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What Is Psychological Spin? A Thermodynamic Framework for Emotions and Social Behavior

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Abstract: One of the most puzzling questions in neuroscience is the nature of emotions and their role in consciousness. The brain's significant energy investment in maintaining the resting state indicates its essential role as the ground state of consciousness, the source of the sense of self. Emotions, the brain's homeostatic master regulators, continuously measure and motivate the recovery of the psychological equilibrium. Moreover, perception's information-energy exchange with the environment gives rise to a closed thermodynamic cycle, the reversible Carnot engine. The Carnot cycle forms an exothermic process; low entropy and reversible resting state turn the focus to the past, causing regret and remorse. The endothermic reversed Carnot cycle creates a high entropy resting state with irreversible activations generating novelty and intellect. We propose that the cycle's direction represents psychological spin, where the endothermic cycle's energy accumulation forms up-spin, and the energy-wasting exothermic cycle represents down-spin. Psychological spin corresponds to attitude, the determining factor in cognitive function and social life. By applying the Pauli exclusion principle for consciousness, we can explain the need for personal space and the formation of hierarchical social structures and animals' territorial needs. Improving intuition about the brain's intelligent computations may allow new treatments for mental diseases and novel applications in robotics and artificial intelligence.

Keywords: quantum cognition; spinor; psychological spin; thermodynamics; positive psychology; emotion regulation



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1. Introduction

The intricate relationship between cognition and physics is a subject of philosophical contemplation and scientific inquiry [1]. Perlovsky's [2] musing, "Is it possible to describe the mind based on the few first principles as physics does?" expresses the need for a falsifiable, systematic, and predictive consciousness hypothesis achieved through scientific method or observation. In this quest, we must consider how the brain is an integral part of the environment's energy-information exchange.

From the most primitive animals to humans, sensory abilities play a fundamental role in perceiving and understanding the environment. These sensory perceptions are often deeply intertwined with memory, learning [3], and temporal orientation, creating varied experiences and cognitive processes [4,5].

According to the scientific definition, perception is the process whereby sensory stimulation is translated into organized experience, whereas cognition is the process of acquiring knowledge and understanding through thought, intellect, experience, and the senses. Therefore, although cognition is highly abstract and flexible [6], it shows a systematic relationship with perception [7].

Perception is an adaptive interface [8] shaped by natural selection to guide adaptive behaviors that improve evolutionary fitness. Intelligent response to stimulus requires a veridical modeling of the physical environment, centering on the intuition of the physical laws. The lion's ability to catch its prey requires superior management of the muscles

against gravity. “Space-time tells particles how to move” according to John Wheeler’s famous quote. Similarly, gravity also instructs the lion’s well-coordinated movements.

Quantum mechanics is a fundamental theory in physics that describes the behavior of nature at the scale of atoms and their constituent particles, like electrons. The brain’s parallel and ultrafast evaluation of the relations between probabilistic variables resembles quantum systems. For example, the sensory cycle can produce superposition, interference, and entanglement, allowing the mathematical tools of quantum mechanics to explain problems in consciousness science [9–11]. While context clues can dramatically modify what we hear, see, or perceive [9], they turn the potential of memory and perception into actual properties [12] of discrete thoughts and decisions. Therefore, cognition shows a point-like (discrete) or wave-like character, i.e., complementarity.

Therefore, quantum cognition is widely accepted in cognitive science in explaining problems in psychology and social sciences and mathematical tools from quantum mechanics find utility in explaining complex problems in consciousness science, further blurring the boundaries between the quantum world and the cognitive realm [9,10]. Although superpositions of mental states are created by complex networks of neurons (classical neural networks), the activity of such neural networks can produce effects formally described as interference (of probabilities) and entanglement.

In quantum mechanics, the “spin” of the electron is intrinsic angular momentum without classical understanding [13]. Fermions, like electrons, have half-integer spin values, which determine their characteristic behavior. For example, the Pauli exclusion principle affects only particles with half-integer spin, dictating that no two identical fermions occupy the same quantum state simultaneously. This principle is responsible for the organization of electrons in atomic orbitals, giving rise to the diverse chemistry and properties we observe in the macroscopic world. When electrons move around, they contribute to macroscopic magnetic fields.

Similar to fermions’ permanent feature of the half spin, consciousness’ constant accompaniments are emotions. Although there is no scientific consensus on a definition [14], emotions are thought of as mental states brought on by neurophysiological changes, thoughts, feelings, behavioral responses, and a degree of pleasure or displeasure. In our discussion, we will use a narrower definition, as deviations from the psychological balance of the mind. In this definition, emotions represent the homeostatic regulators, which aid in the recovery of the resting state [14,15]. The above conclusion gains more significance by understanding that the autonomic nervous system, responsible for encoding the novelty and significance of stimuli, operates involuntarily and regulates arousal, thus influencing the intensity and nature of emotional responses [15,16].

Like temperature, which indexes internal energy, psychological temperature measures the intensity of emotions and arousal [15,17–19]. While arousal is the physiological and psychological state of the sense organs stimulated to the point of perception, psychological temperature includes the intention to respond. For example, low arousal stabilizes focus, but high arousal causes oscillating information processing. Emotions’ varied personal histories, cultural and brain activity profiles [20,21] represent only positive or negative motivation [22,23]. For example, physiological need, such as hunger or thirst, gives rise to an increasingly positive time error illuminating objects relevant to that need [24], where the expectation influences the perception [25] of stimulus. Although emotions are multi-dimensional representations due to personal history, social context, and the qualities of the stimulus, they can be pared down to instant feelings for or against, with a surprising analogy to the photon spin [10].

In addition, emotional clues interfere with and modify what we hear, see, or perceive [9], assuming a fundamental role in mental and psychological balance at the top of the homeostatic hierarchy [26,27]. The resting state’s brain activity consumes most of the brain’s energy [28], indicating its central role in self-determination [29]. Arousal-dependent inputs shape dynamics in occipital cortex circuitries by suppressing α limit cycle activity in

favor of the simultaneous emergence of γ oscillations [30], indicating the thermodynamic consequences of perception.

Human history is characterized by conflicts, revolutions, and wars. Walter Scheidel [31] has shown that inequality and competition for limited resources can trigger social conflict with devastating consequences for the social fabric. What factors make these conflicts necessary? In the following, we will show that competition and conflict in stressed populations can be traced back to a fundamental principle of physics. Our earlier work introduced the fermionic mind hypothesis [32,33], a cohesive theory of consciousness. It defines consciousness as the awareness of being separate from the environment. The organism's reliance on the sensory system for survival embeds the brain within its environment. Intelligent response to stimuli is possible because the brain adopts the physical laws for its operation. In the following, we investigated whether the brain's reversible perception cycle, which represents endothermic or exothermic conditions, acts analogously to particle spin.

2. Mental Unity

Conscious perception is never fractured [34]; ambiguity forces a non-deterministic, quantum-like fluctuation between two concepts, or decisions. For example, two different images presented to the two eyes [35,36] or two different smells registered by the two nostrils [37] do not form averages in perception but trigger a quantum-like fluctuation between the two possibilities. Therefore, the mind is the smallest unit of intellect (Deli, 2020b) that is only meaningful in its unity [38].

Sensory activation evokes involuntary potentials and electric flows in primary sensory regions, forming spatiotemporal symmetry vis-à-vis the brain's resting modules [39], which orients consciousness in time [40]. As response restores the brain's resting state, personal experiences and momentary expectations evolve the resting equilibrium. The limited work produced by one cycle turns mental evolution into a stepwise process, giving rise to discrete understanding and beliefs, which supports self-consciousness' "quantized" character. For example, the evoked cycle discretizes the wave function, analogous to the particle's wave function in a "box".

The frequency of the oscillations through space and time is given by the wavenumber k and the angular frequency ω , respectively. These are both related to the total energy of the particle by the expression

$$E = \hbar\omega = \frac{\hbar^2 k^2}{2m} \quad (1)$$

where $\hbar$ is the reduced Planck constant, and m is the particle's mass. In human psychology, mental energy k is the ability or willingness to perform cognitive tasks, like problem-solving, focusing, and making decisions. Similarly, energy is inversely proportional to attachments, which is analogous to physical mass.

Normalizing the wave function turns the total probability density of finding the particle or making a decision to one, as the mind always seeks meaning. At the boundary points at $x = 0$ and $x = B$.

$$\int_0^B |\Psi(t)|^2 dx = 1 \quad (2)$$

where Ψ is the wave function, representing the evolution of a thought.

The connection between the brain and body allows homeostatic self-regulation [38,41], with bodily signals supporting the sense of self. This dynamic system involves perception and response, with a flexible organization that generates unified perception even in confusing situations [42]. The fermionic mind hypothesis establishes this unity as a fundamental feature of consciousness and intellect [32,33]. Emotions also play a significant role in this system, triggering changes in behavior, hormones, and the body [43] to maintain a constant psychological state. Therefore, emotions form subjective guidance, representing master regulators that adjust internal physiology with expectations.

3. Discussion

3.1. Mental Homeostasis

The physical world obeys the second law of thermodynamics, but life secures a low entropy internal stability against external conditions. From the simplest organisms to humans, homeostasis seems to be a fundamental requirement of life. Cells keep their internal structure, pH, salt concentration, and membrane potential constant. In vertebrates, the heart and the kidneys maintain the body's internal parameters within a very tight range. The brain is a central regulator responsible for thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger, and bodily processes.

Stimulus rapidly collapses the high-dimensional resting state into a lower-dimensional substrate [44,45]. The microscopic membrane potentials and neurotransmitter fluctuations give rise to large-scale functional magnetic resonance signals [46]. Cortical oscillations reflect the priors in the network architecture, stored in the anatomical layout and the weights of synaptic connections [45].

The mind represents an independent inner world with highly personal experiences, memories, and ideas. Moreover, the unified, subjective, and conscious experience of stimulus modifies the synaptic connection map in an expertise and learning-dependent manner (Figure 1). Although perception can be conscious or unconscious, and response can be cognitive or behavioral, it represents an energy-dependent change in synaptic and, thus, cognitive complexity.

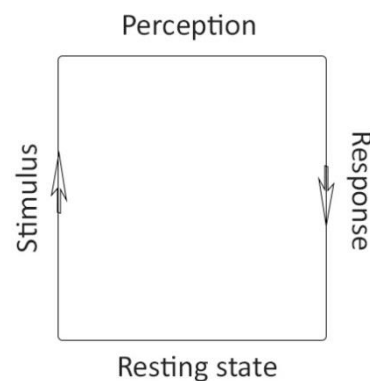


Figure 1. The cognitive perception cycle. The cycle is centered on the recurring resting state. A stimulus (external or internal) activates the cycle, which becomes conscious perception at a certain threshold. Finally, response, a mental process or behavioral action, recovers the resting state. The cognitive cycle, by definition, changes the synaptic connection map.

Our emotional state is closely tied to both our physical and psychological well-being. Disruption of this balance can trigger a range of emotions, which, in turn, serve as a motivating force to restore equilibrium. For instance, hunger prompts food seeking, and even the elation over winning the lottery represents only a temporary departure from our psychological equilibrium.

Furthermore, the actions to regain our unique, personal, and psychological balance are driven by emotions. For example, the excision of the cerebral cortex leads to violent reactions to external stimuli, the so-called sham rage, which underscores emotions, energy nature, and motivational power (Figure 2, top). While our cortical memory library imbues emotions with a multidimensional and nuanced meaning, they fundamentally represent polar states [22,23] (Figure 2, bottom).

A tightly controlled emotional integration restores the resting, neutral position [47,48]. Its relative distance from the primary sensory areas allows the formation of cognitive stability. The cognitive “ground state’s” non-computable and often ungovernable thought processes enable a subjective, transcendental, and privileged first-person experience [49] and psychological, emotional, and mental constancy throughout life [50]. The constantly changing, complex, and elaborate mental world can only be accessed from the inside; for

outside observers, it is a holographic projection that continuously changes while appearing strangely constant from childhood to old age.

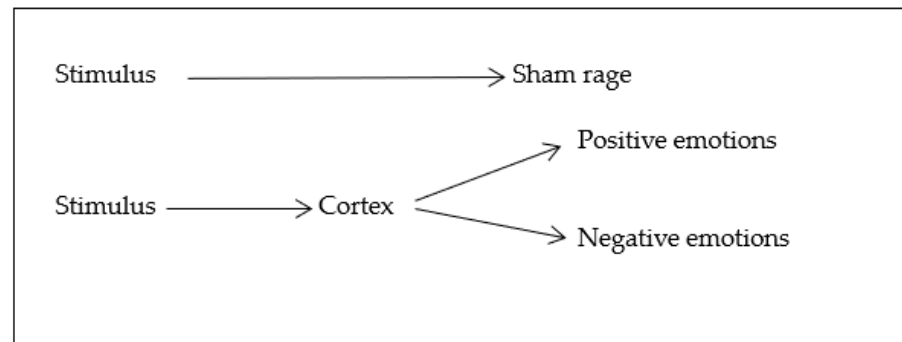


Figure 2. The role of the cortex in emotion formation. Emotions’ multidimensional manifestation can be separated into positive and negative conditions [23]. Stimulus triggers sham rage, a directionless motivation. Emotions’ meaning and directionality emerge from the brain’s memory library.

The autonomic stress pathway connects the corticolimbic stress circuits to the hypothalamus [51] by activating the sweat glands and controlling blood pressure and blood vessel dilation to the muscles, the so-called “fight-or-flight” reaction [52]. Motivation can increase noise resistance [53]. Therefore, emotions can be utilized to maintain culturally prescribed cognitive comfort [54,55]. We will turn our attention to this aspect next.

3.2. The Thermodynamic Analysis of the Evoked Cycle

In the words of Conant and Ashby, “Every good regulator of a system must be a model of that system” [56]. The ability to produce an intelligent response to a stimulus requires a model of that stimulus [45,57]. Learning continuously improves the fit between incoming sensory signals and available mental models or predictions [48] through a thermodynamic modification of the synaptic connections. For example, increased functional connectivity lowers the resting entropy in the parietal cingulate cortex and amygdala [58]. However, information erasure improves contentment and resting synaptic flexibility [59].

Therefore, the brain is a thermodynamic system that partakes in the energy/information cycle of the physical world via the sensory system. In computation theory, dissipative processes reconstruct the past, and intelligent ones control the future [19,60,61]. While exothermic processes dump entropy and energy into the environment, endothermic systems reduce entropy and require energy to operate. In sum, exothermic cycles make endothermic ones possible. Intelligent functions consist of complex metabolic decision-making networks, fueled by endothermic information erasure [62,63].

A closed system changes only energy (as heat or work), not matter, with its surroundings. When the cycle repeats with constant parameters, such as entropy and temperature, it forms a thermodynamic cycle. Therefore, the stimulus and its response form a closed and reversible thermodynamic cycle with discrete processing centering on the resting state [18,19,61,64,65].

In information theory, Shannon entropy represents the amount of information needed to characterize a random variable, roughly its surprise potential [60]. Because Shannon entropy considers discrete random variables, and the brain’s intelligent computation relies on uninterrupted energy flow, brain entropy represents a discretization of a continuous time series. In the maximum entropy situation, the signal-to-energy ratio is very high [66]. For example, access to a significant number of neural states affords high degrees of freedom, fluid intelligence [16,67], trust, and confidence [68,69]. Therefore, the brain’s thermodynamic cycle can represent the psychology of motivation.

The endothermic cycle requires an energy input, such as thalamic neurotensin production and release [70]. Because most brain operations modulate what we see, hear, and think behind conscious awareness, emotions have irresistible power over behavior, leading to the

belief in free will. Attentional focus, responsibility, compassion, and love [71,72] represent energy needed for an endothermic cycle, whereas the exothermic cycle is “free” of initial mental investment. Therefore, tiredness, lack of preparation, or stress often triggers the exothermic cycle. The above arguments can explain the compounded nature of attitude in long-term well-being [73,74].

3.3. Quantum Cognition

The mind cannot be assessed as a classical object because the mental state is inaccessible until decision-making, which turns initial potentials into actual features. The response, even opening the eyes, disrupts and changes the brain. Stimulus (measurement) cannot establish motivation because it decisively changes the emotional state, leaving us uncertain about the original condition. Quantum cognition is based on the idea that chaotic and noisy brain activations give rise to quantum characteristics (Table 1) requiring corresponding mathematical explanations.

Table 1. Analysis of quantum cognition in comparison to fermionic characteristics.

Particle Type	Fermions	Consciousness
Quantum state	Wave function	Quantum cognition
Quantum mechanics	Individual particle behavior	Psychology and social sciences
Spin	An intrinsic angular momentum	The thermodynamic cycle’s direction
Pauli exclusion principle	Fermions cannot simultaneously occupy the same quantum state	A need for personal space and territorial needs
Complementarity	The context generated by the first measurement influences the next one	The context of the first question modulates subsequent responses
Wave-particle duality	The wave function collapses	Chaotic and probabilistic thoughts resolve into unified decisions

Like waves on a pond, thoughts move with considerable liberty; the brain’s wave-like electric activities [75,76] are challenging to govern and almost impossible to retrace. They represent the neural underpinning of response [77]. Therefore, mental history is just as crucial in determining the quality of neuronal activation as the stimulus itself [78]. Thus, in analogy to Shannon understanding of entropy, the stimulus information value and the degree and quality of comprehension depend on the observer [79]. Therefore, the observer effect in the measurement problem associates consciousness with the most debated problem in quantum physics.

Cognition alternates between a fluid charge flow [80] versus thermodynamic balance, continuous unconscious processing, versus discrete conscious percepts and beliefs [4], reminiscent of the quantum and classical divide. The brain’s probabilistic temporal rhythms (Table 1) formulate discrete processing as decision resolves cognitive uncertainty. Continuous and bidirectional body–brain states with a hierarchical but flexible functional organization formulate a dynamic interactive system consisting of perception and response [38]. The bottom-up evidence and top-down expectations [81] and the reversibility of the perception cycle coalesce via decision-making. The incremental switches of beliefs, decisions, and cognitive changes (Table 2) are analog to the quantized energy transformations of decoherence [82].

Table 2. The thermodynamic and psychological consequences of basic emotions.

The Thermodynamic Cycle of Cognition	Endothermic: Reversed Carnot Cycle	Exothermic: Carnot Cycle
Entropy	High entropy resting state	Low entropy resting state
Mental state	Positive emotions, novelty	Negative emotions, repetitious thinking, aggravation, and violence
Temporal orientation	Future orientation	Past focus
Degrees of freedom	Expanding degrees of freedom	Loss of degrees of freedom
Thermodynamic consequences	An endothermic cycle absorbs energy and entropy from the environment.	An exothermic cycle dumps energy and entropy onto the environment.
Consequences for the organism	Mental energy accumulation (intellect)	Mental energy degradation → insecurity, mental and immune problems, depression

The actual outcome of decision-making and social behaviors is based on the squares of the probability amplitudes [83–86]. Analogous to the Born rule, which expresses the probability density of finding a particle at a given point, the medial prefrontal cortex (P.F.C.) efficiently represents hierarchically related choice-outcome associations [57], corresponding to the “position” of latent association.

Superposition between network nodes bears similarities to the simultaneous and probabilistic spontaneous activity priors’ evaluation [45]. Furthermore, the superposed psychological states cannot be defined precisely; instead, all possible values within the superposition have some potential for expression [87]. Ambiguity forces a non-deterministic, quantum-like fluctuation between two possibilities, concepts, or economic decisions [88].

The Social Laser can model the Bandwagon Effect. Content filtering algorithms on social networks create polarized “echo chambers” [89], where the coupling strength of decision-making agents is enhanced within the network [90]. In this case, the mass media pump supports additional reinforcement and acceleration of cascade growth, significantly increasing the speed at which a viral message spreads through social media.

Behaviors and emotions lead to the reflexive production of similar behaviors and emotions in others [91]. The coherent energy flow of high-amplitude information waves can sway public opinion and influence behavior. For example, sentiment contagion is a spontaneous spread of emotions among members of social groups due to the propagation of social energy [92,93]. The phenomenon is analog to the temperature-dependent diffusion process in liquids.

The charge, parity, and time (C.P.T.) theorem states that the quantum field is invariant under the inversion of time direction, charge, and parity [94]. Therefore, the inputs and outputs of physical processes are symmetric: The laws of quantum mechanics are indifferent to the direction of time. Similar to entangled photons’ superposition running forward and backward in time [95,96], emotions are in a limbo between the future and the past [60,61]. Measurement or decision-making settles the superposition.

3.4. Psychological Spin

Elementary particles have spin, which turns them into little magnets. The spin representation of information processing follows the Born rule [97,98], which states that the system’s measured value is proportional to the square of the amplitude of the system’s wave function at that state. Let α be an observable vector with eigenvalue λ_i for an eigenvector e_i from an orthonormal basis of eigenvectors $\{e_i\}$. If a system such as a brain is in state ψ , then the probability $Pr(\alpha = \lambda_i|\psi)$ that λ_i is observed for α equals $|e, \psi|^2$. Furthermore, let $B \in 2^{H^4}$, i.e., B is a collection of vectors that is a subset of a 4-dimensional Hilbert vector field (each vector in this Hilbert space has coordinates (x, y, z, t) , t = instant in time). The Born rule for an observable is

$$Pr\alpha = \lambda_i |\psi\rangle \int_B |\psi(x)|^2 dx \quad (3)$$

which is the probability that the particle x is found in region B in brain state ψ .

Recent investigations learned that emotions are multidimensional representations of attitude, representing an instant inclination toward or against an idea, drawing intriguing parallels with electron spin [10]. For example, a dog's wagging tail and raised hackles are analogous to electric polarities. Similarly, people with enemies want their friends to share their anger or hatred toward them [99]. Like electrons in an electromagnetic field, highly emotional messages and environments force people to take sides by embracing or rejecting them [100,101], which can cause political polarization [102,103]. Furthermore, like electric charges, attraction can switch to repulsion instantly, thus, a simple spin model can explain market frictions and herding behavior in economics [104]. Moreover, a modification of the above idea, the Ising model, can account for decision-making in social and business situations [105–108].

Attitude or disposition represents the direction and magnitude of intention or orientations in a Hilbert space (an abstract vector space) [10,109]. Moreover, the evoked cycle's thermodynamics [18,19,61] permit the psychological interpretation of the cycle's direction as a psychological spin. Thus, the evoked cycle is an abstract, multidimensional "spin space" (Figure 3).

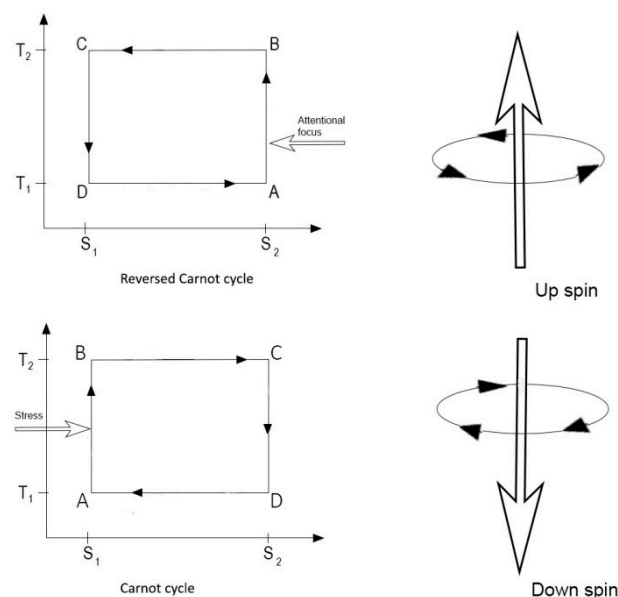


Figure 3. The thermodynamic origin of spin. Sensory interaction with the environment triggers the evoked cycle, a thermodynamic cycle representing discrete steps from A through D, which recovers the starting conditions. The endothermic reversed cognitive cycle (top), which requires attentional focus, absorbs energy from the environment, representing up spin. The energy flow supports mental growth and parallels up spin (top right). Stress triggers the exothermic cycle that degrades mental energy (bottom). The energy flow toward the environment parallels down spin (bottom right).

3.5. The Interpretation of Spinor Psychology

Spin is an intrinsic angular momentum that can change signs. Therefore, spin characterizes the particle, but the connection to the field introduces spinor properties. For example, a spinor transforms to its negative when space is rotated through a complete 360° turn. Likewise, partiality (shown by prior stimulus and after-error negativity), which inverts the thermodynamic cycle, overturns the stimulus' meaning, the pain disappears when serving a noble cause, and sincere words and loving caresses turn into cynicism and abuse [110,111], and tragedy into a farce. At the neural level, reciprocal pairwise comparisons do not satisfy commutativity and associativity [112]. These processes thus represent the division algebra of the octonions, turning into their negative after a 360-degree turn.

A consequence of spinor is that only one electron can exist for each state in an atom, leading to the buildup of the periodic table of the elements. Psychological spinor may

originate in the brainstem proximate and distal sensory projections [16]. In this framework, social comparisons function as the “inner eye” for reflexive consciousness [112], with higher-power individuals perceived at a more pronounced social distance from others [113,114]. The hierarchic organization in career achievement [115,116] often also infuses families and social relationships [117,118].

Even in the non-verbal language of the body, emotional valence and intensity communicate something essential about a person’s credibility, popularity, and other qualities. Therefore, although emotions often remain hidden from conscious awareness, they provide feedback on every aspect of welfare [119], supporting cognitive processes and decision-making [120]. The involuntary nature and action-producing power of attitude are perhaps the best indications of the energy nature and fundamental motivating power of emotions. For example, traditional psychotherapy cannot successfully relieve angry feelings, but acceptance effectively changes one’s physiological response [121].

A representational example of the contrasting spin is a soldier facing the enemy. In the up spin condition, the soldier races toward the enemy [122], but in the down spin condition, the resting activations time-reversal symmetry [46,123] initiate exothermic back-and-forth vacillations canceling progress [16,124]. Rather than being a coward, the soldier fears the future [19,33,65,125]. In the following, we will consider the two spin states in turn.

3.6. The Psychological Down Spin

A Carnot cycle acts as a heat engine. Similarly, the thermodynamic cycle of perception transfers heat between two information reservoirs. Therefore perception, including resting state recovery, imposes an energy need, depending on experience, education, and mood, i.e., the information value of the incoming stimulus.

Although it is difficult to distinguish particular emotions, frequency-based binary emotion classification (positive and negative) can achieve 96.81% accuracy [126,127]. Therefore, based on brain activation profiles, lower frequencies have more positive emotional valence than information-heavy higher ones [22].

Unlike positive emotions, stress and fear occur spontaneously without needing attentional control [70]. In addition, negative emotions have a long tail due to their cumulative effects in the frontal lobe [127], causing guilt, remorse, anxiety, rumination [128], and adverse mind-wandering [129–131].

Negative facial expressions increase arousal [132] and narrow focus. Increased functional connectivity reduces the degrees of freedom [16,58,133], corrupting information processing [134] and lowering resting entropy in proportion to the severity of cognitive impairment [135]. Thus, negative emotions represent unprocessed information, which remains part of the cognitive space. The sense of permanence enhances negative emotions’ stress-inducing power [70,127,136], causing erratic and attack behavior and criticism [128–130].

As speeding reduces the engine’s fuel economy, cognitive information accumulation overwhelms the neural system [127,132], causing significant energy costs [23,137]. For example, glutamate accumulation during long, demanding work corrupts decision control [138] behavior [139], compromising post-error correction [140].

Energy and immune dysregulation trigger stress hormones [141–143], a precursor of pathologic brain conditions [58,144,145], mental and other health problems [23,146,147]. Stress aftereffects in the D.M.N. [148] reduce plasticity within the medial prefrontal cortex (P.F.C.) to drive depressive behavior [70,136]. In anxious youth, amygdala reactivity can induce long-term impulsivity [149]. In addition, cognitive rigidity (putamen and cerebellum) [150] corrupts temporal coherence and self-identity [151].

The exothermic cycle (Table 2) can increase stress sensitivity [138,146] through a Bayesian process. In turn, criticism and violence lead to anxiety [46,123] and depression. Their excessive energy requirements are highly corrosive to mental welfare [23,137,152]. Therefore, mental diseases might have a thermodynamic origin.

3.7. The Psychological Up Spin

The sense of progress is a psychological need for the temporal mind. For that reason, mistakes, which represent a failure to move forward, are painful. Therefore, corrections, achievement, well-being, healthy behavior, and planning [70,153] require future focus [33,60,65]. Mental slowing down to correct mistakes requires persistent mental effort [68] that eliminates negative cognitive burdens [27,46,154]. Likewise, intelligent processing, flexibility [155], and optimism require low psychological temperature [15]. For example, acceptance removes the emotional weight of suffering by turning it into confidence and wisdom [156–158].

The reversed Carnot cycle supports a high entropy resting state [127], which is associated with intelligence [28,159,160], openness [161], and creativity [162]. Slow frequencies can access broader cortical areas (microstates), supporting associative representations and adaptive strategies [163]. Inversely, goal-directed and purposeful action [68,69] increases the degrees of freedom [18,19,61].

Positive psychology recognizes the role of a supportive environment or a positive mind in achievement [71,72]. Optimism reinforces itself through a Bayesian process (Table 2), predisposing the endothermic cycle [48]. For example, novelty (high surprise value) inflates reward expectations through thalamic neurotensin production and release [70] and increases confidence [164]. Therefore, positive emotions have a pivotal role in meaning-making, social relationships [115,116], self-reliance, and academic performance [165].

Cognitive efficiency is the function of the brain network dynamics [79] and organization. Endothermic activity economizes cognitive resources [166], allowing better fractal power (the power-law exponent) in diverse cortical areas, i.e., the ability to formulate a full range of emotions [53,69,167].

Therefore, mental energy is the brain's structural quality [3,168,169], which permits wholesome experiences [170] and optimism. Thus, the thermodynamics of emotions can explain the compounded nature of attitude in long-term well-being [73,74]. Therefore, mental progress and freedom of action might be fundamental psychological requirements for healthy mental function.

4. Discussion and Conclusions

Consciousness science attempts to answer how the neural system produces psychology and social phenomena. Following Conant and Ashby [56], we show that intelligent computation models the physical environment [45,57]. The Fermionic mind hypothesis ascertains the integration of the physical laws into the brain's temporal organization. Therefore, physical principles can explain consciousness, human psychology, and social phenomena. Furthermore, the hypothesis shows that the reversible perception cycle can institute rapid shifts in orientation and decision-making based on incoming information and environmental context. This notion parallels quantum mechanics and leads to many dynamic and probabilistic characteristics of cognition.

Life relies on homeostatic regulation occurring on many levels. In endotherms, cognition, centered on the resting state, sits at the top of this hierarchy. Perception is a thermodynamic cycle that accumulates memory, lending predictive abilities. The mind's (and living organization's) orthogonal organization vis-à-vis the physical environment turns it into a highly efficient energy and entropy absorber, leading to increasing complexity throughout evolution. This perspective provides a thermodynamic argument for the emergence of intellect, as an orthogonal system. The emotional master regulation maintains a genetically, culturally, and personally determined cognitive comfort. While the cortical library turns emotions into multidimensional experiences, their regulatory potency originates in their energy nature. For example, removing the cerebral cortex (sham rage) triggers violent movements in response to stimulus, uncovering motivation action-producing capacity. Therefore, emotions are the forces of motivation.

Therefore, the brain's endothermic or exothermic cognitive cycle forms emotional polarities, analogous to particle spin. The endothermic cycle parallels psychological up spin, forming mental expansion through optimism and creativity. Like a tiny bar magnet,

healthy psychology resists disturbances in its orientation toward the future, permitting social convergence.

In contrast, the exothermic cycle corresponds to down spin. For example, when stress accumulates in synaptic connections, the action space dimensionality reduction leads to impulsivity. Therefore, the exothermic cycle disperses energy and entropy onto the environment through repetitive thinking, criticism, aggravation, or physical violence. The fear-based, insecure orientation requires a defensive or conflict-seeking stance, leading to polarization, and divergence.

By structuring the social environment based on fear or trust, the psychological spin has wider consequences. For example, cynicism, which destroys goodwill, represents a psychological spinor, analogous to the fermionic capacity to transform the wave function into its negative when space is rotated through a complete 360° turn.

The Pauli exclusion principle describes the behavior of all fermions, including consciousness (particles with half-integer spin). The principle shapes matter and leads to territorial or personal space needs in social animals. Because stress acts as time pressure, it causes contradictory tendencies to dominate. The resulting competition can explain the hierarchic social structures and the increasing inequality over history.

Using category theory, computer simulations, and empirical studies can validate the fermionic mind hypothesis. For example, activating the amygdala should cause contradictory tendencies, proving the existence of psychologic spin.

In conclusion, the fermionic mind hypothesis explains the physics of the mind as the wholesale adoption of the physical laws into a temporal organization. The Pauli exclusion principle outlines the devastating consequences of stress on human welfare. A better understanding of consciousness and emotions has potential applications in education, social policy, psychiatry, animal husbandry, and artificial intelligence research.

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