications related to consciousness transformation and eco-social sustainability (e.g., Daniell, 2004; Lefebvre, 2004; Leonard, 2006). Many disciplines have researched entrainment, yet investigation reveals little attempt at developing an integrative theory bringing these fields into a transdisciplinary whole. While interdisciplinary research into the phenomenon has brought together fields such as physics, biology, anthropology, psychology, and neuroscience (e.g., Berger & Turow, 2011; Clayton, Sager, & Will, 2004), the spiritual or mystical realms of entrainment are often reduced to physiological processes, overlooked, or dismissed as uncontrollable variables—leaving out a major dimension of lived experience. Furthermore, the fields of study that do address spiritual dimensions, such as comparative mysticism, tend to focus on the entrainment effects of silence rather than sound or rhythm.

Phenomenologically, research findings suggest that entrainment might relate to the lived experience of "interconnectedness" or "belonging" (Clayton et al., 2004)—comparatively, what humans often strive for in psychospiritual practice. However, entrainment research tends to approach rhythm from a psycho-physiological perspective, focusing on processes such as cognition, attention, and motor development often limited to a single, isolated body or brain (Becker, 2011). Bridging psychophysical and psychospiritual perspectives through an integrative analysis of rhythm entrainment gives rise to at least three lenses: physical (body-oriented), psychological (mind-oriented), and spiritual (spirit-oriented). Each offers valuable insight into the relationship between rhythm entrainment and the lived experience of interconnectedness. It must further be noted, however, that interconnection can be experienced positively or negatively through any of these lenses. In other words, there is a dark side of entrainment that this research also addresses—how certain rhythms can be employed as a means of psychospiritual manipulation and control (e.g., Collier, 2007). Together these perspectives can be woven into an integrative theory, which may be applied as an embodied practice of consciousness transformation in everyday life.

This dissertation does not seek to offer a theory of everything or fit into every worldview. It focuses on an integration of the physical, psychological, and spiritual dimensions of rhythm entrainment related to consciousness transformation and eco-social sustainability. The containing myth of this research is based on a fundamental assumption that everything (and everyone) is interrelated and interconnected, and that this knowing can be embodied through

rhythm. There is no hierarchical value or judgment placed on the various approaches being examined, as they are each valid and necessary within an integrative understanding. A certain amount of mystery remains. One may assume that any theory, even if integrative, will not accurately describe every circumstance. Yet, such theory can be openly and creatively applied to a variety of experiences for gaining new insight. Rather than being an "exhaustive comprehension" of all that is known about rhythm entrainment, this study is meant to be a step toward a more integral framework of the phenomenon—the foundation for a transdisciplinary rhythmic paradigm.

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CHAPTER 2: LITERATURE REVIEW

What follows is a brief literature review on rhythm entrainment, divided into physical ("eye of the flesh"), psychological ("eye of the mind"), and spiritual ("eye of the spirit") domains. While each of these domains has its own devoted chapters in the body of this research—offering a more encompassing literature review throughout—this chapter serves as the basic introduction and overview for each of these perspectives. Concepts introduced herein are further addressed and unfolded within the proceeding chapters. This chapter helps develop the relevance of using an integrative approach and sets the stage for what is next.

The Eye of the Flesh

Picture a sound wave, which can be physically represented as a repetitive flow of peaks and valleys. Entrainment can be thought of as the rhythmic relationship between these peaks and valleys across multiple waves—how they align or sync up. This image is the central concept behind rhythm entrainment, usually termed *phase relationship* or *phasing* in literature exploring the phenomenon. A common assumption in entrainment discussions is that phases match up with exact synchrony, so that each rhythm aligns peak to peak and valley to valley, which is often called *in-phase synchrony*. Rhythms can also get locked into *out-of-phase synchrony*. A 180° out-of-phase example of entrainment is when one wave's peak matches the other wave's valley, so that they are exactly opposite. This dynamic is also known as *antiphase synchrony,* where one pulse expresses the on-beat while the other expresses the off-beat. In relationship dynamics, this expression might appear as a dominant–submissive coupling—

often the path of least resistance. Weaker rhythms tend to naturally entrain to stronger, more coherent rhythms; although, research in nonlinear systems has shown that stronger rhythms can also entrain to weaker signals (Clayton et al., 2004). More complex *polyrhythms* (i.e., multiple rhythms happening simultaneously) have more complex entrainment patterns. Bergquist (1997), for example, suggested a creative model of entrainment that includes out-of-phase "quintessence" and "complex complementary" relationships. Not all rhythms entrain to each other, and any of these phase relationships can get locked into "lagging, synchronous, or leading" (Clayton et al., p. 9) states. These locked states describe the primary entrainment principle of *phase locking*.

Systems thinking and complexity theory have helped explain phase locking as a natural process moving from chaos to order (e.g., Strogatz, 2003). Much has been written on the phenomenon of *synchronization* and *coherence* regarding self-organizing systems. As Oliveira and Melo (2015) noted: "The synchronization between two periodic systems connected through some form of coupling is a recurrent, and still pertinent, problem in Nature, and in particular in Physics" ("Introduction," para. 1). This tendency to synchronize has plagued the minds of physicists and mathematicians such as Albert Einstein, Richard Feynman, and Norbert Wiener, leading to a better understanding of nature and the development of such technology as superconductors (Strogatz, 2003). While the phenomenon is rooted in mathematics that describe the physics and engineering behind two or more interacting oscillating systems (e.g., clock pendulums, electrons, states of matter), research extends to a variety of fields within the

physical sciences. Because entrainment is a concept that fits into complex systems theory, it can manifest in many ways (some of which involve human cognition); thus, no single physical process seems to be able to accurately describe it, and even complex systems theory seems "ignorant as to what constitutes a coupling factor" (Will & Turow, 2011, p. 6).

There are various examples of entrainment to consider in a complex system of rhythmic processes such as life. As Pikovsky, Rosenblum, and Kurths (2001) wrote:

> Radio communication and electrical equipment, violins in an orchestra, fireflies emitting sequences of light pulses, crickets producing chirps, birds flapping their wings, chemical systems exhibiting oscillatory variation of the concentration of reagents, a neural center that controls the contraction of the human heart and the heart itself, a center of pathological activity that causes involuntary shaking of limbs as a consequence of Parkinson's disease—all these and many other systems have a common feature: they produce rhythms. (pp. xvii–xviii)

Even within a single field, such as Earth Science, rhythm entrainment can mean different things. In geology, entrainment might describe the process of surface sediment being integrated into a fluid flow, or the entrapment of one substance by another substance. Geographical studies might apply an entrainment model toward the analysis of erosion patterns. In hydrodynamics, it might be considered the movement of one fluid by another fluid. Meteorology may look at entrainment as a phenomenon of the atmosphere related to air convection and the interaction of currents—noting the importance of *detrainment* (i.e., the process of entrained molecules being dispersed back into the general atmosphere), which can have a greater effect on a system's structure than the process of entrainment itself (see de Rooy et al., 2013).

On the social level, Lefebvre (2004) suggested a "rhythm science" to understand social patterns, interpersonal relationships, and time–space perceptions—explaining that the dynamics of rhythm entrainment directly relate to the dynamics of societal development, interaction, and decline. M. Young (1988) framed this model as the "metronomic society," describing the interplay between social conceptions of time and the rhythms of everyday human life. Entrainment relates to the notion of timing and how humans temporally adapt. For example, chronobiology focuses on the sustainability of biochemical processes related to *circadian* (i.e., 24 hrs), *ultradian* (i.e., shorter than 24 hrs), and *infradian* (i.e., longer than 24 hrs) cycles of time. Repetition (i.e., regularity, periodicity)—or lack thereof (i.e., irregularity, aperiodicity)—is fundamental to rhythm entrainment, and can be made up of equal or unequal intervals. Time is periodic and *isochronous* (i.e., comprised of equally spaced intervals), which makes it not only measurable but also predictable. With entrainment comes routine and thus predictability—why humans can follow a steady beat (i.e., *beat induction*). While work on chaotic transmitters has shown that aperiodic systems can synchronize and entrain (Clayton et al., 2004; Pikovsky et al., 2001), most entrainment research only considers periodic, isochronous rhythms in cycles of time. As Newton (2005) described, introducing Galileo's discovery of *harmonic oscillators* (i.e., isochronous pendulums): "Here is the story of the simplest, yet most fundamental physical system in nature and how it ties the rhythm of time together with our very material existence" (p. 3).

Time and physical matter are primary components of entrainment theory. Hence, the Galilean notion of a harmonic oscillator is a quintessential metaphor underlying entrainment and serves as "a crucial building block for our understanding of nature" (Newton, 2005, p. 137). Yet, for over 350 years, since Huygen's observation of sympathetic clocks (i.e., entrained harmonic oscillators), the precise mechanisms of entrainment have remained relatively unexplained, leaving a lot to be determined regarding the phenomenon. As Schneck and Berger (2006) stated in their research on the physiology of entrainment: "There is much that remains unknown about the details of entrainment—the hows, and whys, and operational definitions" (p. 120). Granted, the research around entrainment is complex across multiple disciplines, particularly when there seems to be no agreed upon definition of even the central term *rhythm*, other than it can be traced back to the Latin and Greek terms *rheîn* and *rhythmos*, meaning "to flow."

Csikszentmihalyi (2008) framed rhythm from this "flow" perspective and suggested that the experience of flow is a state of consciousness related to optimal performance. His research showed that people in a state of flow exhibit more joy, creativity, satisfaction, and a deeper involvement with life. Empirically and metaphorically, rhythm can be—at least—experienced as flow, movement, vibration, sound, cycle, force, field (as in *biofield*), energy, wave, pulse, meter, and pattern. While rhythm can be considered a fundamental aspect of nature and physicality, rhythm is typically thought of in terms of music and researched as an aspect of sound, often studied as an underlying pulse or meter (e.g., London, 2012). However, the notion of rhythm can be expanded to any frequency vibration

on a wide spectrum from light to temperature. It can then be extended beyond that as an inherent quality of any vibration or movement. Using Wilber's (1997) integral model, rhythms can be seen as having internal, external, individual, and collective dimensions. They can be objective or subjective. Some may be peripheral or nonlocal. Essentially, rhythm can be thought of as an archetypal aspect of the psyche (Daniell, 2004).

The Eye of the Mind

The laws of thermodynamics explain entrainment in terms of entropy and equilibrium within physical systems. Extending this to human intentionality, while the physical sciences may frame the phenomenon as the synchronization of matter, the social sciences might frame it as the cooperation of minds. Rhythm entrainment can manifest as an evolutionary function within society, culture, cognition, behavior, physiology, emotion, and the surrounding environment. In other words, entrainment can be an effective means of (a) energy conservation (i.e., following the path of least resistance); (b) information exchange (i.e., learning); and (c) sustainability (i.e., surviving). Relationship dynamics of such cooperative synchronization are often examined from a psychological perspective via *attachment theory*, a prominent approach in psychotherapy that explores parent–child coupling patterns (see Mooney, 2010). In this context, aspects of rhythm entrainment can be associated with the emotions of bonding and the anxieties of separation. Fairhurst, Janata, and Keller (2013) framed such coupling as a process of *dynamic cooperativity* that they neurologically linked to the "socio-emotional consequences of different degrees of entrainment success" (p.

2592). They also determined that adaptivity plays a key role in the human ability to entrain. How individuals adapt to and are affected by the rhythms within and around them—bodies, brain signals, emotions, relationships—can inform their general sense of interconnection (or disconnection) with the world. In other words, rhythm entrainment seems fundamental to basic psychological aspects such as cognition, identity, and behavior on various levels.

Neuropsychology, or brainwave research, is an example of the blending between physical science and psychology within the study of entrainment. Brainwave research (e.g., Buzsaki, 2006; Jovanov & Maxfield, 2011; Pineda, 2005) has shown that active, waking states of consciousness correspond to faster brainwave rhythms, known as *beta* (~ 13–30 cycles per second or *cps*), while relaxed, wakeful states are measured at slightly slower rhythms, or *alpha* (~ 8–13 cps). More receptive, meditative states correspond to even slower rhythms, or *theta* (~ 4–8 cps), and deep sleep is associated with the slowest ones, or *delta* (~ 0.5–4 cps). Further, moments of insight can appear as high frequency bursts, known as *gamma* (~ 30+ cps). These brainwave patterns are fundamental to entrainment research and many therapeutic applications. Applied brainwave entrainment includes utilizing technologies such as *binaural beats*, known to induce altered states of consciousness (e.g., Atwater, 1997; Turow & Lane, 2011). The brain can entrain to the pulse that emerges when two slightly different frequencies are heard simultaneously in each ear. So, if a 100 Hz sound is played in one ear, and a 105 Hz sound is played simultaneously in the other, the brain translates this into a 5 cps pulse, which it entrains to as a low theta state.

Brainwave patterns can also influence other body rhythms like pulse, respiration, and general behavior. The Strong Institute, for instance, developed a program called "Rhythm Entrainment Intervention," which delivers—via speakers or headphones—a personalized composition of prescriptive rhythms purported to address a variety of conditions such as autism, ADHD, PTSD, brain injury, and various psycho-emotional imbalances (see Strong, 2015). Various music therapies serve as rhythm therapies, in that rhythm acts as the underlying foundation that can bridge communication barriers (e.g., Ready, 2016).

More actively participatory in nature, programs like Remo Health*Rhythms* (2012) extend listening to playing and use entrainment through group hand drumming to invoke desired change. Studies have shown that rhythm entrainment can help reduce stress, improve immune system response, increase neurological functioning, develop coordination and motor skills, build community, guide effective communication, manage pain, and enhance overall wellbeing (e.g., Bittman, Bruhn, Stevens, Westengard, & Umbach, 2003; Friedman, 2000). As Mikenas (1999) posited, deeper bonds and channels can be formed when misaligned rhythms come into synchrony:

> If we put people together who are out of sync with themselves (i.e., diseased, addicted) and help them experience the phenomenon of entrainment, it is possible for them to feel with and through others what it is like to be synchronous in a state of preverbal connectedness. (pp. 62–63)

This preverbal state is often experienced in drumming and sounding circles when participants entrain to the same underlying beat. During improvisational music therapy, the process of entrainment can be guided by the therapist, for example, by matching the tempo of music to the client's rate of breath or other movements

(Darrow, 2004; Turry & Marcus, 2003). This approach to entrainment "offers space for transition to occur in a way that is directed by the patient" (Loewy & Stewart, 2006, p. 148), inviting embodied empathy through participatory mindfulness. Within integrative music therapies, synchronizing rhythms in this way can open individual minds, bodies, and hearts to interconnected flow (see Azoulay & Loewy, 2009). From mother–child relationship patterns to therapist–client encounters, entrainment can also be extended to include human interactions with the greater world (e.g., psychological field theories).

The Heartmath Institute (2018a) has looked at rhythm from the perspective of heart rate variability (HRV), suggesting that emotions and stress are rhythmically interconnected with heart rate and human fields of energetic coherence. The Global Coherence Initiative (GCI) extended this notion of "heart coherence" from personal rhythms to the collective world—how human energy fields interact with the environment (see Heartmath Institute, 2018b). As Marian-Balasa (2004) postulated: "Rhythms made by people should induce entrainment within them, as well as in the surrounding sensitive world" (p. 60). While chronobiology offers an understanding of the human biochemical and neurological relationship to environmental rhythms, as well as their psychological implications, such research tends to approach the relationship unilaterally (i.e., external-to-internal). As Leeds (2010) suggested: "Anything that vibrates is susceptible to the influence of the external rhythms around it. This is what makes entrainment so powerful" (p. 44). Leeds focused on external-to-internal rhythm entrainment—the effects that the "outer" has on the "inner," mirroring the

empirical, linear approach of most psychophysical entrainment research. Yet, how are external rhythms affected by internal ones (i.e., the effects of the inner psyche on the outer world)? What about rhythms that are not necessarily internal or external but more nonlocal? In other words, how is entraining to an external rhythm (e.g., sound, circadian cycles, places) or an internal body rhythm (e.g., heart beats, brain waves, breath rate) different from entraining to a more subtle, peripheral, or nonlocal rhythm (e.g., collective consciousness, nonphysical presences)?

One way to look at nonlocality is through quantum mechanics, which discusses the potential of reality in such a way that "the observer" is inseparable from "the observed." In this sense, the study of quantum mechanics has an inherent psychological component. It discusses how particles are interconnected nonlocally so that if one is changed (even by observing it), the other is instantaneously affected (regardless of distance). This phenomenon is framed as "entanglement" and extends to mind–matter research such as remote viewing, distance healing, and other *psi*, or psychic, phenomena (Radin, 2006). Thus, entrainment might not only be an observable, temporal–spatial process related to internal and external physical rhythms but might be happening at nonlocal levels interconnecting people and the environment beyond conceptions of time–space (such as in mystical or healing experiences). Broadening the understanding of entrainment to include nonlocal events and these subtle, or unseen, processes is crucial to exploring the full breadth of the phenomenon and its implications regarding consciousness transformation and eco-social sustainability.

The Eye of the Spirit

Many spiritual practices connect with such subtle realms through trance—gazing into a flickering fire, participating in ritual, dancing with music. Hand drumming has been a means of entraining individuals, communities, and cultures for millennia, employed as a tool to connect with the sacred and commune with mystical, spiritual, and healing dimensions. As Redmond (1997) presented: "The rituals of the earliest known religions evolved around the beat of a frame drum" (p. 1). Consciously and intentionally working with rhythm teaches how to flow through chaos and uncertainty, offering a sense that individuals are still being held in the container of interconnectedness—through a shared, sacred pulse. Extraordinary examples of entrainment in spiritual practice come from the West African tradition *Orisha* (also known as *Orixa*, *Ifa, Santeria, Yoruba, Lucumi*), where drumming is used as a means of delivering specific rhythms for inciting specific experiences—cleansing or purifying, healing, acquiring psychic abilities, connecting with ancestors and the deceased, communicating with various deities (Karade, 1994; Velez, 2000). As Velez (2000) explained, these ancestral deities, or *Orisha*, "descend only in response to their specific musical themes" (pp. 43–44), communicating with—and through—the rhythms of the drum to create a trance state where they can "possess" or "mount" people to pass on mystical knowing. This spiritual approach to entrainment has been happening for thousands of years (much before Huygens' discovery of clock pendulums) via such participatory practices as drumming; dancing; and singing, chanting, or toning.

In Vedic traditions, rhythm entrainment can be understood through the chanting of mantras. There are four main books of the Vedas, all of which are comprised of mantras that impart knowledge of how to live in relation with the true nature of reality—offering a means of liberation from ignorance and suffering. As Saraswati (1991) outlined, the Vedas present mantras for each of the tradition's deities with proper instructions for chanting, show how to use mantras appropriately in ritual and worship, and discuss the magical or mystical properties of the mantras (e.g., chanting this so many times will produce such an effect). Throughout the Vedas is the interconnection between sonic vibration, knowledge, and spiritual transformation. Through the mantric practice of repetition (*japa*), "the receiving vibrations are created again and again, resulting in [the practitioner's] own well-being and, through the power so created . . . the general well-being of the world" (Saraswati, 1991, p. 29). The Vedic system is an example of a "sonic theology" (Beck, 2008). Mantric chanting offers an experiential practice of exploring the relationship between rhythmic vibration and direct, immediate transformation, often including entrained hand and arm movements that match the active quality of the mantra being supported. These Vedic practices can be related to the notion of *Nada Brahma*, or the metaphysical philosophy that holds sound vibration to be the basic nature of the universe (see Berendt, 1991), mirrored in cross-cultural worldviews ranging from Pythagoras' Music of the Spheres to various shamanic sound healing principles. As Gaynor (2002) expressed:

> An extensive body of research now exists that has measured and validated the psychological and physiological benefits of music on human

> development and behavior. But we must not forget the shamanic model: Music, whether produced by voice, instrument, or the two in concert, restores our connection with our essence—the realm beyond our conscious awareness—and thus, with the cosmos. (p. 78)

For example, as Tindall (2008) presented: "The Shipibo [a shamanic culture indigenous to the Peruvian Amazon] heal by perceiving the energy fields in their patients and *singing* them back into harmony, something akin to how a physicist would correct an anomaly in a mathematical field" (p. 119).

From a shamanic perspective, sound and rhythm can act as carrier waves that transfer intentional energies and spiritual powers. The idea that soundwaves can carry with them the intentions of the practitioner is also a core principle (i.e., *frequency + intention = healing*) in sound healing philosophies (Beaulieu, 2010; Goldman & Sims, 2015). Rudhyar (1982) referred to this sound healing principle as the *magic tone*, in which one places an intention into a sound, and the sound becomes a carrier wave for that intention. In other words, entrainment with a sound or rhythm can become a method for receiving encoded intention, energy, or power. For example, during shamanic *power quests*, which are rites of passage akin to Native American *vision quests*, "the seeker might not see the spirit but instead receive its power through an auditory experience, such as a song and words" (Harner, 2013, p. 12). As a spiritual practice, sonic entrainment—driven via drums, chants, rattles, gongs, claps, or other sounds—has been used as a consciousness transformation device, mode of healing, and gateway into mystical realms by indigenous cultures around the world. As Turow (2005) discussed, such auditory driving is an ancient *ritual technology*. Likewise, discussing entrainment as a yogic method for synchronizing humans and deities to the same frequencies,

Marian-Balasa (2004) suggested that "the issue of entrainment is basic to many ancient and contemporary [mystical] schools of thought, and basic to both old and recent spiritual/religious practices" (p. 61). For instance, as Marian-Balasa further stated, applying entrainment theory to Hindu philosophies:

> According to the most popular layers of Shivaism [a Hindu tradition devoted to the supreme being *Shiva*], the universe itself was made, and is constantly maintained, destroyed[,] and recreated, by entrainment to the dance of Shiva. . . . Consequently, the worldly realm and consciousness is the "dream" or the narcosis of this entrainment to that "dance" of the Absolute Consciousness. (p. 60)

Hence, entrainment is not limited to auditory-based spiritual experiences but taps into the underlying ontological makeup of various cosmologies. To put it another way, rhythm entrainment can be approached epistemically (i.e., rhythm as a means of knowing) or ontologically (i.e., rhythm as the nature of reality). It may be an entry point to bridging existential subjective–objective divides.

Phenomenologically, spirituality is often about exploring larger connections, and rhythm interconnects. These connections can also extend beyond the experience of space–time. Going back to the notion of time, rhythm entrainment within spiritual practice can often result in transcendental experiences of timelessness. Leonard (2006) referred to this realm in the title of his book as "the silent pulse." Kouwenhoven (2004) made a case for entrainment theory to be extended to mystical experiences by suggesting that "if entrainment is the study of 'reorganized time,' it is also, by definition, the domain of metaphysics—a realm where poets operate more successfully than most academics" (p. 52). This extension might be experienced as shifting from "clock time" to "deep time," which might help one attune awareness to slower, ecological rhythms of nature,

ancestry, and the health of future generations (Macy & Brown, 1998). In Greek mythology, this distinction might be described by comparing *Chronos* (quantitative clock time) with *Kairos* (qualitative moments). This qualitative shift into timeless realms can be associated with spiritual or sacred elements of entrainment (e.g., liberation, healing, wholeness). Norris (2012) coined the term s*acred entrainment* to describe the practice of intentionally interconnecting with sacred realms through rhythm (i.e., interconnected flow) and associated it with feelings of awe and ecstasy. This approach can be applied as a transformative practice in everyday life. For instance, Hart (1998) suggested that rhythm is the foundation to most African drumming mythologies, observing that "the proper rhythm and the proper life go hand in hand: a good person is one who is filled with right rhythm" (p. 195). In that regard, rhythm entrainment may be a means of not only spiritual transformation and healing but also as a gauge for morality. It extends from transitory mystical experiences to sustained spiritual development and can include both sacred and mundane levels of reality. Developing these examples into a rhythm-based cosmology toward a transpersonal model of entrainment in daily life is an aim of this study.

Chapter Summary

The process of entrainment is intimately interconnected with human life and the rhythms of the world. There are many dimensions to rhythm entrainment, and the above examples are just glimpses into the physical mechanics, psychological factors, and spiritual components of the phenomenon. To more effectively draw out the full scope of rhythm entrainment, each is unpacked

further, along with other examples, and organized throughout the body of this research. As Will and Turow (2011) expressed:

> One important aspect of entrainment theory is that, in many regards, it is a unifying concept, a concept with the potential to cut across disciplinary boundaries and to form a coherent basis applicable in various disciplines. It permits linkages between the cultural and the biological as well as the individual and the social, and it offers a new approach to understanding human action and perception as an integrated, embodied, and interactive process. (p. 14)

Further, to examine the unobservable aspects of entrainment that the physical sciences omit, as well as to integrate the spiritual, or mystical, experiences that traditional psychology tends to reduce to psychophysiological processes, a theoretical approach is used. This proposed extension follows the suggestion of Marian-Balasa (2004) to broaden entrainment theory to include "impalpable" realms like imagination, poetic vision, and sacred experience:

> A full acceptance and application of the concept of entrainment leads to acceptance and application of all possible idea-facts that "validate" the subtle, apparently immaterial manifestation of life, expressive culture, beliefs, or faith. Objective analysis of phenomena does not mean ignoring subjectivity, but incorporating it into its sphere of interests and competence. (p. 61)

From an integral perspective, all domains of experience are equally valid and can be integrated into an overarching model to be applied in everyday life. The idea of objective and subjective realms might be expressed as a continuum rather than one or the other, forming a quantum perspective where the whole is greater than the sum of its parts. Using rhythm entrainment as the foundation to describe various phenomena—that may at first seem unrelated—might help researchers understand certain dynamics in a new light or unveil greater mysteries. Building upon this notion, I acknowledge that applying rhythm

entrainment as an integrative model across disciplines has limitations and may not be an accurate representation in all instances. However, in those instances, it can be approached as a theoretical analogy that may open new areas of inquiry. As Alexander (2016) proposed in using improvisational jazz to describe the workings of the cosmos, "analogies would always be limited, but it is their very limitations that provide the seeds for new insights and discoveries" (p. 40). In other words, within the following chapters, I acknowledge that there is a degree of artful interpretation that is meant to extend the perception of rhythm into new areas of discovery. As Alexander concluded: "Applying analogies across disparate fields is more of an art . . . than pure science" (p. 40). With these caveats in mind, what follows is an exploration of a myriad of phenomena that describe physical, psychological, and spiritual notions of interconnectedness through the lens of rhythm entrainment.

CHAPTERS 3-9 OMITTED FOR PREVIEW

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