The Chinese View on Time – A Reflection on The Concept of Time in Dao/Yijing And Modern Science

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Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

This paper investigates the intricate relationship between consciousness, time, and free will action by human agents intermediated between the construct of Heaven and Earth. By conducting a comprehensive literature review across different disciplines, such as Chinese philosophy, and reflecting on time and related ideas in *Yijing*, the time perspective in the arrow of time in modern science, insights into the nature of time and its implications can be gained.

While the second law of thermodynamics supports a one-directional time arrow, microscopic fluctuations complicate this understanding. In addition, cultural and historical factors have influenced our understanding of time, highlighting the need for interdisciplinary inquiry. The research challenges causality principles and introduces a Co-Occurrence Time Model, raising questions about the independence of time from an observer. The study emphasizes the importance of a comprehensive approach to understanding human experience and calls for further investigation into these concepts. The paper underscores the need to explore the multifaceted aspects of time, consciousness, and free will to broaden our understanding of the world and our place within the *tian ren di* framework.

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Keywords: Book of Changes, Yijing, Transformation, Changes, Quantum physics, linear, cyclical.

Introduction

Time has been a subject of great philosophical inquiry for centuries. From ancient Greek philosophers like Heraclitus and Parmenides to contemporary physicists and philosophers, the nature of time has fascinated scholars for generations (Prier, 2011). McTaggart's (1908) argument posited that time is not real and distinguished between A-theories and B-theories of time. The former divides time into past, present, and future, with the present as the reference point, while the latter describes temporal properties as earlier, later, or simultaneous with reference to a particular discourse. The primary issue in this debate revolves around whether the present holds ontological significance. A-theorists view time as a unidirectional arrow, progressing towards an unrealized future, while B-theorists see time as eternal, with events being contents of any temporal position. Modern physics, particularly quantum mechanics, has introduced new perspectives and challenges to the concept of time, with theories like entanglement and complementarity challenging conventional understandings of temporal properties.

Time is intimately linked to the change process and is a fundamental precept in *Yijing*. Liu (2017) concluded that “change is not only possible in the *Yijing*’s B-theory of time, but that change is what makes time possible. The notions of change and time are fully compatible in the Yijing” (p. 88). Liu (2017)’s concept of time aligns with Aristotle’s description of time as ‘a kind of number’[1]. More specifically, “a number of change in respect of before and after”[2], highlighting the idea that time is inherently connected to the movement of objects and the passage from one state to another (Martineau, 2021). This view of time persisted until the advent of modern physics, which presented new challenges to the traditional understanding of time. In classical physics, time is seen as an absolute and universal quantity that flows uniformly for all observers (Wheeler, 1979). Thomsen (2021) argued that

> *Inside small isolated quantum systems, time does not pass as we are used to, and it is primarily in this sense that quantum objects enjoy only limited reality. Quantum systems, which we know, are embedded in the everyday classical world. Their preparation as well as their measurement phases leave durable records and traces in the entropy of the environment (p. 772).*

Cheng (1976) added that the classical world operates under the principle of causal determinism, where every object and motion depends on things that existed before it in time. The conditions before a given thing are necessary and sufficient conditions for its existence, with the cause of a thing being the set of conditions that existed as individually necessary and

jointly sufficient for it. However, this logical description of causation does not fully capture how a set of conditions becomes the cause of a thing, which requires the power of motion to produce an impact or act on another thing to produce motion. Thus, the law of causality involves the sufficiency and necessity of conditions, the efficacy of motion and force (free will), and priority in time.

However, with Einstein's theory of relativity, this view was challenged, and a new concept of time emerged relative to the observer's frame of reference (Bergmann, 1976). The concept of time is a fundamental aspect of everyday lived experience and plays a central role in many scientific disciplines, including physics, cosmology, and neuroscience. At its core, time refers to the ordering and duration of events "as history unfolds and events come into being" (Dieks, 2006, p. 157) and provides a framework for understanding the behaviour of physical systems with the timing of space[3] and the spacing of time[4] (Malpas, 2015). "The old mechanical metaphor 'The world is a giant clock' condenses in one image the principal features of Newtonian physics – namely, atomicity, objectivity, and determinism" (Herbert, 2011, p. xi) and time's linearity in the observable world. Hooft (2018) further described the universe as structured by space-time, which serves as a framework for events defined by their locations in space and moments in time. The number of coordinates needed indicates the space-time dimension, typically real numbers. The time coordinate is distinct, the only coordinate that allows for a meaningful definition of an ordering, known as the arrow of time, which establishes an orientation for events and enables the definition of a partial ordering for all events. This notion figuratively depicts time as an 'arrow', a 'flow', a 'passage', or a 'flight' (Liu, 2017).

The ordering of all events has a defined orientation temporally rooted in the arrow of time. On the Chinese view of time, Chai (2014) differentiated *Dao* time, cosmological time (or heavenly time), and human-measured time as follows:

> ***Dao*** *time is the nontime of* ***Dao*** *and ontological nothingness, whereas cosmological time pertains to the state of primal chaos, also known as the One, and human-measured time is the causal or durational time of everyday human experience (p. 362).*

Merleau-Ponty (2012), in defining human-measured time, employed a Daoist-like language to reject any semblance of a linear sequence. Merleau-Ponty (2012) posited that time is not a tangible process nor a series of events that one can record. Rather, time emerges from one's relationship with the world, implying a relation to a conscious observer or participant. Merleau-Ponty (2012) explored "a series of dimensions of our experience that cannot be separated from our lived embodiment, cannot be accounted for so long as an interpretive distance removes the observer from the spectacle, and cannot be viewed from above through a high-altitude thinking that forgets the exceptional relation between the subject and its body and its world" (p. xxxi). Merleau-Ponty (2012) further added: "Events are carved out of the spatiotemporal totality of the objective world by a finite observer" (p. 433).

However, whether time exists independently of observers is a longstanding and controversial topic in philosophy and physics. "Many western scientists, influenced by Eastern sciences and philosophies, have come to the startling conclusion that life does not come from non-life, that intelligence is already inherent in 'dumb mud,' and that planets, as well as people and their brains, evolve within a limitless universal consciousness that gives rise to everything we know as our

universe" (Sahtouris, 2009, p. 5).

The passage from the *Daodejing* in Chapter 25 presents a cosmological perspective that delves into the concept of time within the context of primal chaos. The phrase (*you wu hun cheng, xian tian di sheng*) signifies a pre-existent state of undifferentiated wholeness and chaos before the formation of the heavens and the earth. This notion of undifferentiated wholeness, known as primal chaos or " " (hundun), is situated in timelessness (Chai, 2014). This cosmological framework is timeless, where distinctions and order have yet to manifest. The manifestation passage signifies the initiation of time and the commencement of the cosmic order through the emergence of the *Dao* as the ultimate reality (Jhou, 2020). Time is viewed as a transformative catalyst that facilitates the emergence of distinctions and the unfolding of the cosmic order. It marks the transition from primal chaos to the structured existence of the heavens and the earth, enabling the development of diverse phenomena. Time assumes a pivotal role in the process of creation and transformation within the cosmological framework presented in the passage.

Furthermore, the passage implies that time is intimately connected to the notion of way-making (*Dao*). Way-making is presented as a timeless and all-pervading force that transcends temporal boundaries. It is described as grand and associated with passing, distancing, and returning. This suggests that time governs the cyclical patterns and movements within the cosmic order in conjunction with the way-making.

In summary, the passage acknowledges the significance of time within chaos by highlighting its transformative role in the emergence of the cosmos. It emphasises the transition from an undifferentiated, timeless state to a structured and ordered existence. Time is intricately linked to the concept of way-making, representing the cyclical nature of the cosmic order and the continuous flow of transformation. This cosmological perspective offers insights into the interplay between time, primal chaos, and the universe's unfolding within the *Dao* framework.

Chai (2014) described the *Dao* as ineffable, indescribable, and timeless, but it is experienced through its manifestations in the world. Ontologically, the *Dao* is emblematic of absolute reality and births the One (yi), an entity composed of pre-phenomenological forms yet to differentiate (Goulding, 2021). As the arrow of time moves forward, the One metamorphoses, giving rise to *wanwu* 'ten thousand things,' symbolizing our experienced and lived reality. Regardless of their apparent diversity, these entities are interconnected, sharing a common origin in the *Dao*. Jhou (2020) asserted that the *Dao*, described as infinite, indeterminate, and eternal, first presents itself as mere possibilities, then self-differentiates into the One, and subsequently into a multitude of existences. This signifies a transformative process in which the *Dao*, through self-differentiation, brings forth all things in the cosmos. However, the Dao's timelessness is contingent upon a conscious observer's absence. *Dao* transcends time. Wang and Li (2023) differentiated time as transcendental time or empirical time.

> *Its complexity stems from the fact that there are two distinct concepts of time: the temporality of empirical things, which is constructed as a finitely continuous temporal succession that is perceptible, and the temporality of the shapeless* ***dao*** *, which is conceived of as a transcendental and infinitely continuous temporal succession that is imperceptible (Wang & Li, 2023, p. 1).*

However, with an “embodied participant and an impersonal, detached-observer, ‘bracketed phenomenological’ approach to the ongoing condition” (Blakeley, 2008, p. 323) emerges along the arrow of time, or Wang and Li's (2023) empirical time. When an ‘embodied participant’ or ‘detached-observer’ comes into play, a new, temporal dimension is introduced into the otherwise timeless *Dao*. This suggests that human consciousness and participation can bracket the phenomenological occurrence and place it within the confines of time. Thus, while the *Dao* is timeless, the unfolding of its manifestations, as observed and experienced by conscious beings, transpires within the domain of time. This presents a complex interplay between temporality and timelessness, embodiment and detachment, underscoring the nuanced philosophy of Daoism.

Chapter 25 of the *Daodejing* describes a grand, cyclical process of passing, distancing, and returning, signifying a non-linear, cyclical concept of time, where events recur in a 'grand' pattern. “Every event and being is in the middle of a self-realizing, self-creating process” (Chang, 2009, p. 217). This pattern is likened to natural cycles and is seen as a process of constant transformation, suggesting that time is integral to this cyclical process. Each event in this fluid process emerges, attains complexity, and then returns to the process, perpetually reconstituting it. This cyclicality, emblematic of *ziran*, indicates that each process is distinct from and continuous with its context, exhibiting a certain distance (linearly) and returning synchronically (cyclically). Ames and Hall (2003) described this as a diachronic and synchronic account of the perpetual process of experience and its manifold manifestations in the presence of a conscious observing actor. The grandness initiating each cycle signifies the start of a new one, with the return marking the end and the beginning of another process. “Chinese philosophers see that things are always provisional and conclude that transformation is time itself. They understand time as the primary aspect of changing, myriad events” (Chang, 2009, p. 216-217).

The dilemma facing science is its inability to explain the presence of a conscious observing actor within reality (Schwartz & Schwartz, 1955). The paper discusses this challenging but fundamental assumption of contemporary physics, which states that an objective universe exists independently of our existence. Karakostas and Hadzidaki (2005) argued that

> *the objects of science do not simply constitute ‘personal constructions’ of the human mind for interpreting nature, as individualist constructivists consider, neither do they form products of a ‘social construction’, as sociological constructivists assume; on the contrary, they reflect objective structural aspects of the physical world. A realist interpretation of quantum mechanics, we suggest, is not only possible but also necessary for revealing the inner meaning of the theory’s scientific content. It is pointed out, however, that a viable realist interpretation of quantum theory requires the abandonment or radical revision of the classical conception of physical reality and its traditional metaphysical presuppositions (p. 607).*

The social construction, where the sociological constructivist assumes reality is a mind-dependent and observable reality, is therefore co-determined by the measurement context at a particular time. The paper offers a new perspective on the relationship between consciousness and physical reality by considering the role of the observer as an active participant in the creation of reality. By recognizing the subjective and dynamic nature of consciousness, the proposed approach

challenges the traditional view of an objective reality that exists independently of observers' existence. Chai (2014) described this as the 'rationalizations of the human mind':

> *It is here, at the Gate of Heaven—the pivot of nothingness— where creation abounds and the true nature of things is freed of the seductive language of time, whose artificial durations are but rationalizations of the human mind" (p. 368).*

"Isaac Newton, the founder of modern physics, claims that in the absence of things, time would still exist. This claim is not an invention of Newton's but an expression of the enduring Platonic tradition, which holds that reality exists beyond temporal boundaries" (Chang, 2009, p. 216). Stapp (1980) emphasised that there is "no suggestion that any observed attribute has a physical existence outside the observer who observes it in some particular local experimental situation. The analysis would be -and is- perfectly legitimate in a model in which the observed attribute is explicitly a joint characteristic of the object and the observer together, having no meaning whatever except in the conjunction or confluence of these two parts" (p. 25).

This proposed perspective has far-reaching implications for physics. It challenges the traditional paradigm of a purely materialistic view of reality by referring to the inner level of reality that is mind-independent but inaccessibly operational. By acknowledging the role of consciousness in shaping reality, this paper proposes new avenues for exploring the nature of reality and the fundamental *Laozi's* 'Way-making' laws that govern it.

Karakostas and Hadzidaki's (2005) study sheds light on the concept of 'scientific objects' in quantum mechanics. These objects, acquiring distinct identities within specific experimental contexts, are central to physical science. Owing to the inherently nonseparable structure of quantum mechanics and the resultant context-dependent portrayal of physical reality, "a quantum object can produce no informational content that may be subjected to experimental testing without the object itself being transformed into a contextual object" (Karakostas & Hadzidaki, 2005, p. 18). Quantum nonseparability pertains to an operationally inaccessible, mind-independent reality, while incorporating a context corresponds to an empirical reality perceivable by humans.

This framework contrasts with a materialistic worldview, which posits that all universal phenomena can be elucidated through physical laws and material properties. This view characterises 'scientific objects' as entities with "well-defined identities within concrete experimental contexts" (Karakostas & Hadzidaki, 2005, p. 18). Nevertheless, this perspective is confined to an outer level of reality accessible to human cognition. Pillars of scientific thought, such as the laws of thermodynamics, the theory of relativity, and the concept of entropy, underpin this view and are integral to the natural sciences, particularly physics. This viewpoint maintains that all phenomena can be reduced to their fundamental components, and every existent entity can be defined by its physical properties.

However, the intricate nature of quantum objects, as expounded by Karakostas and Hadzidaki (2005), challenges this materialistic viewpoint. The unique nature of quantum mechanics, where context-dependent descriptions and nonseparability are fundamental, introduces a new dimension to understanding reality, compelling a re-evaluation of

traditional materialistic perspectives. This discourse enriches the exploration of reality, demonstrating the need for a nuanced approach that incorporates both the empirically observable and the quantum context-dependent aspects of reality.

However, a growing body of evidence suggests the existence of an inner level of reality that is mind-independent and operationally inaccessible to human perception (Karakostas & Hadzidaki, 2005). Karakostas (2012) added

> *Whereas quantum non-separability refers to an inner level of reality, a mind-independent reality that is operationally elusive, the introduction of a context is related to the outer level of reality, the contextual or empirical reality that results as an abstraction in human perception through the deliberate negligence of the all-pervasive entangled (non-separable) correlations between objects and their environments. In this sense, quantum mechanics has displaced the verificationist referent of physics from 'mind-independent reality' to 'contextual' or 'empirical reality' (p. 57).*

This view is often associated with the field of quantum mechanics, which suggests that particles do not have a well-defined identity at the subatomic level and exist in a state of superposition[5], where they are simultaneously in multiple states at once (Friedman et al., 2000; Zhiling Wang et al., 2022). The existence of an inner level of reality, in a state of superposition of potential, suggests that emerging events are not subject to linear time (Kenkre et al., 1998). Chai (2014) explained this superposition of potential in terms of the creative potentiality of *dao*

> *Dao populates cosmological time and, from the resultant intermingling, the measurability of human reality comes to fruition. Cosmological time is hence a marker of the One in light of the mysteriousness of Dao. We can thus explain the complementariness of Daoist cosmogony as follows: out of the timeless, empty equanimity of ontological nothingness, Dao spontaneously gave birth to itself. What arose from this self-birthing was not the framework for time, but merely its potential. This creative negativity underwent a meontological self-transformation that engendered the one. Here, however, the Dao qua nothingness has yet to be known as Dao qua the One. Dao qua oneness can only occur with the epistemological act of naming it so. With the One named as such, ontic being[6] and nonbeing arise, filling the universe with myriad variation (p. 364).*

This excerpt puts forth a unique perception of the universe's constitution, contrasting it with the materialistic worldview. According to this perspective, the universe is not simply a collection of material objects existing in a linear timeline; instead, it is a manifestation of the interplay between the timeless emptiness of ontological nothingness and the creative potential of *Dao*. The emergence of the One from the self-engendering*Dao*, recognized only upon naming and birthing ontic beings, implies a deeper reality that is not confined to linear time but exists as potentiality actualized through observation. This notion challenges the materialistic perspective by hinting at an inner reality, inaccessible to human cognition and unaffected by linear time measures.

This concept of an inner reality level disrupts the materialistic premise of linear time progression, suggesting significant

implications for this research. An in-depth comparison between paradoxical views in Chinese philosophy and modern science is undertaken to further delve into this concept, facilitating a profound understanding of time, reality, and the conscious observer's nature. This idea also impacts the understanding of the causality and free will interplay, hinting at the intertwined nature of human consciousness, agency, and time.

This paper scrutinizes the theoretical base of *tianshi* (heavenly time) and the correlative facets of temporality. As Chang (2009) stated, “In the *Yijing*, *shi* as time signifies exploring accumulated momentum or taking advantage of propensity” (p. 227). The paper also introduces a Co-Occurrence Time model, employing *Dao*'s *wuji* and *taiji* concepts to portray the simultaneous existence of linear and cyclical time.

Lastly, the paper analyses the congruities and differences between ancient Chinese philosophy's philosophical principles and current scientific thought, focusing on several paradoxes. It examines varied topics such as philosophical and scientific time perspectives, the arrow of time concept in physics, and consciousness's impact on reality.

Discussion

Some perspectives suggest that time is a subjective experience that arises only in relation to conscious observers. “The common person, however, only sees things on the level of their ontic existence; for him, measured time is both real and inescapable” (Chai, 2014, p. 369). Quantum physics theories suggest that time may not be a fundamental aspect of the universe; rather, it could be an emergent property resulting from observer interactions. Gibbons (2012) posited that such emergent properties arise due to the unique state in which observers find themselves. “The universe started with very special initial conditions when neither time nor quantum mechanics were present. Both are emergent phenomena. Both are consequences of the special state we find ourselves in” (Gibbons, 2012, p. 29). This perspective challenges the conventional idea of reality as an independent and objective entity, prompting essential inquiries about consciousness and observer influence on reality. This paper evaluates classical and contemporary theories and the ongoing debate on time's independence from observers. It investigates the notion of a timeless universe (*Dao* time), cosmological time, and the arrow of time, discussing their implications for our comprehension of reality.

Timelessness and Timeliness

Favalli and Smerzi (2020) broached the subject of time observables in a timeless universe, contributing to the discourse on the emergent arrow of time. Traditionally, Newtonian physics portrays time as an absolute, external factor that flows unswervingly, independent of the physical world. This perspective was revisited with the introduction of the theory of relativity.

> *Maxwell (1985) has claimed that special relativity and “probabilism” are incompatible; “probabilism” he defines as the doctrine that "the universe is such that, at any instant, there is only one past but many alternative possible futures". Thus defined, the doctrine is evidently prerelativistic as it depends on the notion of a universal instant of*

> *the universe (Dieks, 1988, p. 456).*

Diverging from this perspective, Favalli and Smerzi (2020) proposed that the arrow of time emerges from the entanglement between two parts: the observer and the observed. As the observer acquires knowledge of the observed, the entanglement between the two parts increases, leading to the emergence of an arrow of time. This novel concept suggests that the idea of a universal instant is tied to the entanglement between subsystems, providing an alternative prerelativistic perspective on time.

The concept of a universal instant presupposes that a single moment in time applies to the entire universe. In classical physics, this concept is often linked to the notion of an absolute time, which is independent of any observer or reference frame. In contrast, in quantum physics, the concept of a universal instant is less well-defined, and time is often treated as a parameter that enters into the equations of motion. In addition, the emergence of entanglement in quantum physics provides a new perspective on time. Entanglement is a phenomenon in which two or more quantum systems become correlated in such a way that the state of one system is dependent on the state of the other, even if large distances separate the systems and they are causally disconnected at a particular time (Tu et al., 2020).

The emergence of entanglement, therefore, creates an arrow of time, which refers to the direction in which the entanglement increases over time. “The arrow of time and the second law of thermodynamics are one of the most famous and controversial problems in physics” (Haddad, 2012, p. 407).

The timeliness of entanglement can be measured by observing the rate at which the entanglement between two subsystems increases. This rate can be quantified using various entanglement measures, such as the von Neumann entropy or the mutual information (Belavkin & Ohya, 2002). The emergence of entanglement and the associated arrow of time are fundamental concepts in modern quantum physics and have been the subject of much research in recent years.

In summary, the concept of time in physics is complex and multifaceted, and its precise definition and role in physical theories depend on the specific context. The emergence of a universal instant and entanglement in quantum physics has provided new perspectives on time. Moreover, it has led to the development of new measures and models for quantifying and understanding the arrow of time.

Complexities of Time

This paper scrutinises the complexities of time as interpreted through the lens of Einstein's theory of relativity and quantum physics. It further probes into its association with human perception, free will, and consciousness, incorporating the temporal conceptualization depicted in *Yijing*. Finally, the paper underscores the reciprocal interaction between physical and philosophical viewpoints of time, thus analysing time’s multi-dimensional nature.

The understanding of time is crucial for our comprehension of free will and consciousness. If relativity's assertion of the relativity of time holds true, traditional views of free will warrant reconsideration. In contrast, the observer's role in quantum mechanics could hint at a ‘quantum free will’, where conscious observers shape reality through the observer

effect. “The observer effect is the fact that observing a situation or phenomenon necessarily changes it. Observer effects are especially prominent in physics, where observation and uncertainty are fundamental aspects of modern quantum mechanics” (Baclawski, 2018, p. 83). This complex interaction poses substantial inquiries concerning the fundamental nature of consciousness and its association with the material world.

Modern Theories of Time, Entanglement, and Quantum Mechanics

> *Quantum mechanics seemingly offers something to everyone. Some find free will in quantum mechanics. Others discover consciousness and value. Still others locate the hand of God in the quantum wave function. It may come as no surprise, therefore, to hear that many believe quantum mechanics implies, or at least makes the world more hospitable to, the tensed theory of time (Callender, 2007, p. 50).*

Quantum physics and Einstein's theory of relativity (Einstein, 1905) offer distinct perspectives on time. Quantum physics treats time as a critical parameter but not as an observable in the conventional sense (Butterfield, 2013). In contrast, relativity provides a more pliable interpretation in which time, woven with space into a four-dimensional spacetime continuum, is relative (Ramaswamy & Francis, 2014). This perspective also introduces the concept of the observer’s role in determining temporal order, influencing our perception of time. The theory of relativity significantly altered our understanding of time by stating that it is relative to the observer's frame of reference (Bergmann, 1961). Time dilation, occurring due to relative motion or gravity in special and general relativity, respectively, causes time to pass at different rates for different observers (Pikovski et al., 2017). Quantum physics further underscores the observer's importance in the double-slit experiment, where the act of measurement by the observer collapses the wave function and determines the particle’s behaviour (Kastner, 2022). This suggests a profound connection between the observer’s consciousness and the physical world, including the experience of time. Wheeler's (1978) ‘delayed choice’ variant of the double-slit experiment takes this further. In his thought experiment, whether to observe which path the photon takes is delayed until after the photon has passed the double slit but before it hits the detector screen. Remarkably, the results suggested that measurement seems to retroactively determine whether the photon acted as a particle or a wave in the past, adding a layer of temporal mystery to the quantum conundrum.

In the context of relativity, the observer's role is paramount. This is most strikingly displayed in the relativity of simultaneity, where two events appearing simultaneous to one observer might not appear so to another observer moving relative to the first (Latour, 1988). This counterintuitive characteristic, rooted in the invariance of the light speed in all inertial frames, profoundly shapes our understanding of temporal order and causality.

The debate about time’s existence independent of an observer has been ongoing for centuries. Classical theories assert that time is an objective and linear aspect of the universe (Adam, 2013). However, contemporary theories suggest a tighter relationship between time and consciousness or perception. The repercussions of this debate are critical for our understanding of the fundamental nature of reality.

Modern theories of time, entanglement, and quantum mechanics are connected to issues in the philosophy of time and its

role in physical phenomena. In the context of quantum mechanics, time assumes a different meaning. The principle of entanglement, first proposed by Einstein, Podolsky, and Rosen in 1935 (Einstein et al., 1935), postulates an intriguing scenario where the states of two particles become intrinsically interlinked such that they reciprocally determine each other, irrespective of their spatial separation. This inherent relationship manifests as the simultaneous reality of two physical quantities with noncommuting operators (Einstein et al., 1935). Intriguingly, entanglement appears to embody an element of immediacy, as depicted in Figure 3. In this regard, the condition of one particle instantaneously influences the other, irrespective of their physical distance. This instantaneous interaction further implies the nonexistence of a time lag in the information exchange between the entangled particles, which questions traditional notions of time and causality.

Free Will, Consciousness, and Time

This review critically evaluates and dissects the complications entwined with the dialogue between consciousness and free will. It underscores three core elements of quantum theory that have been postulated to be pertinent to the discourse of free will - indeterminism, nonlocality, and observer-participation in relation to time (Hodgson, 2012). It is argued that consciousness represents an independent variable privy to the phenomenological manifestation within the tangible, visible realm but remains oblivious to the quantum interactivity occurring in the backdrop. This notion is visually represented in Figure 3, delineating the unseen and visible material world.

> *Bohm's theory, that quantum events are partly determined by subtler forces operating at deeper levels of reality, ties in with John Eccles' theory that our minds exist outside the material world and interact with our brains at the quantum level (Pratt, 1997, p. 69).*

This exploration posits the phenomenon of a novel aspect of reality materializing within the domain of quantum physics, which resists conventional causal interpretation. The paper expounds on the invisible realm that originates from the enigma of *Dao*, characterised by limitless potentialities, giving rise to the duality of*yin* and *yang* and the process of materializing with countless variations. The ensuing interplay culminates in the actualization of measurable human reality. Quantum entanglement, invisible to human observation, takes place during this phase. It is postulated that the intertwinement of *yin* and *yang* instigates the directionality of time.

Correspondingly, the introspective features of consciousness present the inception of a distinct quality that extends beyond an exhaustive causal interpretation of reality. Both these spheres necessitate a categorization scheme that surpasses the primary approach of separately addressing factual facets of an ever-evolving reality. The ‘birth’ or emergence is determined probabilistically through conscious observation, entangled within the complex system at a time.

This concept resonates with the changing line dynamics in the hexagrams as illustrated in the*Yijing*, reflecting a metaphysical model analogous to contemporary conceptions of probabilistic emergence or ‘coming into being’. Each line within a hexagram transitions from *yin to yang*, or, conversely, generates a new hexagram at a time, denoting the advent of a new state or phase. This dynamic is intrinsically probabilistic, resembling how quantum states evolve over time, adhering to the principles of quantum mechanics.

The transformation symbolised by each line in the *Yijing* hexagrams can be viewed as a metaphor for the evolution of quantum states over time, forming a metaphysical nexus between age-old wisdom and modern science. This perspective could potentially augment our comprehension of probabilistic emergence and the essence of time in quantum systems, thereby pioneering new directions for exploration within theoretical physics and the philosophy of science.

The connection between these two discussions lies in their shared theme of emergent properties in complex systems that elude traditional causality. In both the quantum and consciousness realms, the 'coming into being' or 'materialising' of new facets of reality goes beyond a simple cause-effect dynamic. Figure 3 illustrates that the probabilistic emergence and materialisation occur between Heaven and Earth, denoted by the 64 hexagrams. This hints at a more complex, interconnected model of reality that may be better understood through novel, more holistic frameworks expressed by *Yijing's* hexagrams. The concept of *yin* and *yang* potentially provides such a framework, resonating with the dualities observed in both quantum physics (wave-particle duality, entanglement) and consciousness studies (subjective-objective, conscious-unconscious).

This intriguing parallel offers fertile ground for further exploration and cross-pollination between these two fields, potentially illuminating some of the enigmatic aspects of each. This includes the birth of new qualities from the intertwining of *yin* and *yang* at the *taiji* stage illustrated in Figure 3, and the role of such emergent properties in forming what we perceive as 'time'. Furthermore, the introspective attributes of consciousness might be seen as a macro-level manifestation of the same principle, with self-awareness emerging from complex neurological processes in a manner that defies reductionist, causal explanation. Thus, quantum physics and consciousness studies may benefit from an approach incorporating the *Dao* concept of *yin* and *yang*, offering new perspectives on some of their most challenging questions.

On free will, Libet (2005) explored the temporal dimensions of conscious cognisance, drawing upon his experimental outcomes. One of his landmark studies involved the temporal measurement of when a subject becomes aware of a sensation in relation to the timing of the associated brain activity, where "the unconscious cerebral processes precede a subjective sensory experience" (Libet, 2006, p. 322). Libet (2006) added: "If this can be generalised to all kinds of subjective experiences, it would mean that all mental events begin unconsciously, and not just those that never become conscious. In spite of the delay for a sensory experience, subjectively there appears to be no delay" (p. 322). The findings indicated a latency of 0.5s between the instance of a cerebral event and the conscious recognition of the event, demonstrating the phenomenon of an antedating of the delayed experience (Libet et al., 1993). Despite its actually delayed awareness, the subjectively perceived time of an event appears to occur instantaneously. This temporal anomaly, or Libet's (2006) 'backward referral,' is a delayed awareness "subjectively referred backwards in time to the time of the primary evoked response of the sensory cortex" (Libet, 2006, p. 324).

This paper broadens the scope of this concept (illustrated in Figure 3), highlighting an analogous relationship with the subtle quantum dynamics occurring during the *taiji* stage within the hidden reality—outside the purview of our conscious sensory and cerebral faculties. The conscious processes primarily interpret the material manifestations resulting from the probabilistic emergence in the visible world/observable reality. Nevertheless, the foundational quantum mechanical

principles operate at the *taiji* level.

By establishing this correlation, we propose that our perception of reality, primarily grounded in our conscious sensory and cerebral mechanisms, might only be encountering a fraction of an expansive, quantum-based reality. This discourse refers to the earlier discussion surrounding ‘coming into being’ over time, where the inherent probabilistic aspect of quantum physics permits many possibilities to manifest in the perceivable world from this unobserved quantum domain. This connection suggests that our perceptions and consciousness may have limitations in fully grasping reality as it is. Instead, we perceive the quantum-mechanical world through the lens of classical physics—via our senses—which may be inadequate to comprehend reality's true nature fully. This ties back to quantum mechanics, where observation influences the outcome, suggesting a deep intertwining of consciousness and the physical world at a fundamental level. This revelation holds considerable implications for our interpretation of free will and the temporal essence of consciousness.

Drawing parallels with Wheeler's (1978) ‘delayed choice’ variant of the double-slit experiment, we find a striking semblance in how they both defy our conventional comprehension of time and causality, despite addressing different aspects of reality - quantum mechanics and neuroscience, respectively. In Wheeler's (1978) delayed choice experiment, the measurement act can retrospectively dictate a particle's past behaviour. Such a concept offers a profound demonstration of the anomalies of quantum mechanics, hinting at the potential for future events (the act of measurement) to influence past occurrences (the trajectory taken by the particle). In contrast, Libet’s neuroscientific investigations suggested a temporal disparity between a cerebral event and the conscious awareness of that event. Libet's (2006) ‘backward referral’ or ‘antedating’ is where the conscious sensation is retrospectively attributed to the moment of the physical act, thereby creating the illusion that the conscious decision instigated the action. This striking similarity lies in their subversion of intuitive implications about time. Both propositions challenge our conventional understanding of cause and effect and, more fundamentally, suggest that our understanding of time might be incomplete or even incorrect. Moreover, they both seem to insinuate, within their respective fields, that effects antedate their causes, with future events influencing past ones. Nonetheless, it is vital to note that these intriguing theories, while provocative, remain contentious and continue to be subjects of ongoing debate within their respective disciplines.

The *Dao*’s Notion of Time

The Dao, as outlined in Chinese philosophy, embodies an intrinsic cosmic structure (Figure 3).*Daodejing* Chapter 16 identifies *Dao* as the reason behind the universe's cyclical flow, where phenomena perpetually emerge, develop, and ultimately return to their root. Zhou (2023) clarified *Zhuangzi*’s perspective that “time is not only continuous, infinite, and one-dimensionally linear, but also intermittent, finite, and cyclical” (p.1). Therefore, the arrow of time in the material world is visualized as an unending cycle of birth, expansion, decay, and demise, with all things ceaselessly manifesting and retracting to their origin (illustrated in Figure 1).

Cheng (1994) proposed a cyclical view of time in Chinese culture, which is depicted as successive generations and repeated spirals with variations, demonstrating multiple time concepts and the generative processes of life and death. Cheng advocated for a continuous cycle of birth, growth, decay, and rebirth, diverging from the linear concept of time that

presents life as a singular temporal stream from birth to death. This cyclic understanding of time is mirrored in several facets of Chinese philosophy, including the seasonal and life-death cycles. The self-contained time loops represent a return to the root. The principle of *fan* (reversion) and *fu* (return) in *Dao* signifies a cyclical return to the root and the primordial state of things. Cheng (2023) highlighted the importance of equilibrium achieved through the return to the origin. It suggests a propensity for cyclical patterns, reflecting the inherent cyclicality and dynamic nature of the *Dao*, characterized by constant change and transformation. *Wuwei*, or non-action, as explored by Cheng (1994), aligns with the natural course of events and the rhythm of time. It advocates for harmonising with the flow of time rather than exerting control. These concepts interweave to reveal the cyclical nature embedded within the *Dao*. These notions, coupled with the cyclical nature of time, endure in Chinese philosophy and propose that the universe perpetually transforms, guided by an underpinning order and principle governing the Way-making process.

Daodejing Chapter 40 contemplates the cyclical universe and the *Dao*'s function within it. The notions of 'returning' and 'weakening' pertain to the cyclical repetition of cosmic and earthly processes (Cheng, 2023). The 'returning' addresses recurrent natural phenomena such as day-night cycles, lunar and planetary rotations, and seasons. These cycles are integral to the natural world and influence everything from agricultural growth to animal behaviours to human rhythms.

The concept of 'returning' denotes that cycles are inherent to a broader pattern of movement and change orchestrated by the *Dao*. Cheng (2023) suggested this notion is followed by a subsequent change that involves an exploration of the creative aspects of the universe, life, and the mind, responding to the creative forces of the universe. This perspective highlights the perpetual nature of philosophical inquiry as an unending pursuit, driven by the vast possibilities arising from the creative universe and the creative mind through an interplay of *yin* and *yang*. The existence of indeterminacy ensures an abundance of creativity, as there is no conceivable endpoint to the creative universe and the creative mind.

Time in *Yijing*'s Concept

Yijing uses hexagrams composed of six different lines of *yin* and *yang* to represent the temporal position of a particular situation. The hexagram provides an overall image of the situation, while each line indicates a temporal progression and expresses different characteristics concerning the past and future. This change process is similar to evolution in that it is not teleological, but instead involves the emergence of things and events from undifferentiated situations through interactions with the environment. In this sense, the *Yijing* can be seen as a tool for understanding the complex and dynamic nature of the world and the processes by which it evolves over time (Chang, 2009) within the *tian ren di* (Heaven-Human-Earth) framework. Chang (2009) further clarified

> *Many expressions used to designate heaven in the Yijing are not discrete terms, but paired compounds such as tiandi and qiankun, implying that a single term would not constitute a self-sufficient entity. Nevertheless, some interpreters tried to relate tian with God or heaven in the Judeo- Christian tradition (p. 220).*

The role of heaven in the *Yijing* is open to debate as to whether it possesses a transcendent nature similar to that found in the Judeo-Christian traditions. Also, Confucian heaven is not timeless but has a linear, process-oriented, and temporal

character. *tian*, the Confucian concept of heaven, permeates everything and achieves self-realization through creativity. Between *tiandi*, the space presents *ji*[7], and this space is characterized as *Yijing* cosmological time, which is described by Chai (2014) as a state of primal chaos, and the observed time is the causal (or the durational time in an event, refer to Figure 1) of everyday human experience. This primal chaos is illustrated in Figure 3 as the *hundun*. In quantum terms, Šorli and Čelan (2021) named it "superfluid quantum space—SQS that is the primordial energy of the universe".

> *With heaven and earth having their dispositions determined, the changes ensue within them.* ***Dao*** *fulfills and sustains the natural tendencies of things and events. This is the gate whereby the appropriateness of* ***dao*** *operates*[8] *(Chang, 2009, p. 221).*

This space creates everything in the world, *wanwu*, and imparts its creativity to all things that achieve self-realization.

A Co-Occurrence Time Model

This study introduces a Co-Occurrence Time Model (Figure 1) incorporating linear and cyclical time, observer interaction, and inflationary chaos. The model recognises the dynamic and intricate nature of consciousness and the observer's interaction with the physical world in a linear timescale.

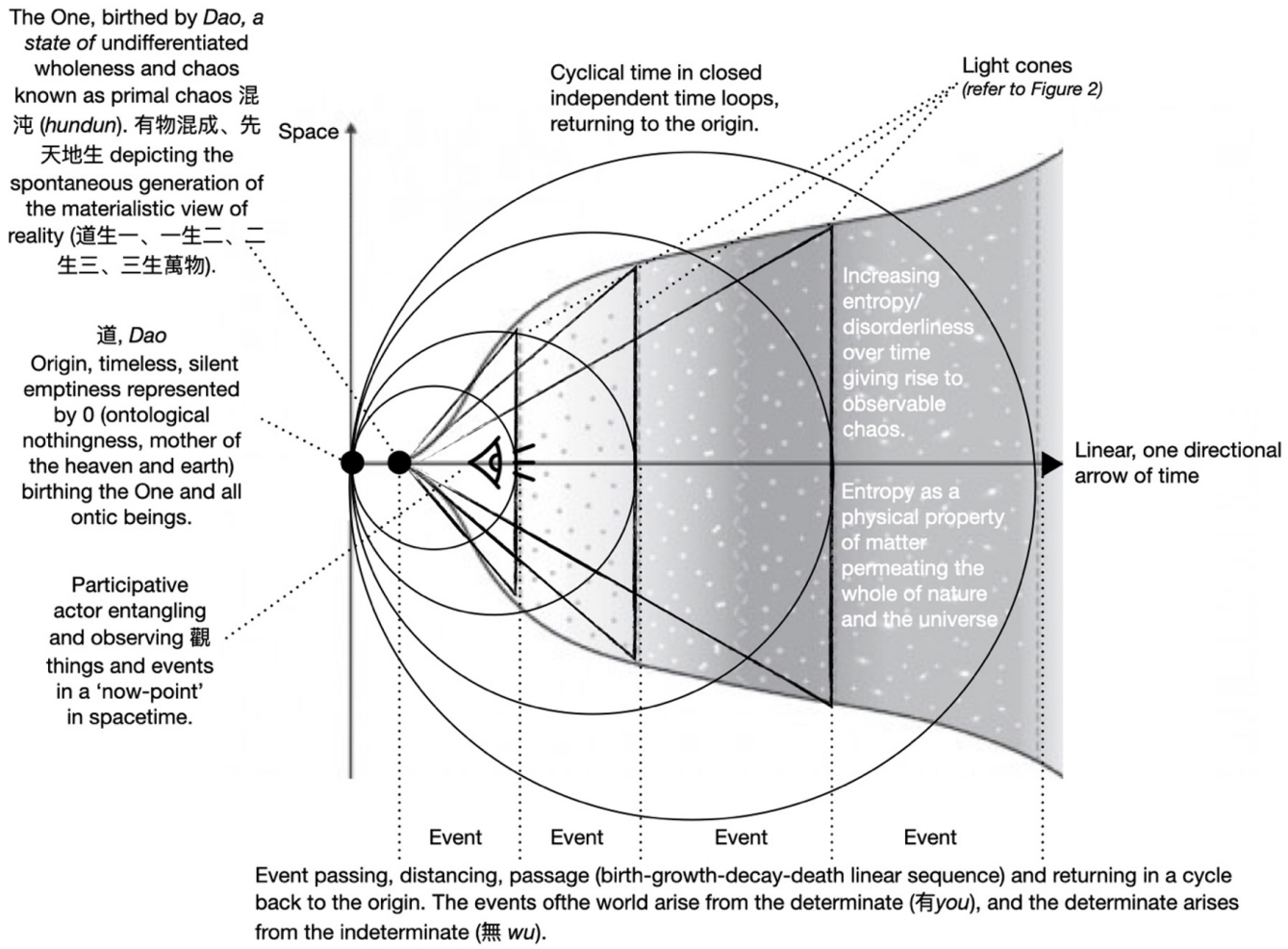

Figure 1. Co-Occurrence Time Model

The Co-Occurrence Time Model is a theoretical proposition suggesting the concurrent existence of dual time streams operating within distinct domains, wherein the correlation is relative rather than absolute. The foundation of this model is grounded in Favalli and Smerzi's (2020) conceptualization of an arrow of time arising from the entanglement between two constituents: the observer and the observed. As the observer gathers the knowledge of the observed entity, the level of entanglement between them intensifies, facilitating the emergence of an arrow of time. This innovative concept introduces the notion of a universal instant or now-point inherently linked to the entanglement among subsystems, offering an alternative perspective to prerelativistic concepts of time. Consequently, the importance of entanglement within physical reality can only be acknowledged when the relationship is accepted as relative to an inertial frame. This conceptualization is congruent with quantum mechanics, where the act of observation modifies the inertial frame, suggesting a profound linkage between consciousness and the physical world at a fundamental level. This understanding carries substantial implications for our perception of free will and the temporal characteristics of consciousness.

In visualizing the progression of time, a 'now-point' is accentuated (in Figure 2), generating a limitless series of potential states (conceptually depicted by *Yijing* hexagrams). This visualization aligns with the principle of relativity and resonates with prior discussions regarding the concept of 'coming into being' over time. Here, the probabilistic underpinning of

quantum physics enables a plethora of potential realities to manifest in the observable universe from this unobserved quantum state. This association suggests that our perceptions and consciousness might possess inherent limitations in fully apprehending reality. Instead, we perceive the quantum realm through the classical physics framework—through conscious sensory and cerebral mechanisms—which may not entirely capture the true essence of reality.

The concept of the ‘now-point’ interlinked with a multitude of events and entities unveils new avenues for the observer’s role in crafting new pathways along the time continuum, thereby potentially facilitating the influence of both conscious choices and unconscious possibilities. As such, the Co-Occurrence Time Model, with its amalgamation of quantum entanglement, relativity, and temporal structure, lays a foundational pathway towards a more holistic understanding of time. Moreover, this model contributes significantly to ongoing discourses in physics, philosophy, and the study of consciousness.

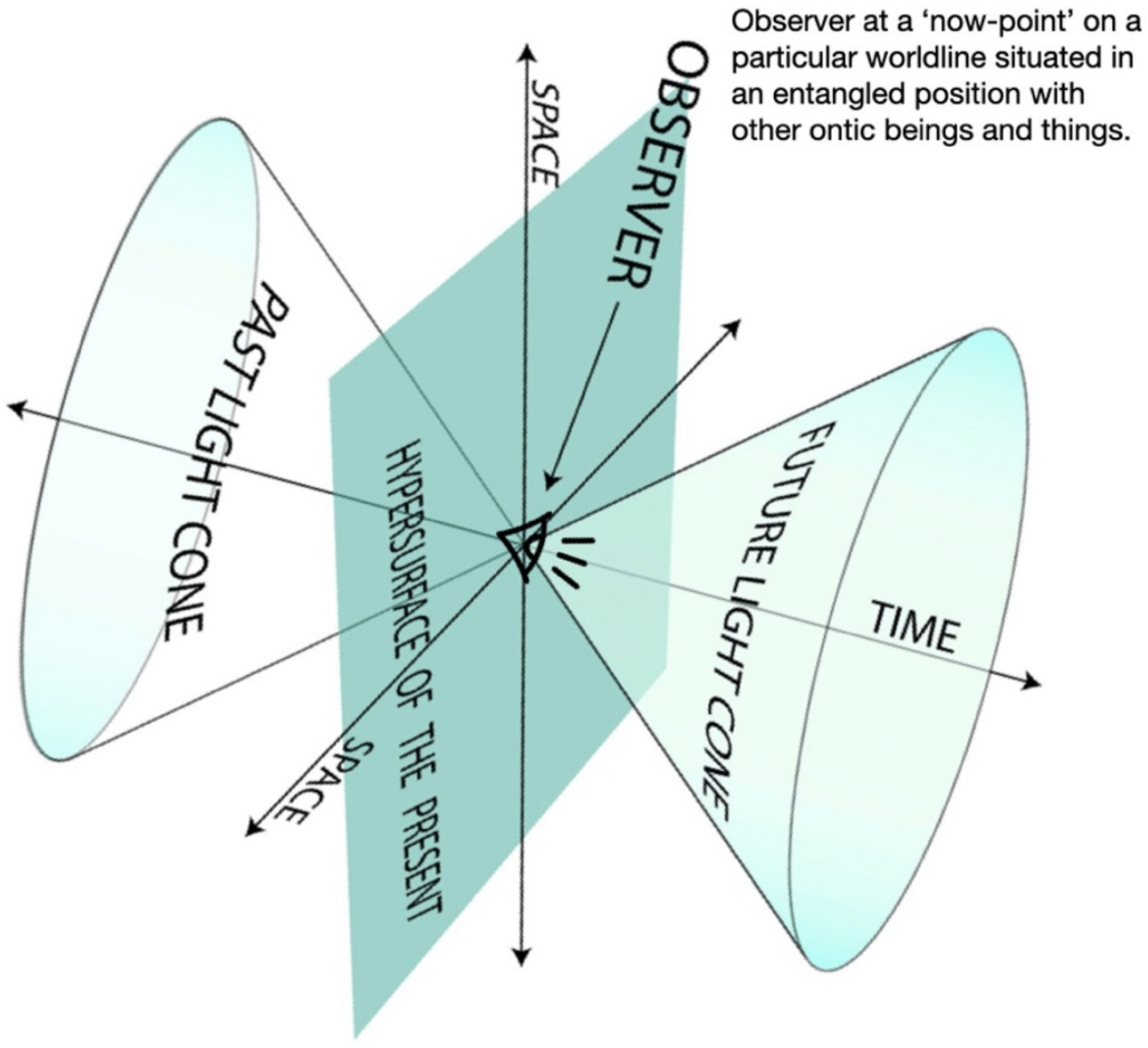

Figure 2. Time Cones, illustration credits to Dendrinos (2019)

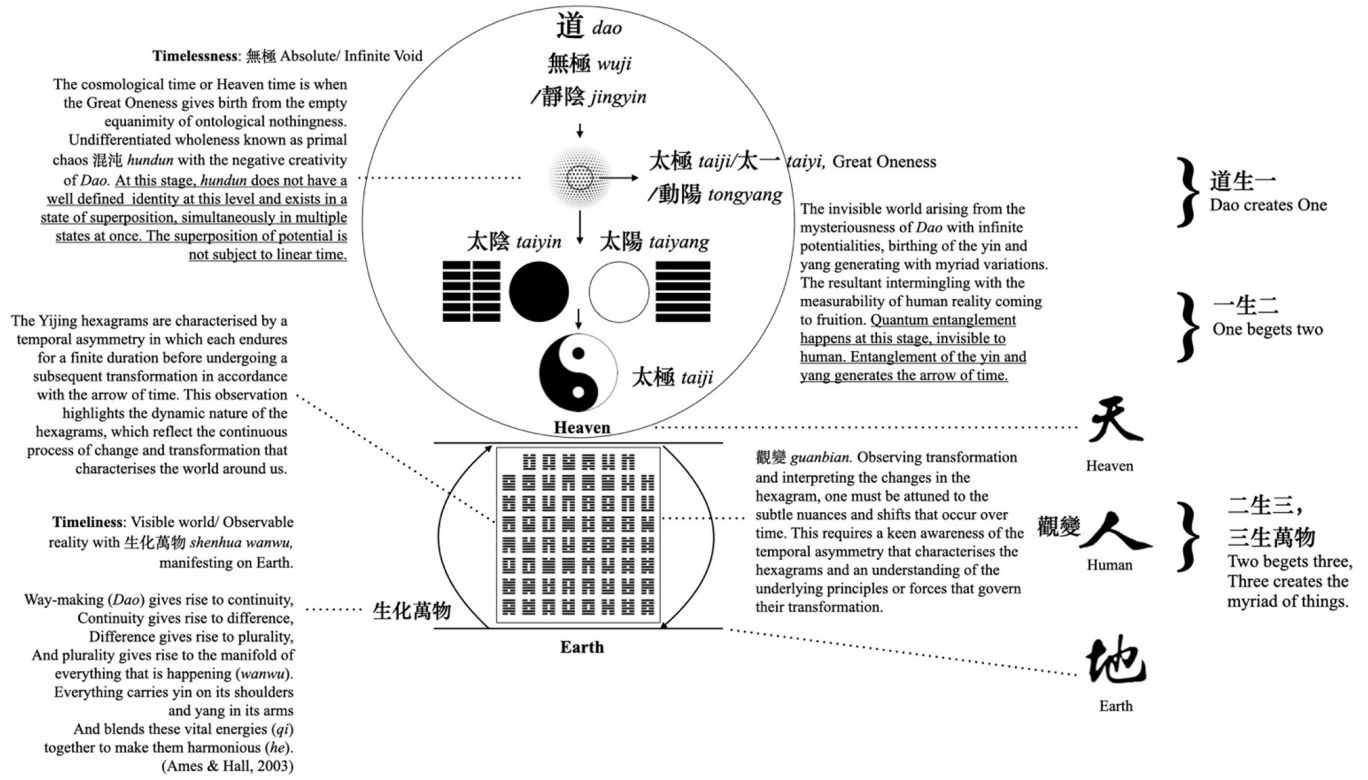

Figure 3. Timelessness to Timeliness, from undifferentiated infinite void to materialisation to the myriad of things

The Co-Occurrence Time Model and the observer's role in guiding new trajectories along the temporal stream are not merely confined to physics but also resonate with ancient Chinese philosophical doctrines. The *Dao*'s concept of *hundun* and *you wu hun cheng, xian tian di sheng*suggests the interplay between the timeless emptiness of ontological nothingness and the creative potential of *Dao* embody these ideas. This suggests that the notion of the 'now-point' is not predetermined but contingent on the observer's conscious actions, engendering new possibilities and branching trajectories along the time flow (illustrated in Figure 1). This paper argues that the 'Great Oneness' (illustrated in Figure 3) derived from the *Dao* is situated in the observer's unconsciousness. *Daodejing* Chapter 42 explains the universe as a manifestation of the interplay between the timeless emptiness of ontological nothingness and the creative potential of *Dao* in chapter 42 of the Daodejing *dao sheng yi, yi sheng er, er sheng san, san sheng wanwu.*

Adler (2020) translated as:

> *Dao engenders one,*
> *One two,*
> *Two three,*
> *And three, the myriad things.*

This might also be read as:

> *Dao gives rise to continuity,*
> *Continuity to difference,*
> *Difference to plurality,*
> *And plurality, to multiplicity.*

The Co-Occurrence Time Model and the observer's role in moulding new trajectories challenge the materialistic perspective of reality, suggesting a deeper plane of reality accessible only through an understanding of the interaction between void and potentiality. This contests the notion of a linear timeline, positing instead a cyclical time that spirals back to its origin. Furthermore, the 'Great Oneness' symbolises the primordial state of existence that precedes any material manifestation and entanglements on Earth. These concepts, resonating in contemporary physics and ancient Chinese philosophy, offer valuable insights into the nature of time and the universe. However, further research is warranted to grasp their implications fully. Nevertheless, this synthesis of ancient philosophical thought and modern theoretical physics paves the way for new directions in understanding time, consciousness, and free will.

Conclusion

The mystifying nature of human temporal perception is a widely recognised phenomenon, examined through numerous cultural lenses, including *Dao*, *Yijing*, and contemporary science. *Zhuangzi*'s cosmology, as explained by Chai (2014):

> *one must forget the distinctions between things so as to grasp their true nature. Having grasped the notion that things do not originate in the realm of human measured time, the sage forgets it so as to attend to that pertaining to heaven. In knowing heaven, he sees the myriad transformations of things as but the self-so fulfillment of cosmological time. Having grasped the notion of cosmic temporality, the sage also learns to forget it so as to comprehend that which belongs to the timelessness of Dao (p. 369).*

Contrastingly, traditional Western theories often dissect present time via socio-historical conditions, placing past and future time in context. The prevalence of A-theorists' perception of time in Western thought is exemplified by Zimmerman's appeal to 'commonsense' to advocate for presentism (Liu, 2017). However, time's existential and ontological reality is not in the past events as future possibilities. Instead, it lies in the realization that time is illusory, and the perception of distinct temporal moments stems from the observer's consciousness. From relativity theory to quantum mechanics, scientific frameworks to describe time's nature have advanced but find uncanny congruency with *Dao*. Nevertheless, the enigmatic nature of time experience remains elusive. Time seems to flow continuously but is also shaped by the observer's consciousness, generating an illusion of discrete temporal moments. Cultural interpretations, such as *Dao* and *Yijing*, offer unique perspectives on time's nature. *Dao* considers time a cosmological concept amalgamating the 'past-present-future' linearity in cyclicity, while *Yijing* associates motion with hexagram representations.

In conclusion, fully comprehending the elusive nature of human temporal perception remains a formidable challenge, with

various cultural interpretations, such as *Dao* and *Yijing*, offering unique insights. The recognition that time is illusory and that any perception of discrete temporal moments is a product of the observer's consciousness and free-will actions is a vital component of comprehending time within the *tian ren di* (Heaven-Human-Earth) framework presenting *ji*. The integration of scientific and cultural perspectives is essential in the pursuit of understanding the enigmatic nature of temporal experience.

About the Author

David Leong, Ph.D., is an entrepreneurship theorist with over twenty-five years of practical experience as a serial entrepreneur. His entrepreneurial journey commenced shortly after obtaining his Bachelor of Business Administration degree from the National University of Singapore in 1994. Dr Leong has been the driving force behind the inception of no fewer than fifteen ventures, traversing sectors that include corporate finance, consultancy in business and marketing, technology solutions, asset management, and human resources.

Acknowledged as an authoritative figure and thought leader in the business domain, Dr. Leong's expertise is frequently solicited by local media outlets like The Straits Times, Business Times, Lianhe Zaobao, and Channel News Asia, particularly for his insights on economic trends, political analyses, and human resources developments. His academic endeavours are focused on the study of entrepreneurship, while he also has a scholarly interest in the ancient Chinese Yijing (Book of Changes), exploring its intersections with contemporary scientific fields such as quantum physics.

Dr. Leong is a prolific contributor to academic and professional literature, authoring numerous articles and book chapters that span his diverse research interests. He has also penned a book titled "Uncertainty, Timing and Luck on Quantum Terms in Entrepreneurship", which delves into the nuanced interplay of chance and strategic decision-making in the entrepreneurial landscape- https://www.amazon.com/Uncertainty-Timing-Quantum-Terms-Entrepreneurship/dp/1636483534

For a more comprehensive overview of his work and contributions, please refer to https://peopleworldwide.com/davidleong.html.

Statements and Declarations

Acknowledgements

I am profoundly grateful to Professor Cheng Chung-Ying for his guidance when I investigate the convergence of metaphysics and contemporary science. His invaluable guidance, delivered through numerous telephone consultations, insightful feedback on my drafts, and the sharing of his extensive research in these thematic areas, has been instrumental to my studies. In addition, he has expertly directed my attention to many specific academic papers, which I have found to be congruent and pertinent to my work. Finally, I wish to extend my sincere appreciation to Professor Cheng for his enduring interest in and support for my research endeavours. His contributions have significantly shaped the quality and depth of this academic pursuit.

Conflict of Interest Statement

The author declares that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Footnotes

[1] Physics 219 5–6

[2] Physics 219a 34–219b 1

[3] Timing of space refers to the idea that time is a dimension that can be measured and represented in a similar way to space. In this approach, time is seen as a linear and objective dimension that can be divided into discrete units and measured with clocks. This perspective is often used in fields such as physics, where time is seen as a fundamental part of the universe that can be measured and studied using mathematical models.

[4] Spacing of time, on the other hand, refers to the idea that time is not a linear and objective dimension, but rather a subjective experience that is influenced by our perceptions, emotions, and cultural backgrounds. In this approach, time is seen as a flexible and context-dependent concept that is shaped by our experiences and interpretations. This perspective is often used in fields such as anthropology, where the cultural and social dimensions of time are studied and analysed.

[5] Superposition is the ability of a quantum system to be in multiple states at the same time until it is measured. In quantum mechanics, particles can exist in a superposition of multiple states simultaneously, meaning they have a probability of being in any one of those states when measured. This is in contrast to classical mechanics where particles have a definite state at all times.

[6] Oxford dictionary defines ontic as relating to entities and the facts about them; relating to real as opposed to phenomenal existence.

[7] *ji* represents the opportunity for creative combination or creative entanglement of primordial elements to effect a materialistic reality. Chang (2009) described *ji* as the incipient movement; *ji* is "a symbol of the initial movement that a person must spot in order to understand the direction of change and the environment of the future" (p. 219).

[8] Ibid., Xici Zhuan 1 : 7.

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