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THE PARTICLE-WAVE DUALITY OF HUMANS

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Abstract
This research aimed to elucidate the duality of body and soul in humans by using quantum physics to conceptually explain the body of light and energy of near-death experiencers. The idea of particle-wave duality was initially proposed by Louis de Broglie, a physicist, in 1923. He suggested that matter could display both particle-like and wave-like characteristics. It was developed to describe the behaviour of microscopic entities, such as light and electrons. This study extended the concept non-empirically to humans and called it "The Particle-Wave duality of Humans. From quantum physics, the particles within the human body may even act as waves outside the body after death or during near-death experiences (NDEs). Individuals who have had these experiences reported feeling as if they hovered above their lifeless bodies as entities of light and energy. Given that matter can occupy both particle and wave forms, the intertwined particles in the human body behave as waves (soul) and can depart from the body at death. These waves contain energy, which aligns with the law of conservation of energy, stating that "energy can neither be created nor destroyed, but can be converted from one form to another." The energy carried by these intertwined particles changes into light energy, carried by light waves. The soul is non-corporeal (meaning it has wave properties). By introducing the concept of quantum physics into near-death experiences reported, we concluded that a human exists as a particle in a physical realm and as a wave in a non-physical realm.

Key terms: Body, near-death experiences, particle-wave duality, quantum physics, soul.

1.0 INTRODUCTION

In many philosophical and religious beliefs, the soul is seen as something that is not made of matter and exists beyond the physical world (Falk, 2004; Pickette & Rutherford, 2010). However, science does not support the idea of a soul because there's no proof that can be tested or measured. The scientific method needs evidence that can be observed, tested, and repeated, and the soul does not fit that standard. Neuroscience and physiology relate consciousness to brain activity. A lot of scientists have a materialistic viewpoint, which holds that reality is basically material and subject to physical laws, leaving no space for non-material entities like souls. However, there are some neuroscientists who advocate for a soul. Mario Beauregard, a neuroscientist, showed that our emotions, which are presumably not physical in nature, can change our brain states and affect our epigenetic patterns (Beauregard & O'Leary, 2007). Jeffrey et al. (1996), a research psychiatrist at the University of California, studied the idea that the actions of the mind have an effect on the workings of the brain. His breakthrough work on obsessive-compulsive disorder provided the hard evidence that the mind can control the brain's chemistry. Researchers have been studying near-death experiences, consciousness beyond the brain, and unexplained energy patterns that suggest the existence of something beyond physical.

The human body is a complex biological machine composed of trillions of cells organised into tissues, organs, and eleven major organ systems (integumentary, skeletal, muscular, nervous, cardiovascular, lymphatic, respiratory, digestive, urinary, endocrine, and reproductive) that work together to maintain life. The human body contains elements like oxygen, carbon, and hydrogen, which interact to maintain the body's internal environment. The human body, being material, can be represented by the particle in the particle-wave duality of matter (De Broglie, 1924), while the soul, being immaterial, can be represented by a wave. A wave refers to a fluctuation that moves through a medium. As the wave moves, the medium may show some local back-and-forth movements, but the individual particles in the medium do not actually travel along with the wave. For instance, sound waves in air make the air particles move back and forth around their resting positions, but it is the disturbance itself that travels, rather than the particles in the air. The concept of particle-wave duality is a fundamental principle of quantum physics. Quantum physics is the study of matter and energy at and below the scale of atoms. In this study, we will conceptually demonstrate via quantum mechanics that a human possesses an immaterial entity called the soul in addition to the body.

2.0 LITERATURE REVIEW

Perspectives of Some Fields on Body and Soul

The Psychology of Body and Soul

In what is known as "physiological psychology," a Persian physician named Avicenna established a link between emotions and bodily reactions as early as the eleventh century. Neurobiological, psychodynamic/psychoanalytic, behavioristic, cognitive, social learning, and humanistic perspectives are some of the theoretical approaches or perspectives of contemporary psychology. These approaches have their roots in the works of various scholars, including ancient Greek philosophers, physicians, and scientists. This explains the evolution of modern psychology from physiology and philosophy. One of the theories that aided in the development of psychology is called "Dualism", or the psychology of body and soul. We would consider a few of Descartes, Plato, Aristotle, and Wilhelm Wundt's contributions.

The idea of dualism holds that the human body and mind are two distinct entities. Cognitive psychology, the concept and study of cognition or thought processes, is thought to have originated from this point of view. Cogniton, ergo sum, which means "I think, therefore, I am" in Latin, is what Descartes claims it means in English. Descartes went on to say that the ability to think is what gives humans the right to exist. Plato (428-347 BC) introduced the concept of "dualism," which holds that there are two types of substances: mental and physical. A physical substance is a material representation of our body. The soul is the immaterial or mental substance. Aristotle, a renowned ancient Greek philosopher and scientist (who was Plato's student), was credited with being the first to fully discuss psychological issues. Sensations, sleep, /dreams, memory, and so forth were among his concepts. He disagreed with the mind/body dichotomy, despite advocating for the application of objective, systematic observation. As previously mentioned, Wilhelm Wundt, a German physician with training in physiology, developed an interest in the human mind and eventually founded the first laboratory in 1879. He examined a psychological system in his book "Principles of Physiological Psychology."

The psyche, representing a person's soul, allows individuals to be aware of their environment, other individuals, and their own bodies. Therefore, people can carefully observe their bodies, the actions of others, and the intricate layers of nature, but they cannot examine their own souls. Similar to higher animals, humans at this psychological level experience a range of strong emotions, from intense aggression to the more positive feelings linked with empathy, care, and attachment. At the "soul" level, people can engage in insightful learning or pattern recognition, as well as programmed or operant learning. Additionally, individuals at this stage can perceive and respond to the "rhythms" and "cycles" found in society and nature. Beyond their sensory systems and motor abilities, areas such as the Insula, Cingulate Gyrus, and lower Limbic System play significant roles in the mid-brain regions. Some functions at this level are conscious and voluntary, while others occur automatically and unconsciously. Psychologists have proposed that substances like adrenaline, serotonin, dopamine, endorphins, and encephalins facilitate and modify numerous brain and mind functions, influencing personality traits.

The Physiology of Body and Soul

Human physiology focuses on how the body works and functions. Once people comprehended the layout of the human body and its operations, the groundwork for contemporary medicine was established, leading to significant changes. This understanding has brought about remarkable achievements and progress in medical science. The brain serves as the organ that maps our body, the external environment, and our experiences. Injuries to the brain, such as from accidents, dementia, or congenital defects, can result in corresponding damage to one’s personality.

Think about one of the roles that the soul is believed to perform, as suggested by Plato, which is memory. A significant blow to the head can erase memories from the last few years. If the soul is a non-physical entity distinct from our body, it should remain unharmed by such an impact. If memory were to be stored in the soul, it would not have been affected.

The brain's neuronal activity is responsible for the cognitive and emotional issues experienced by individuals with autism; it would be harsh and unethical to hold their supposed souls accountable. Adjustments to the brain are enough to change feelings and moods. The soul plays no necessary role in this process. The impact of psychotropic medications on mood offers further support against the existence of the soul. Creating a chemical imbalance in the brain, like lowering dopamine, noradrenaline, and serotonin levels with tetrabenazine, can lead to depression in some individuals. Similarly, many who suffer

from depression may find relief through medications that enhance the activity of these neurotransmitters in the brain. The brain is the centre for thought processes, where love and hate exist, sensations become perceptions, personality develops, memories and beliefs are stored, and choices are made. As D.K. Johnson remarked: "There is nothing left for the soul to do."

Soma (the human body) encompasses all the necessary functions to sustain a person physically, such as digestion, metabolism, breathing, restoring Cerebrospinal Fluid (CSF), heart functions, waste removal, and the cycles of waking and sleeping. Many of these operations are governed by the Medulla and Pons, which form the "brain stem" located at the top of the spinal column. Physiology investigates measurable correlates such as consciousness, cognition, and self-awareness. Contemporary neuroscience frames these phenomena as emergent properties of dynamic brain–body interactions, supported by large-scale integration of neural processes. The concept of the Neural Correlates of Consciousness **(**NCCs**)** focuses on identifying the minimal neural mechanisms sufficient for conscious perception (Koch et al., 2016). These have been explored using EEG, fMRI, and behavioural paradigms to assess consciousness in various states (Friedman et al., 2023; Gammel et al., 2023).

The Philosophy of Body and Soul

For Plato, the idea of the soul being immortal implied that the soul existed before it connected with the body and that it continues to exist after the body dies. Many years later, Descartes published his work Passions of the Soul, in which he asserted that a difference exists between the mind, which he referred to as a "thinking substance," and the body, described as "the extended substance." He stated: … since we cannot think of the body as having thoughts in any form, we have justification to claim that every thought we experience belongs to the soul. One of the several points Descartes put forth in support of the soul's existence was that the brain, a component of the body, is mortal and has parts – implying it can be divided – whereas the soul is everlasting and cannot be divided – meaning it is a complete unit. Consequently, he deduced that they must be separate entities. The monist viewpoint in philosophy arose in the 20th century, entirely rejecting dualism. This perspective aligned with the behaviourist movement in psychology (Watson, 1930), asserting that the mind and body form a single entity.

A specific kind of monism, known as materialism, argues that all mental experiences (like thoughts, feelings, wishes, and consciousness) originate from physical matter. From the dualist viewpoint, the mind and body are seen as distinct entities; thus, mental experiences are somewhat separate from physical matter and occurrences. In Phaedo, Plato outlined his well-known dualist theory (Cooper, 1997). He suggested that eternal, non-physical forms (or immortal souls) exist as separate entities from physical bodies; they inhabit bodies during life but aim to return to the immaterial realm after death. Aristotle also supported the notion that non-material souls consist of different substances than physical bodies, but he argued that souls cannot exist on their own apart from bodies (and are therefore not immortal) (Hamlyn, 1993).

In a similar manner, Aquinas (1948) held the belief that souls are non-material substances and that individuals are only complete when their souls are united with their bodies; he suggested that without the body, no memories are retained. Descartes (1641) is recognised for establishing contemporary dualism in his Meditations. He advocated for substance dualism, suggesting that mental substances are distinct from material substances. Mental substances (or minds) lack spatial extension, whereas material substances (or bodies) cannot think. Descartes proposed that minds affect bodies via the pineal gland. His dualism supports the notion of immortal souls, as this perspective allows for non-material substances to exist

independently of the material realm. However, an alternative form of dualism, known as property dualism, maintains that only a single substance exists, which can possess either physical or mental characteristics. According to this belief, mental experiences emerge from matter but cannot be condensed into physical matter.

Overview of Human Dualism

Valtonen et al. (2021) examined the concept of neurodualism. They suggest that individuals modify cultural assertions about the brain to align with their dualist belief that minds and brains are separate, interacting entities. They carried out five studies that included both thought experiments and real-life situations that demonstrated evidence of neurodualism among the general public and, to some degree, even among practising therapists. General participants indicated that "a change in an individual's brain" is more often linked to "a change in the individual's mind" rather than the reverse. Inengite (2022) proposes that our thoughts can be likened to quantum particles and can be understood through wave-particle duality.

Vyacheslav (2023) created an overarching theory that encompasses the entirety of humanity using quantum mechanics concepts. Qureshi et al. (2023) analyse Durkheim's theories, emphasising the crucial impact of individuality and psychological factors in influencing social life. They show that Durkheim's application of the spirit/body dualism captured the complex nature of social understanding, yet it conflicted with his idea of "social fact" as an accurate representation of the external world. Rickabaugh and Moreland (2023) put forth a uniquely compelling and robust case for modern substance dualism in their work. They assert that the human being is an embodied, fundamental, non-material, and unified essence. Sergey (2024) examined panpsychism and dualism in the context of consciousness science, highlighting that panpsychism is often seen as a clear solution to the challenge of fitting consciousness into the material world, while dualism seeks a straightforward resolution to the issue of free will by attributing causal influence to consciousness as a condition for moral accountability. There seems to be no literature on the quantum entanglement interpretation of the immaterial existence of humans. We would predict conceptually the existence of the soul using quantum entanglement in this research.

Is it worthwhile to explore the concepts of body and soul in a setting where they are often regarded as outdated and sometimes considered a non-academic approach? We believe it is important and even urgent; at the very least, we should not dismiss potential alternatives while earlier questions still seem difficult to address from today's viewpoint (Majorek, 2012). The examination of how body and soul relate has been an important topic in both philosophical and psychological inquiry (Kreitler, 2018; Weger et al., 2018; Duoyi, 2023). Weger et al. (2021) investigate aspects of a dichotomous (body-soul) versus a trichotomous (body-soul-spirit) view of human nature. For this study, we will adopt the dichotomous (body-soul) view of human essence. In this research, the question of the existence of the soul is answered conceptually using the concept of quantum entanglement in quantum physics.

Quantum Physics

The behaviour of matter and energy at the atomic and subatomic levels is explained by quantum physics, incorporating concepts such as quantisation, wave-particle duality, quantum wave function, entanglement and the uncertainty principle (Einstein, 1905; Born & Jordan, 1925; Born, 1978). Developed in the early 20th century to explain things that classical physics couldn't, such as blackbody radiation, the photoelectric effect, and atomic spectra, quantum mechanics describes particles through wavefunctions, which are governed by the Schrödinger equation. The world of quantum physics is very different from how we

usually see our macroscopic world, which is controlled by classical physics. Quantum physics came out of the amazing achievements that physicists made in the early 20th century to understand the microscopic world around us and how it is different from the macroscopic world. Quantum physics describes a paradoxical world where particles behave like waves, events are determined by probability, and the mere act of viewing something has the power to alter it. Far from being just a theoretical idea, quantum physics is the bedrock of numerous contemporary technologies, such as semiconductors, lasers, and even quantum computers. Quantum mechanics is fundamentally probabilistic, unlike classical physics. The wave function describes the likelihood of different outcomes, not certainties. The following are studied in quantum physics.

Wave-Particle Duality

In diffraction tests, light acts like a wave, but in the photoelectric effect, it removes electrons from metals like a particle would. Similarly, when electrons are exposed to a double slit experiment, they exhibit interference patterns. This was summed up in the de Broglie hypothesis.

The Uncertainty Principle

We cannot exactly know both the position (x) and momentum (p) of a particle simultaneously according to this principle. It is a basic limit, not just an error in observation.

Superposition and Entanglement

A quantum particle in many states can collapse into one state when observed. Entanglement takes place when particles become associated in such a way that the state of one immediately affects the other, regardless of the distance.

The Schrödinger Equation

The Schrödinger equation transformed physics by introducing a model based on probability for particles and making predictions about phenomena that classical physics could not, such as quantum tunnelling, energy quantisation, and wave-particle duality.

Scattering Theory in Quantum Mechanics

Scattering theory focuses on how quantum particles (like electrons or neutrons) interact with targets or potentials. It helps understand particle collisions, atomic structures, and nuclear reactions.

Quantum Entanglement

Quantum entanglement is the phenomenon where the quantum state of each particle in a set of particles cannot be described apart from the state of the others, even when the particles are widely separated from one another (Alain, 1982). Quantum entanglement is an intricate phenomenon in quantum physics that explains an invisible connection between distant quantum objects that causes one to instantly affect the other. These quantum particles could be, for example, electrons or photons, and the state could be the direction of spinning. The concept of quantum entanglement is a primary focus in quantum physics, not classical physics. The soul can be conceptualised as a complex, interconnected system similar to quantum entangled particles that connects and influences various aspects of our being, and can interact beyond the physical body as a wave. This interconnectedness may help to explain phenomena like near-death experiences, where consciousness appears to persist independently of the physical body.

3.0 FINDINGS AND DISCUSSION

The human body, being composed of many particles, is represented conceptually by a particle. We represent the soul as a wave by using the concept of quantum entanglement in quantum physics. Quantum entanglement is applied conceptually to the described immaterial bodies of near-death experiencers. The immaterial body (soul) is made up of a more refined substance that does not have physical presence compared to the denser material body (Serdahely, 1993). One of the characteristics of the soul is its ability to travel at a high speed. Increasingly, recent literature on NDEs has highlighted instances suggesting that human personalities exist as both a physical entity and an ethereal being. Some features of NDEs are challenging to clarify within our existing frameworks of psychological or physiological processes. For instance, individuals often report having observed their own bodies from an external vantage point and can accurately recount events that transpired around them while they were believed to be unconscious, or they perceive events happening at a distance far beyond their natural sensory capabilities, including blind participants who describe accurate visual experiences during their NDEs.

Particle Nature of Humans

For a long time, scientists have understood that all materials are made up of atoms, which include neutrons that carry no charge, protons that have a positive charge, and electrons that are negatively charged. In stable atoms, neutrons and protons form the nucleus and are bound tightly by a strong nuclear force, making them hard to separate. The lightweight electrons are attracted to the nucleus by a weaker nuclear force and can be easily removed from the atom through high temperatures or chemical reactions. With the introduction of high-energy particle accelerators, it became feasible to disrupt the strong nuclear force by boosting nuclear particles to significant energies and colliding them with target atoms. These collisions resulted in the disintegration of target atoms, enabling scientists to explore the particles generated from the original atom. The behaviour of matter suggests its characteristics are partly influenced by quantum connections with the environment. Thus, the nature of an object, such as an electron, acting more as a wave or a particle, is not exclusively defined by the electron alone but is also influenced by its surroundings (Bohm, 1989).

When viewed in relation to the vast universe, the human body can be regarded as a particle according to classical physics. Human bodies consist of numerous particles. At their most basic form, they are constructed from atoms, the essential units of matter. These atoms are further made up of smaller entities known as protons, neutrons, and electrons. A human body comprises an incredible number of atoms, estimated to be around $7x10^{27}$ for a person weighing 70kg. Atoms join to create molecules, which consist of two or more atoms connected by chemical bonds. In turn, these molecules form the intricate structures of cells, the fundamental units of life. Cells are grouped into tissues, which create organs, and these organs are organised into systems that collaborate to execute particular functions.

Wave Nature of Humans

According to the concept of quantum entanglement in quantum physics, when two particles are intertwined, they function as a single unit rather than as distinct entities, indicating that phenomena in the quantum realm differ greatly from our observations in the larger world. In an entangled condition of subatomic particles, there will be a perpetual transfer of energy among these particles, allowing them to interact in ways that lead to the accumulation of information. These particles might even communicate as waves outside the physical form. Given that the human body consists of numerous interacting particles, continuous interactions might persist beyond the body after death or during experiences close to death.

Those who have had near-death experiences describe their immaterial bodies or souls as being lighter, more elastic, and more in harmony with their environment, with enhanced capabilities of sight and hearing. These spiritual forms are frequently depicted as energy bodies, luminous forms, or bodies of fine matter, serving as sources of light and power for their physical counterparts (Gibson, 1994; Eadie & Taylor, 1992).

The Physics of Body of Light and Energy in Near-Death Experiences

The human body is made up of many (atomic and subatomic) particles that interact with each other. According to quantum physics, each particle possesses a unique quantum state. Occasionally, two particles may influence each other and form an entangled system. This describes a situation where the characteristics of two or more particles become interconnected in ways that classical physics cannot clarify. Despite having extensive information about each other, these particles do not communicate directly. There are no communications such as, "I'm going down, so you must go up," waiting for a response. Nevertheless, these particles remain linked and can function as a single entity. Since matter can be both particles and waves, these entangled particles can behave as waves and may exit the human body upon death. These waves carry energy, which aligns with the conservation of energy principle, stating that energy cannot be created or destroyed, only transformed from one type to another. The energy from these entangled particles changes into light energy, transmitted through light waves, and this can be taken as a soul. A soul departing from the physical body can be regarded as a body of light carrying energy. The soul is non-physical, meaning it has wave-like qualities and can move at the speed of light.

4.0 CONCLUSION AND RECOMMENDATIONS

Conclusion: In this paper, we examined the nature of human beings as both body and soul nonempirically through the lens of quantum entanglement. We extended the wave-particle duality concept from quantum physics to the realm of human consciousness. The physical body is made up of numerous particles. Fundamentally, it consists of atoms, which serve as the essential components of matter. Atoms, in turn, are formed from even tinier particles, such as protons, neutrons, and electrons. When atoms join together, they create molecules, which are clusters of two or more atoms bonded by chemical forces. These molecules then constitute the intricate formations of cells, the fundamental units of life. Cells are arranged into tissues, which form organs, and these organs are organised into systems that collaboratively perform designated functions. The human body contains many interacting particles that may entangle and interact in the form of a wave according to the particle-wave duality of matter. Ongoing interactions of the waveform might occur beyond one's physical body after death or during a near-death event. Individuals who have experienced near-death describe their souls as a luminous body of energy. The entangled particles transport energy, and following the principle of energy conservation, which asserts that energy cannot be created or destroyed, only changed from one form to another, the energy from these interconnected particles shifts into light energy that is emitted through light waves. When a soul departs from its physical body, it becomes a body of light that carries energy. The soul is incorporeal (i.e. wave-like in nature) and travels at the speed of light. In philosophical and religious contexts, the soul aligns with the psyche in psychology and the concepts of mind or consciousness in scientific discussions. The mass of a soul (as a body of light) is exceedingly minimal to the point of being considered massless, thus it can move through obstacles. The particle aspect of humanity corresponds to the physical body, while the wave aspect represents the soul. In conclusion, we present a new concept in this study called "The particle-wave duality of humans." It states that humans exist both as a particle (body) in the physical realm and as a wave (soul) in the non-physical realm.

Recommendations: Presently, the scientific community has not provided an adequate explanation for near-death experiences, even though substantial data have been collected on this phenomenon for nearly twenty-five years. Therefore, we suggest further investigations to analyse the body-soul dualism in humans empirically from a scientific viewpoint by examining near-death experiences. Also, further research is important to know how the brain interacts with the entangled particles in the body.

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