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Review Article

Disinhibition: A Conceptual Hypothesis to Explain Near-Death Experiences and Out-of-Body Experiences

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Abstract

Living beings create order while, under the second law of thermodynamics, producing greater disorder through metabolic heat dissipation. Consciousness creates additional order that supports survival and reproduction, generating an entropy debt that must be discharged non-metabolically as heat according to Landauer's principle through information erasure within the "explanatory gap" of the hard problem. Consciousness is assumed to depend on tryptophan in microtubules and its capacity for heat dissipation through superradiation. After post-mortem microtubule decomposition, this mechanism would cease, violating Landauer's principle and the second law; therefore, survival after death would imply life-before-death solipsism. This framework distinguishes near-death experiences (NDEs) and out-of-body experiences (OBEs) from life after death and proposes natural biophysical mechanisms. NDEs and OBEs may result from disinhibited microtubular consciousness after electroencephalographic activity stops, while microtubular tryptophan remains activated by ultraviolet photons. These photons may originate from light reaching the retina or skin and be transmitted to the brain through mitochondria and microtubules functioning as optical waveguides. Ultra-weak photon emissions also accompany membrane depolarization at death. The transactional interpretation of quantum mechanics may explain entanglement between microtubular and environmental photons, potentially accounting for rare veridical extraocular perceptions. Veridical auditory experiences may involve ambient sound stimulation of Heschl's gyrus through auditory-nerve axonal solitons or transcranial low-frequency sound perception. Finally, near death, a pseudo-solipsistic sense of "added time" may produce an apparent eternity despite progressively declining microtubular stimulation in the dying brain during the final stages of consciousness.

Keywords: *Consciousness, Near-Death Experience, Out-of-Body Experience, Microtubules, Biophotons.*

Ethics committee approval: There is no need for ethics committee approval.

Introduction

Is death the end, or is there a possibility of an encore? It is possible to show that a life after death would violate entropy, a fundamental principle of physics. This principle requires that for every physical process, the total amount of disorder increases, primarily through heat dissipation and decreased capacity to do work. To understand how this relates to consciousness (and its ultimate extinction), I will need to connect the physics of entropy to quantum mechanics and the biology of microtubules and biophotons. This will provide conceptual support for a disinhibitionary hypothesis explaining near-death and out-of-body experiences, placing limits on the duration of life-after-death as being necessary to guarantee a genuine life-before-death.

Consciousness and Entropy

A paper published in 2024 linked entropy to consciousness.[1]The entropic theory of the emergence of consciousness solves the problem of how a conscious level of information, such as qualia, etc., could be created as an emerging event, while, at the same time, preserving the conservation law of information, which denies the possibility of creating information. This dilemma is resolved by treating such events as irreversible computations. As David Chalmers, who coined the term "the hard problem of consciousness", wrote, "if computation is sufficient for consciousness, then we will have consciousness".[2]Irreversible computations, like consciousness, combine two or more inputs into a single output and are subject to Landauer's principle, according to which bits of information temporarily stored during computation are subsequently destroyed and converted into heat.[3]This allows the repetition of the computational cycle. Simultaneously with the emergence of consciousness, the destruction of information in the computations that lead to consciousness preserves the conservation law that prohibits the formation of conscious information, while also performing work, releasing heat, and increasing entropy.

Consciousness and quantum theory

Consciousness has been associated with quantum theory since quantum theory’s inception because micro-scale particles, if undisturbed, behave in a perfectly defined, time-reversible manner, mathematically described by the Schrödinger equation, according to which the particle exists in a probabilistic superposition of all possible positions. However, consciously observing such a particle causes the wave function to be reduced or "collapsed," and the particle appears at a particular point. The puzzle was how a conscious observation could subjectively cause this reduction. Later theorists inverted this puzzle, suggesting that the reduction occurs spontaneously or objectively, and that a small burst of consciousness emerges each time it occurs. Meanwhile, quantum particles interact with their environment, making them "entangled" with countless other particles, linking their behavior but diluting or leaking the quantum properties associated with their probabilistic superposition. Consequently, numerous interacting quantum particles no longer behave deterministically and time-reversibly; instead, we observe their familiar "classical" behavior. This blurring of the probabilistic determinism of quantum particles introduces uncertainty into the classical physics we experience, while simultaneously settling on the most robust of possible outcomes. This process is called "decoherence".

A theoretical inverted mechanics of how consciousness emerges from neurons through the objective reduction of the quantum wave function was provided by Roger Penrose and Stuart Hameroff's Orchestrated Objective Reduction (Orch-OR) theory. In this theory, the superpositions of particles are progressively separated by the curvature of spacetime between them until the wave function collapses under the influence of gravity, creating a momentary consciousness. To create sustainable consciousness, this effect needs to be rapidly amplified in a repeated manner; this is uniquely facilitated by the specific properties of tryptophan amino acids in the microtubules of neurons.[4] As part of the calculations that lead to the formation of consciousness, these molecules exhibit fluorescence and superradiance[5], while emitting the heat required by Landauer's principle to complete each step of the process. In the Entropic Theory of the Emergence of Consciousness, the wave function collapse theory is a Direct Action theory of objective reduction, proposed by Ruth Kastner[6] which differs from the gravitationally-induced model of Penrose. Instead, the collapse is triggered by the absorption of ultraviolet photons by tryptophan molecules.

The attainment of consciousness reduces an individual's entropy by enhancing their ability to self-organize and, especially, to non-instinctively solve novel problems; this, in turn, increases their probability of survival and their capacity and willingness to perform the often complex rituals necessary for successful sexual reproduction. This decrease in entropy is not free, and must be accompanied by a balancing increase in entropy. This could be achieved through fluorescence and

superradiance as the computations that led to the emergence of consciousness are erased.

Consciousness and the Landauer Principle

From this, it was proposed that the increase in entropy in an irreversible, unpredictable (emergent) system necessitates the simultaneous and permanent erasure of information related to the associated steps or computations, in order to balance the decreasing entropy associated with the emergence. The decreasing entropy of the emerging system is balanced by the increase in entropy radiated as heat. From this, it follows that the steps sought in the quest to understand consciousness are annihilated by entropy and will always remain a mystery. The theory predicts that consciousness must be work and must be hot. Since we must continuously apply Landauer's principle to the erasure of the associated computations as long as we are conscious, consciousness is considered work. Consequently, we can expect to tire of consciousness after a number of hours and switch it off and sleep. The warmth is due to the heat generated by applying the Landauer principle to the associated computations; it may eventually be possible to measure this heat and compare it to a calculated emission based on the theory.

Life after death can, in principle, be reduced to solipsism

If this entropic constraint on the mystery of consciousness is accepted, it eliminates the possibility of life after death as being contrary to the laws of thermodynamics; for there would be no physical system through which consciousness could dissipate the waste heat of the necessary computations, which rely on the superradiance of tryptophan. Accordingly, the experience of life after death in a religious sense would mean that our entire existence occurred without the benefit of neurons, which can only mean that our life takes place within the power of imagination of a some form of spiritual existence not bound by the physical laws it envisions. Such an existence could be considered as the culmination of mystical experience, but it would be indistinguishable from what is known as solipsism. Solipsism is a lonely, empty, meaningless illusory existence in which all our joys are false and all our sufferings are self-inflicted without reason. A desire to avoid solipsism should strengthen the justification for belief in the finality of death.

Near-Death Experience

As a consolation for the absence of an afterlife, there is still the possibility of having a positive near-death experience, often described as pleasant and reassuring.[7]Interviews of survivors of near-death experiences (NDEs) reveals a variety of visions, first described by Raymond Moody, typically beginning with an out-of-body experience and progressing through up to nine stages. In a personal communication, one NDE survivor highlighted the extraordinary *vividness* of both the experience and the memory of it, which were unlike any dream. These experiences might include light at the end of a tunnel, sounds, joyful encounters, life-reviews, and even a message from one's deity that one's time had not yet come; however, there is no way of knowing what happened to those who did not survive. In fairness, perhaps 10-20% of cases are reported as being distressing, painful, "hellish," and void-like.[8]One young woman was taunted by voices telling her that all of life was a hallucination and that she would remain forever naked in a vacuum—the existential horror of solipsism! (Others familiar with Buddhism, however, viewed such a void as a blissful Nirvana). Negative life assessments have led to overwhelming remorse, but there is no evidence that career criminals are more likely to experience disturbing NDEs. A common feature of NDEs is their ability to stretch and extend perceived time relative to that of the bedside observer.

Timing of Near-Death Experiences and Associated Brain Electrical Activity

All of this must depend on some kind of continuing brain cell function. Microtubules in the brain, in particular, are thought to be very stable and can last a lifetime; however, when they break down, disorders like Alzheimer's disease occur. According to Orch-OR, some form of consciousness can continue until our microtubules deteriorate. According to the Entropic theory, this time frame is further limited by the time photons remain in the brain able to interact with tryptophan. Even so, the few minutes it takes for someone to die in the time frame of an outside observer does not necessarily equate to the time elapsed in the dying person's time frame. As Robert King, director of the NDE OBE project, suggests in his review paper titled "The Irrelevance of Time in Near-Death Experiences," the time perceived by the dying person can be arbitrarily long and may not be related to the amount of time the patient was deprived of oxygen during a heart attack.[9]If we consider the example of a referee starting a stopwatch after the 90th minute of a football match, it might seem as if the

"added time" for the person about to die could last for an eternity.

Studies by Lakhmir Chawla *et al* suggest that NDEs may be associated with an end-of-life high-frequency frontal cortex electroencephalographic (EEG) surge in the brain, seen in approximately half of deceased patients, all of whom were sedated. This increase appeared as a single spike 180–300 seconds after complete loss of blood pressure and typically lasted 30–180 seconds.[10-11]Individual examples of double and triple spikes were observed.[11]These were not seizure-like. The authors hypothesized that this increase was related to hypoxemia-induced membrane depolarizations and that the increase in interstitial potassium caused a rapidly declining cascade of electrical activity consistent with transient cerebral excitation. They suggested that this could explain the clarity of OBEs in near-death. "Patients who suffer "near-death" experiences may be recalling the aggregate memory of the synaptic activity associated with this terminal but potentially reversible hypoxemia".[10]They speculated that this may be a "last resort" survival mechanism.[11].

Research conducted by Jimo Borjigin *et al* in rats subjected to induced cardiac arrest after general anesthesia have shown a transient increase in coherent, highly synchronized gamma wave oscillations across the brain; these oscillations are typically associated with conscious perception.[12]These were organized from front to back and were stronger than during wakefulness and anesthesia. They were tightly coupled to theta and delta waves, associated with memory tasks and cognitive control, and alpha waves, associated with visual tasks in awake humans. This research has shown that mammalian brain cells can produce neural correlates of heightened consciousness and internal information processing in the near-death period.

Out-of-Body Experiences do not necessarily have to be near-death.

Several research papers cited by King indicate that the entire NDE, including the life-review component, can occur during the few seconds of brain functionality remaining when the patient's electroencephalogram flattens or as it recovers after cardiac arrest. On the other hand, his analysis of out-of-body experiences (OBEs), relying on questionnaires completed by more than 100 people, made clear that these can occur as part of or before NDEs, but can also occur during life-in-danger experiences that may or may not proceed to NDEs, other spontaneously perceived OBEs, and self-triggered OBEs.[13]Collectively, they featured the same phenomenal experiences as are commonly reported in NDEs, although with differing commonality distributions among OBEs of different causes. Over half of the OBE subjects reported time passing faster or slower, or being meaningless or absent. Most of the phenomena reported in perceived OBEs occurring during actual near-death were also found in some perceived OBEs where the subjects were not actually near-death.

The Evolutionary Theory of Afterlife Experiences

A 2025 paper by Charlotte Martial *et al*, out of the Coma Science Group of the University of Liège, proposes an evolutionary theory to explain NDEs.[14] This theory is based on a comprehensive analysis of their neurophysiology and neurochemistry. NDEs can occur with varying levels of low blood oxygen (hypoxia), but are usually triggered by cardiac arrest. Impaired cellular respiration disrupts cellular function, and acidosis leads to an influx of sodium ions and the triggering of action potentials, an increase in intracellular calcium ions, and heightened excitability. The resultant cascade of reactions is typically seen as a response to physiological stress. Certain neurons become overactive, secreting high levels of neurotransmitters that are no longer rapidly broken down. To briefly summate, these include acetylcholine, norepinephrine, glutamate, GABA, endorphins, serotonin, and dopamine. These transmitters normally play a role in functions such as learning, attention, the fight-or-flight response, memory enhancement, coordination of brain functions, pain relief, calmness, relaxation, serenity, and feelings of self-reward. Serotonin 5-HT_{2A} receptors can activate regions of the Default Mode Network responsible for self-representation. Serotonin and dopamine in particular can also cause vivid hallucinations of self-representation with enhanced realism of the altered visual experiences. Excess dopamine can cause aberrant memories where insignificant stimuli are given excessive importance. This could explain King's observation that memories of places and structures during all classes of OBEs tended towards inaccurate perception. The suggestion that an endogenous ketamine-like neurotransmitter receptor might be responsible for dissociative effects, such as those caused by ketamine, currently lacks supporting evidence.

In certain non-near-fatal conditions, such as certain types of seizures, people can experience auras similar to NDEs. Stimulation of the temporal-parietal junction on the right side of the brain produces sensations reminiscent of disembodiment, while on the left side, it creates illusions similar to NDE encounters of other people.[14] It would seem likely that activation of these

areas during NDE/OBEs could explain much of the reported phenomenology.

Martial *et al* consider that all of these may be an evolutionarily conserved response to threats where the fight-or-flight option is no longer available. Psychologically, these may be determined, in part, by top-down processes facilitated by cognitive traits such as a predisposition to dissociation. Entering a state of mental dissociation by focusing attention on dream-like states may aid in survival in extreme situations. A tendency towards intense daydreaming and the tendency for Rapid Eye Movement (REM) sleep to intrude on wakefulness, or non-REM sleep, have been associated with NDEs. Under hypoxia, REM intrusion, along with bodily immobility, can contribute to the imagery of NDEs. The fact that they can occur with almost equal frequency in non-life-threatening situations such as fainting, near-miss accidents, or drug use, led Martial *et al* to consider that NDEs could be a defense mechanism activated by the brain when it perceives a serious threat; similar to the state of thanatosis, or "playing dead", observed in some species as a defense against predators. Indeed, some researchers have suggested that NDEs evolved from such a response; however, given that survival from an NDE is extremely rare and many individuals who experience cardiac arrest are of a post-reproductive age, I believe it is unlikely that NDEs have a strong evolutionary impact.

A Disinhibition theory of near-death and out-of-body experiences

My own theory is that the near-death experience releases unfiltered microtubular tryptophan activity from the overall inhibitory modulation of the rest of the brain's activity (i.e., electromagnetic brainwaves, axon spikes, synaptic neurotransmitters, and hormones). According to this theory, these more superficial aspects of the brain's measurable activity are critical for receiving environmental and internal stimuli, directing attention towards them and to forming and retrieving memories, directing focus and emphasis towards targets and goals, formulating inner speech, speech, and directing our motor activities. To do this, the intensity of our experienced consciousness is modulated from a state of being heightened during danger all the way to being ignored during many routine activities. This activity level of various regions of the brain during focused behavior versus various internal goal-directed tasks seems to be coordinated by the Default Mode Network.[15]However, once blood flow stops, all of the rest of the brain's activity soon ceases, and the oxygen-deprived neurons can no longer produce electrical activity detectable by electroencephalogram (EEG). If our electrochemical brain activity does indeed function to diminish the intensity of the consciousness we experience, then its elimination should release the full intensity of primary microtubular consciousness. Sam Parnia *et al* also consider NDEs to result from inhibitory elimination.[16] The neural mechanisms underlying REM sleep disturbances are similar to those underlying NDEs, leading to a massive release of neurotransmitters.[14]This could explain NDE-like and OBE reports as an alternative mechanism to hypoxia, arising when the experient is not actually near death. This mechanism can allow the Disinhibition hypothesis to explain the full range of NDE/OBEs.

Microtubules as the primary source of consciousness

The modulating and partly inhibitory effect of hormones, electromagnetic brainwaves, and axonal-synaptic oscillation circuits on the "pure" consciousness produced by microtubules may stem from the need to minimize what Karl Friston called the system's Free Energy; this requires balancing the need for matching expectations to experience with a contrary need to avoid "overfitting", when too much detail congests the ability to make quick, roughly appropriate decisions.[17]When cardiac arrest stops blood flow, modulation will also cease, but microtubules stabilized by Microtubule-Associated Proteins in neurons will survive for much longer. Once freed from inhibition, they would be allowed to express a vividness of consciousness not normally experienced.

Exposure of microtubules to photons after blood flow and neuronal EEG activity have ceased

According to the Penrose-Hameroff model, an objective reduction theory driven by gravity, tryptophan in microtubules could continue to produce consciousness until the microtubules degrade and break down. However, according to the Entropic Theory, consciousness would depend on continuous access to ultraviolet (UV) photons absorbed by tryptophan. There is evidence that photon flux densities of 10 kilolux, equivalent to outdoor sunlight but ten times brighter than a typical office, can pass through the skull to a physiological degree.[18]Karboski *et al* note that the skull isn't solid; it's riddled with canaliculi filled with osteocytes and blood vessels and their associated microtubules. They found that applying physiologically patterned bright blue light to the right side of the blindfolded subjects' heads could cause shifts in specific bands of electrical activity within the cerebral volume, could induce visual images and sensed presences, and an emotional response

(terror, panic) appropriate to the targeted brain region.[18]However, this experimental setup doesn't seem to align well with the hospital environments where NDEs have been reported.

The role of ultraweak photon emission (biophotons) in microtubule stimulation

The version of the disinhibition hypothesis proposed in this paper, based, as it is, on Kastner's Direct Action theory of Objective Reduction operating on microtubular tryptophan, requires, to maintain consciousness, a source of photons within the brain after cessation of blood flow. It further speculates that these photons can become entangled with environmental photons (i.e., in the hospital room), in order to create appropriate images in the visual cortex.

This version of the disinhibition hypothesis depends on a class of photons best known through pioneering research by Fritz-Albert Popp and colleagues since the 1980s. Living tissues continuously emit very low intensity, high energy light, in the form of Ultraweak Photon Emissions (UPEs, or biophotons), at a constant rate of several photons per cell per day to several hundred photons per organism per day.[19] Their wavelengths, from 200-800 nm, include UV frequencies. DNA is a primary source for the storage and release of biophotons, where they can enter a coherent Bose-Einstein condensate between the DNA's paired strands, postulated as critical to DNA's support and function. Here, they acquire properties comparable to liquids, fusing with elections to form "excitons", which form chains of emission and absorption events. Their emission creates an electromagnetic information field inside and around cells. Microtubules and contact communication connections conduct biophotonic release from DNA into the extracellular matrix and to neighboring cells, and, it is postulated, through optical wave guide meridians of the Primo Vascular System, across the body.[19] UPEs are also generated by radiative decay of excited molecules, corresponding to the production of Reactive Oxygen Species.[20] Production by ligand-receptor interactions and recent exposure to external light suggests both endogenous and delayed re-emission mechanisms. They play a role in intercellular communication, and neurons may have waveguide properties supporting optical channels. Microtubules, closely connected to mitochondrial UPE sources, absorb and direct UPE-induced coherent excitation over micrometer-length scales through resonant energy transfer.[21] Amplification of initially low levels of coherently excited photon signals within microtubules facilitates their functional uptake within the cells.[22] UPEs respond dynamically to tasks and stimulation.[20]They correlate modestly with brain alpha rhythms.[23] Therefore it is conjectured that they may be involved in the realization of consciousness.[19]

Mitochondria cease producing photons from glucose after approximately four minutes elapse post cardiac arrest. When Cardio-Pulmonary Resuscitation (CPR) is applied within two minutes, blood should still be flowing through arteries, and oxygen entering major organs.[24] CPR can prevent total brain ischemic death that would otherwise occur between 4-6 minutes post-cardiac arrest, and survival with CPR is possible after 10 minutes, even an almost 5% chance after 20 minutes at normal temperatures. Residual blood flow will be sustained longest in densely perfused brain regions such as the cortex, basal ganglia, thalamus and hypothalamus. Biophotons can be generated in metabolically active tissues, i.e., brain and liver, for up to an hour after loss of oxygen supply.[25]

The refractive index of microtubules and mitochondria is higher than that of the surrounding cytoplasm; this allows them to function as optical waveguides.[26]Cells are able to communicate non-chemically using UV light, and also longer wavelengths, to influence the behavior of other cells.[27]Photons could be conveyed in this way from the skin, and most obviously, from the retina, to the brain via sensory nerves, where they might stimulate the near-death experience. After cardiac arrest, the pupils dilate and the eyes usually remain open, but they may roll upwards as if having a seizure. Therefore, one might suspect that NDEs would correlate with more light falling on the retina of patients during cardiac arrest. Microtubules in the centrioles and cilia of retinal cells can accurately determine the positions of other cells in the retina's azimuth plane relative to the perpendicular axis.[26]Could this orientation ability play a role in OBEs?

However, literature reviews by Patrizio Tressoldi found 10-11 veridical (verified by those present) reports of visual and auditory NDE/OBEs in patients under general anesthesia or who had suffered cardiac arrest and had their eyes closed or taped shut.[28]Some of these patients accurately described what they saw or heard. A woman having a heart attack and lying on her back on the table was able to see the plaid shoelaces of the attending medical staff. Therefore, another source of photons is needed. Ultra-weak photon emission could be speculatively considered as a source that could entangle with photons in the surrounding room.

Ultra-weak photon emission also occurs as a result of neuronal membrane depolarization and the influx of calcium ions into cells, facilitated by high potassium

ion concentrations.[29]This is a consequence of dysfunction of energy-dependent ion pumps, depolarizing the neural membrane, and opening of calcium channels, allowing a massive influx of calcium ions. This, and the release of excitatory glutamate neurotransmitter, causes excessive neurostimulation, an influx of calcium, sodium, and zinc, and subsequent degradation of cellular components. This may be an alternative source for ultraviolet stimulation of tryptophan after mitochondrial production has ceased.

On cell death, the (approximately) 75% of cellular UPEs stored in DNA (nuclear and mitochondrial) are immediately released into the surrounding environment. Oxidative stress immediately before and during cell death can cause a transient phenomenon called the “death flash”, which may act as a “death signal” inducing apoptosis in neighboring cells.[30]

Communication via biophotons in the brain occurs primarily through the axonal pathways, especially those of dopamine, serotonin, and norepinephrine; which appear to be most closely associated with biophoton emission and fluorescence.[31]These neurons are highly active during NDEs. Biophotons also cross the extracellular matrix, possibly involving many neurons across an entire cerebral lobe almost instantaneously with very little energy. Therefore, they might be good candidates for a source of entanglement-ready photons able to account for veridical visual NDEs.

Furthermore, the tails of lipid molecules in axonal myelin sheaths (for instance, in the brain’s white matter) possess C-H bonds with a vibration spectrum able to generate entangled biphotons through cascade emission.[32] It is postulated that these may serve as a source of quantum entanglement resources for the nervous system. The brain may be able to leverage such a resource for quantum information transfer, synchronizing neuronal activity.

István Bókkon's biophoton hypothesis of neurocolography is even more speculative. It proposes that visual images are based primarily on neuronal biophoton fields rather than action potentials, and that the brain constructs a holographic representation from biophotons in the visual cortex during wakefulness and dreams.[33]According to this hypothesis, biophotons can be absorbed within a short range of cells, but due to the interconnected cytoskeletal system and extracellular connective tissue matrix, molecular configuration waves can propagate along microtubules. As optical signals, biophotons can be stored by surface acoustic waves and, after a long delay, converted back into light at a distance. These waves, called conformons, can propagate in a manner similar to phonons, which are quantized energy packets that can behave like quasiparticles, acting as mechanical vibrations. Biophotons can mediate long-range interaction and signal amplification within the cellular network; this is a faster information processing process than an electrical process. This mechanism, which suggests that these biophotons can be generated in the retina and propagate in parallel with action potentials, could allow for continued photon production even after blood flow stops, until brain temperature drops below the optimum level.[33]However, under general anesthesia, body temperature often drops significantly, prolonging recovery time, and perhaps blocking any neurocholographic effect.

Taking into account extra-ocular and auditory out-of-body experiences

The mechanisms described above may support continuing microtubular consciousness perimortally, but they cannot explain the extra-ocular (closed-eyes) vision reported in veridical OBEs, nor hearing spoken words. For this, it can be speculatively hypothesized that quantum entanglement exists between the outside world (i.e., the hospital room) and the brain of the experient. However, this entanglement can only lead to perceptions under extraordinary circumstances. Stuart Hameroff and Deepak Chopra have proposed that consciousness acts as a bridge between the macro/classical and micro/quantum realms, at the boundary between the two.[34]They equated the microtubular quantum calculations within neurons to fluctuations in the fundamental spacetime geometry that could conceivably exist independently of biology in various scalar planes of the geometry, as a "quantum soul". They suggest that Orch-OR's linking of quantum consciousness to spacetime geometry could explain NDE/OBEs and reincarnation; a quantum soul could provide interconnectedness via entanglement among living beings and the Universe, contact with cosmic wisdom and Platonic values embedded as quantum information in spacetime geometry, and a potential bridge between science and all religions.

The problem of quantum entanglement

I propose that the quantum computations in the neurons responsible for the emergence of consciousness are permanently deleted as a consequence of Landauer's principle and cannot be reconstructed. They cannot transmit the relevant information about the quantum computations of consciousness to the "quantum soul" of spacetime geometry. After death, superradiance finally ceases,

and entanglement also ends. However, in order to explain OBEs, given that the eyelids are too thick for photons to "tunnel" through, and any other transmission would be devoid of all visual acuity, it seems necessary to assume that environmental photons can somehow entangle with intracranial photonic input to microtubular tryptophan without decoherence, thus providing visual images. Although our consciousness cannot "reach out," perhaps there is a way for entangled photons to reach in.

This seems problematic because photons cannot transmit information nonlocally by virtue of their entanglement, and the quantum behavioral capabilities of photons are rapidly lost on their way from the plaid shoelaces to the brain unless they are shielded from decoherence. Stuart Hameroff described the type of shielding necessary for quantum effects to occur in microtubules as: "coherent pumping, actin gelatin, ordered water, and topological resonances".[34]I suggest either we don't understand the necessary physics, or reports of "veridical" NDEs are an incredible coincidence, or they are the result of fabrications, or existence itself is a solipsism.

The quantum substratum may provide the necessary communication for out-of-body experiences

The purpose of this paper is to speculate on the necessary physics needed to support a Disinhibition hypothesis. Ruth Kastner's Direct Action theory of Objective Reduction, otherwise known as the Relativistic Transactional Interpretation of quantum mechanics, rejects the concept of a "fundamental spacetime geometry" as containing everything else. Kastner maintains that photon emitters (e.g., shoelaces) and absorbers (e.g., microtubules) exist not in spacetime (which emerges from their transactions) but in a Quantum Substratum (QS). Here, they exist as potential activity or 'res potentia' capable of entering superpositions, but that these collapse if they complete a transaction: a transaction being a photon's emission and subsequent absorption.[35]She suggested: "The space-time 'theater' of actualities is emergent from a sub-empirical QS of potentiae that are more fluid, tenuous, abstract, and 'mind-like'", and "Maybe mind is taking place in the res potentia, subempirically analogous to a higher dimension space. Topologically, everything is connected, even though the connections are not by way of the usual classical fields - they are by way of quantum probabilities". "In this situation, the brain... might not be able to tell the experimenter that you're aware of something but other aspects of your self may be quite busy attending to other issues that cannot be represented at the 3D (empirical) level. The experimenter records 'subject not conscious' when really, the subject's attention is elsewhere".[36]

It follows from this that some potential processes in the QS could be made more apparent in our awareness, leading to an explanation for clairvoyance. Could this be a way to search for missing physics? Specifically, this could explain the accounts of NDE survivors interviewed 2 and 8 years later by Pim van Lommel, who developed enhanced intuitive gifts including clairvoyance, precognition, and the sense of knowing when someone would die (usually correct).[37]However, I would be cautious about filling QS with paranormal events seeking explanations unless one is prepared to explain why they remain extremely rare, instead of being commonplace.

Seeking an explanation for auditory near-death and out-of-body experiences

The speculations so far have not explained veridical auditory NDEs or OBEs. For these to occur, information would need to be transmitted across the auditory (eighth cranial) nerve, or reach the brain's auditory processing areas transcranially.

One speculative possibility has to do with non-electrical transmission of signals along the auditory nerve from the eardrum into the brain. Thomas Heimburg and Andrew Jackson in 2005 proposed that nerve impulses traversed nerves as adiabatic mechanical propulsions of axonal solitons, not directly requiring energy from the breakdown of aerobically generated adenosine triphosphate. They might even, it has been speculated, be able to modulate synaptic vesicles, leading to neurotransmitter release.[38] This could represent an efficient way to bring veridical auditory input to an electrically-dead auditory cortex.

The alternative would be transcranial stimulation. Although sound waves, even within the range of human speech, can pass through the skull and directly affect cortical neurons, clinical effects are generally only achieved with low-intensity, low-frequency focused ultrasound, and these effects are modulatory in nature, such as alleviating depression or improving cognitive function.[39]It would be impossible to recognize words spoken in this way. Some other explanation for a transcranial auditory mechanism would be necessary.

Brain regions respond to various forms of transcranial ultrasonic stimulation with theta and gamma oscillations, which can induce long-term potentiation or long-term depression-like plasticity, as observed in learning and memory, and can modulate behavioral learning in the motor cortex.[39]A combination of low-frequency (0.44-0.67 megahertz) and low-power (23

milliwatts/ square cm brain area) ultrasound, can cross the skull of mice, interact with neurons, open their voltage gate sodium channels, and trigger neurotransmitter release to influence neighboring neurons.[40]In addition, the primary auditory cortex of the human brain has a tonotypic representation in Heschl's gyrus. A study using chemically fixed postmortem brain slices showed that the capacity to discriminate in response to weak electrical stimuli in the auditory frequency range was preserved; suggesting that portions of the postmortem brain may retain latent capacities to respond with potentially life-like and virtual properties.[41] Neurotransmitter doses induced specific local brainwave responses in the right or left parahippocampal gyrus (PHG) or hippocampal body, associated with memory, and also glutamate-induced microvolt fluctuations with coupled photon emissions. These may be central to quantum-dependent neural information processing. Flux densities were comparable to those of specific conditions generated in living brains. Serotonin doses delivered to the right PHG produced a primary electrophysical correlate by which conscious awareness is linked to memory. These remarkable papers suggest that veridical auditory NDEs may have a natural explanation.

Conclusion

The Disinhibition Hypothesis holds consciousness to be dependent on objective reduction taking place in tryptophan amino acids within microtubules but triggered by the Relativistic Transactional Interpretation of quantum mechanics rather than gravitationally. Ongoing access to biophotons after the cessation of blood-flow is necessitated. The cessation of EEG activity disinhibits the experience of consciousness produced by tryptophan through its interactions with biophotons, accounting for the vividness of NDE/OBEs. Veridical visual NDE/OBEs depend on entanglement between environmental photons with biophotons in select brain regions once inhibitions have been lifted. Veridical auditory NDE/OBEs may depend on adiabatic axonal solitons, or perhaps transcranial stimulation.

Claims of clairvoyance experienced by some NDE survivors can also find an explanation within the Disinhibition Hypothesis.

The theory requires prolonged post-mortem production of biophotons, and a source of readily entangled biophotons, both recently discovered.

The extension of consciousness into "added time" during dying, if it occurs, puts the mind into a pseudo-solipsism: a state detached from external reality, yet still dependent on the existential reality of the dying brain. How might the dying person distinguish between this pseudo-solipsism and a true state of solipsism, should it arise as life after death? It can be considered that the pseudo-solipsism of "added time" ends with the same lack of awareness of its end that one experiences while falling asleep. If the person "wakes up" in a different place that never fades out, then they would have to consider their existence as solipsism, although it still could be part of a prolonged "added time", rather than "eternal life". Of course, only a fraction of those who survive cardiac arrest report having an NDE. It is possible that others have had this experience without remembering it, or that most people don't have them.

If we want to believe that life-before-death is real and that our living existence is not solipsistic, it behooves us to anticipate that death will be final, albeit possibly extended by "added time", an extra curtain call at least, but not an unending encore.

Patient informed consent

There is no need for patient informed consent.

Ethics committee approval

There is no need for ethics committee approval.

Conflict of interest

There is no conflict of interest to declare.

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Author contribution subject and rate

Peter Lugten (100%): Conceptualized and designed the research, data collection and wrote the whole manuscript.

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