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ALÉM DO ESPAÇO-TEMPO: O PENSAMENTO COMO INTERFACE COM UMA DIMENSÃO INFORMACIONAL

BEYOND SPACETIME: THOUGHT AS AN INTERFACE WITH AN INFORMATIONAL DIMENSION

MÁS ALLÁ DEL ESPACIO-TIEMPO: EL PENSAMIENTO COMO INTERFAZ CON UNA DIMENSIÓN INFORMACIONAL

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Resumo: O pensamento humano apresenta características, como associações não lineares, antecipação e criatividade, que desafiam explicações restritas à atividade neural localizada no espaço-tempo clássico. Este artigo propõe um modelo teórico que reconceitua o pensamento como acesso seletivo a uma dimensão informacional ontologicamente independente, denominada ψ. A pesquisa foi conduzida por meio de análise teórica e formalização conceitual, com base em princípios da física teórica, epistemologia e estudos da consciência. Utilizou-se como estudo de caso o evento cognitivo de Leonardo da Vinci ao conceber o desenho helicoidal, antecipando conceitos aeroespaciais ausentes em seu contexto histórico. O modelo formal identifica variáveis reguladoras do acoplamento cognitivo com a dimensão ψ, incluindo vetor intencional, histórico cultural, estado atencional e linguagem simbólica disponível. Diferentemente de teorias como IIT e GNWT, o modelo propõe que o conteúdo do pensamento não é gerado exclusivamente por substratos neurais, mas resulta do acesso a estruturas informacionais pré-existentes. O estudo oferece uma base formal para investigações interdisciplinares sobre cognição como fenômeno informacional não local, abrindo perspectivas para a neurociência, filosofia da mente e epistemologia.
Palavras-chave: Dimensão informacional; Ontologia do pensamento; Cognição dimensional; Informação integrada; Espaço-tempo não euclidiano.

Abstract: Human thought exhibits characteristics, such as non-linear associations, anticipation, and creativity, that challenge explanations confined to neural activity localized within classical spacetime. This article proposes a theoretical model that reconceptualizes thought as selective access to an ontologically independent informational dimension, referred to as ψ. The research was conducted through theoretical analysis and conceptual formalization, drawing on principles from theoretical physics, epistemology, and consciousness studies. As a case study, the article examines Leonardo da Vinci's cognitive event in conceiving the helical device, anticipating aeronautical concepts absent from his historical context. The formal model identifies variables that regulate cognitive coupling with dimension ψ, including the intentional vector, cultural background, attentional state, and available symbolic language. Unlike theories such as IIT and GNWT, the model proposes that the content of thought is not exclusively generated by neural substrates but results from access to pre-existing informational structures. The study provides a formal basis for interdisciplinary investigations into cognition as a non-local informational phenomenon, opening new perspectives for neuroscience, philosophy of mind, and epistemology.
Keywords: informational dimension; Ontology of thought; Dimensional cognition; Integrated information; Non-euclidean spacetime.

Resumen: El pensamiento humano presenta características — como asociaciones no lineales, anticipación y creatividad — que desafían las explicaciones limitadas a la actividad neuronal localizada

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en el espacio-tiempo clásico. Este artículo propone un modelo teórico que reconceptualiza el pensamiento como acceso selectivo a una dimensión informacional ontológicamente independiente, denominada ψ. La investigación se llevó a cabo mediante análisis teórico y formalización conceptual, con base en principios de la física teórica, la epistemología y los estudios sobre la consciencia. Se utilizó como estudio de caso el evento cognitivo de Leonardo da Vinci al concebir el diseño helicoidal, anticipando conceptos aeronáuticos ausentes en su contexto histórico. El modelo formal identifica variables que regulan el acoplamiento cognitivo con la dimensión ψ, incluyendo el vector intencional, el contexto cultural, el estado atencional y el lenguaje simbólico disponible. A diferencia de teorías como la IIT y la GNWT, el modelo propone que el contenido del pensamiento no es generado exclusivamente por sustratos neuronales, sino que resulta del acceso a estructuras informacionales preexistentes. El estudio ofrece una base formal para investigaciones interdisciplinarias sobre la cognición como fenómeno informacional no local, abriendo perspectivas para la neurociencia, la filosofía de la mente y la epistemología.
Palabras clave: Dimensión informacional; Ontología del pensamiento; Cognición dimensional; Información integrada; Espacio-tiempo no euclidiano.

In classical physics, scientists describe the fabric of reality as a four-dimensional continuum of spacetime, initially formalized within the framework of special and general relativity. Based on integrating three spatial dimensions (x, y, z) with one temporal dimension (t), this model successfully accounts for the physical behavior of all inanimate matter and energetic phenomena within the observable universe. The structure of spacetime is mathematically represented by Minkowski's metric (Minkowski, 1908; Einstein, 1923; Misner et al., 1973; Rindler, 2006; Greiner, 2004), given by Equation (1).

$$S^2=x^2+y^2+z^2-c^2t^2 \quad (1)$$

Where c represents the speed of light and S is the invariant spacetime interval. This four-dimensional model has provided an extremely robust framework for understanding gravitational phenomena, light propagation, and physical objects' dynamics.

This four-dimensional structure has been fundamental in shaping our understanding of physical interactions and the very nature of reality. However, alternative models that offer a deeper understanding of the interrelations between space, time, energy, and matter may challenge this traditional view. Exploring these alternative models may reveal insights into the interconnectedness of reality, echoing the relational matrix model proposed by Buckminster Fuller and Albert Einstein. These models can help us perceive reality as a complex and interconnected network rather than a simple sequence of linear events. Recognizing this complexity may transform our approach to physics, enabling a richer and more comprehensive understanding of the nature of the universe.

Building upon this perspective, a fascinating question arises concerning the fundamental nature of time and its role in defining the interconnectedness of events across the cosmos. Traditionally, synchronizing temporal measurements between independent systems has required the transmission of physical signals, such as pulses of light, to establish a shared frame of reference and ensure coherence between observers. This necessity highlights how deeply space, time, and physical processes are interwoven.

However, contemplating the existence of a domain beyond spacetime—a realm where information might exist independently of physical dimensions—invites us to reconsider the very essence of synchronization and simultaneity. If such an informational domain exists, it raises the question of

whether independent systems could achieve a form of coordination without exchanging any physical signals. This leads to the intriguing concept of random synchronization, where two clocks or processes, completely isolated from one another, might coincidentally align within an extremely narrow margin of precision purely by chance.

Mathematically, the likelihood of such random synchronization is exceedingly small. Consider two independent clocks, each capable of displaying hours, minutes, seconds, and milliseconds. There are 24 × 60 × 60 × 1,000 = 86,400,000 possible time combinations within a 24-hour period. Therefore, the probability that both clocks would, purely by coincidence, show exactly the same time is: $P = 1/86{,}400{,}000 \approx 1.157 \times 10^{-8}$ which corresponds to approximately 0.000001157%, or one chance in 86.4 million. If we consider synchronization at the nanosecond level, this probability becomes even more negligible, approaching practical impossibility. Such calculations demonstrate that without the exchange of physical signals, meaningful synchronization between independent physical systems is virtually unattainable.

Yet, beyond the realm of physics, human history offers compelling examples of seemingly synchronous phenomena. Across different epochs and distant cultures, similar ideas, inventions, and scientific theories have emerged independently, even in the absence of direct communication. These instances suggest that certain concepts or solutions may arise spontaneously under similar conditions, hinting at deeper patterns or structures that interconnect seemingly isolated minds and events.

This parallel invites a profound question: could the universe harbor an underlying informational matrix that allows for such correlations, enabling ideas to emerge synchronously without conventional interactions? Just as random synchronization of clocks is statistically improbable, yet theoretically possible, the emergence of similar ideas across humanity may reflect not merely coincidence, but perhaps a hidden interconnectedness rooted in the very fabric of reality.

Exploring this hypothesis encourages a multidisciplinary approach, bridging physics, information theory, and philosophy. It challenges us to envision the universe not solely as a continuum of physical events, but as an intricate web of informational relationships that may transcend traditional boundaries of space and time.

Such reflections inevitably lead to another essential domain of reality: the realm of cognitive processes. Although relativistic physics has achieved extraordinary success in describing material phenomena, it remains epistemologically incomplete when confronted with cognitive phenomena such as thought, creativity, intuition, and anticipation. These processes often exhibit non-local, non-causal, and temporally non-linear characteristics, challenging explanations confined solely to the four-dimensional continuum of spacetime.

Unlike physical systems, human thought demonstrates the ability to establish instantaneous associations between information distant in time or space, to integrate diverse data suddenly, and to project future scenarios without necessarily adhering to rigid causal sequences. These attributes raise fundamental ontological questions: Is thought entirely contained within spacetime, or does it access informational structures beyond the classical physical continuum?

To address such inquiries, it is essential to clarify what is meant by thought. Broadly defined, thought refers to the mental process by which individuals generate, organize, and manipulate internal representations, drawing upon memory, sensory input, and imagination. It encompasses reasoning, problem-solving, planning, and the emergence of novel ideas. As Holyoak and Morrison (2012) explain, "thinking refers to the higher mental processes such as problem solving, reasoning, and creating representations of the world, which are essential for making decisions and constructing meaning" (p. 2). In this context, understanding the nature of thought becomes central to evaluating whether it may function as an interface with dimensions beyond the classical physical framework.

This article hypothesizes that thought may not merely be an emergent property of neurophysiological activity within spacetime but rather a phenomenon involving interaction with a distinct informational domain. In this model, thinking constitutes a form of selective access to pre-existing informational states that reside beyond conventional spacetime metrics. This access may vary across individuals, historical epochs, and civilizational structures, potentially explaining historical surges in innovation, anticipatory knowledge, and divergent intellectual capabilities.

Just as random synchronization between clocks is statistically improbable yet theoretically possible, it is conceivable that the simultaneous emergence of correlated ideas in different parts of the world might reflect not merely fortuitous coincidences but also the influence of a shared informational substrate accessed by cognitive systems under certain conditions. This possibility suggests the existence of informational patterns capable of transcending spatiotemporal barriers.

Based on this reasoning, the present work proposes that thought may not be fully embedded in spacetime but instead interacts with a specific informational domain, here designated as the ψ dimension. In this model, cognitive systems are not considered generators of information ex nihilo but are understood as temporary access points to pre-existing informational states beyond conventional spacetime. The degree of access to this dimension may vary among individuals and societies, offering a potential key to understanding historical periods marked by creative explosions, knowledge leaps, or striking differences in intellectual capability.

Literature Review

The Cogitate Consortium study represents one of the most extensive and methodologically rigorous attempts to empirically compare competing consciousness theories, namely the Global Neuronal Workspace Theory (GNWT) and the Integrated Information Theory (IIT). However, their experiment remains confined to investigating localized neural substrates (posterior cortex vs. prefrontal cortex) without extending their analysis to the ontology of thought as a potentially independent entity dissociated from neural support. Both tested models assume consciousness fully emerges from neural architectures and do not explore ontological structures external to spacetime as informational sources (Cogitate Consortium et al., 2025).

Our hypothesis broadens this discussion by suggesting that thought is not generated ex nihilo by the brain but corresponds to selective access to pre-existing informational fields in an independent dimensional structure. While the Cogitate Consortium demonstrates the sophistication of current empirical methods, even advanced models such as IIT 3.0 and GNWT remain bound to neural generators, leaving open the research gap we address: thought as dimensional informational projection (Cogitate Consortium et al., 2025).

The study by Nemirovsky et al. represents one of the first empirical efforts to operationalize IIT 3.0 using real fMRI data, particularly under propofol-induced sedation conditions. However, the research remains focused on locating, measuring, and correlating variations in Φmax within brain networks, consistently assuming that the neural substrate entirely generates both conscious states and, by extension, thought itself (Nemirovsky et al., 2023).

Our proposal moves beyond this empirical approach: while Nemirovsky et al. successfully measure Φmax within brain activity, our hypothesis suggests that thought content itself does not entirely originate in neural structures but results from access to a pre-existing informational field external to spacetime—a dimension not contemplated in their study (Nemirovsky et al., 2023).

IIT 4.0, as presented by Albantakis et al., provides a highly formalized structure for integrated information theory, establishing phenomenological axioms and physical postulates with mathematical rigor. However, even in its advanced formulation, IIT 4.0 remains confined to the physical causal substrate as both the generator and carrier of conscious experience without considering an informational field external to the system's physical structure (Albantakis et al., 2023).

Our hypothesis precisely addresses this unexplored zone: instead of thought being exclusively the product of internal causal structure, we propose that cognition performs access to informational blocks already existing in an external informational dimension. While IIT 4.0 builds a coherent logic for the substrate, it does not incorporate the dimensional external coupling we propose (Albantakis et al., 2023).

In exploring the nuanced relationship between cognitive restructuring and self-compassion, Turaman (2023) highlights how internal psychological mechanisms may serve as gateways to higher-order thought and emotional regulation transformations. Although grounded in a more therapeutic context, the study inadvertently points to latent informational patterns that become cognitively accessible through deliberate introspective practices. This resonates with the proposed hypothesis of thought as an access mechanism to an informational dimension, especially when intentional states (such as those fostered in compassionate cognition) play a central role in activating latent informational configurations.

Gier and Belote (2023) investigate the cognitive underpinnings of imagination and creativity in educational contexts, emphasizing the importance of internal representations, metaphorical thinking, and narrative coherence. Their discussion of mental models as tools for navigating abstract domains implicitly supports the idea that cognitive systems can construct bridges to informational structures not yet fully codified in experience. In this light, the educational imagination functions analogously to a weak

coupling key (χ) within the ψ framework, modulated by intention, cultural context, and expressive language.

Houser (2022) engages with the theme of meaning and transcendence in aging, proposing that late-life cognitive shifts often give rise to profound insights and existential clarity. These cognitive transitions suggest that the mind becomes more attuned to abstract or anticipatory knowledge under certain life-stage or psychological thresholds. While Houser's work remains within humanistic psychology, its attention to inner transitions and symbolic cognition echoes the model's premise that thought can modulate access to dimensions of knowledge that are not linearly tied to chronological development or sensory input.

Mediano et al. present an expanded taxonomy of integrated information dynamics through Integrated Information Decomposition (ΦID), addressing some limitations of classical IIT. However, despite advancing its mathematical formulation, the model remains focused on material multivariate systems—such as neural networks and physical complex systems—without considering thought as an ontological interface that accesses non-physical layers of information (Mediano et al., 2021).

Our work precisely addresses this gap: rather than decomposing internal interactions within a physical system; we propose that human thought already operates as a kind of "informational bridge," accessing a non-spatial, non-temporal field where information pre-exists. While ΦID offers powerful tools to describe internal dynamics, it does not address the origin of cognitive access to the informational field (Mediano et al., 2021).

Singh and Kaur (2021) approach consciousness from a neurophilosophical lens, critically evaluating dualistic and monistic interpretations while calling for more integrative paradigms. Their perspective underscores the epistemic limitations of reductionist models and defends the need for frameworks that can accommodate subjective experience and ontological complexity. This gesture toward multidimensional integration converges with the current proposal, especially in its attempt to introduce a new axis (dimension ψ) through which cognitive access to pre-existing informational content can be formalized, analyzed, and possibly expanded.

Moss (2019) examines the philosophical lineage of mental health and its connection to existential frameworks, offering a critical perspective on human consciousness that challenges strictly biological reductions. Although philosophical in tone, his analysis underscores the relevance of incorporating ontological perspectives into understanding conscious experience. This view aligns closely with the foundational premise of the ψ dimension model, in which consciousness is not merely a neurophysiological emergence but operates within broader existential coordinates—potentially situated beyond classical spacetime.

Foschini revisits Wheeler's proposal ("It from Bit"), suggesting that physical reality may ultimately emerge from elementary informational structures, stating that "information may be what creates the world." While this ontological approach supports our informational dimension hypothesis, Foschini's work focuses primarily on the epistemological constitution of physical matter without addressing thought as an independent dimensional access phenomenon (Foschini, 2013).

Our hypothesis extends this ontological foundation by proposing that thought is an active coupling with this pre-existing informational dimension. Foschini provides conceptual support for informational substrates but does not advance the argument that human thought is a direct interface with such a dimensional field (Foschini, 2013).

The research developments in embodied cognition have broadened the understanding of consciousness beyond neural mechanisms, emphasizing the role of bodily and environmental interactions in the emergence of mental content (Souza, Halfpap, Min, & Alves, 2007). In this perspective, the mind is conceived not as a property of the brain alone but as part of an intentional network that spans body, environment, and cognition. This view resonates with the theoretical proposal of an ontological space composed of five dimensions—four pertaining to spacetime and one informational. Just as embodied cognition suggests that cognitive processes extend into the surrounding world, our model proposes that thought can interface with a non-Euclidean informational field, wherein symbolic structures exist independently of physical manifestation. This dimension of information, although not directly observable, may play a fundamental role in shaping conscious experience.

The theoretical challenge in understanding consciousness lies largely in what Chalmers (1996) referred to as the “hard problem of consciousness”: the task of explaining why and how subjective experiences arise from physical processes. While various models attempt to describe the brain mechanisms involved in cognition, many of them encounter limitations when trying to account for more abstract aspects of thought, such as creativity, intentionality, and the formation of complex concepts. These elements continue to challenge strictly physicalist models and motivate theoretical approaches that seek to broaden our understanding of the nature of conscious experience and higher cognitive processes.

In a complementary line of thought, Baars (1988) proposed the Global Workspace Theory, suggesting that consciousness functions as a dynamic space for the integration of information from different cognitive subsystems. This model provides a valuable framework for understanding how multiple informational contents are selectively brought into awareness and articulated through symbolic language. By emphasizing the integrative and selective nature of conscious processes, Baars’s theory contributes to the notion that thought cannot be reduced to isolated neural reactions, but must be considered within a broader functional context involving access, coordination, and semantic structuring.

This article fills this gap by proposing a theoretical framework that reconceptualizes thought as selective access to an informational dimension distinct from classical spacetime. Such a model extends beyond current neural correlates or informational decompositions, offering an ontological hypothesis that thought operates as a dimensional interface, not merely as an emergent property of physical neural substrates.

Theoretical Model and Formalization

To formalize the proposed hypothesis, we extend the conventional four-dimensional description of physical reality by introducing an additional informational dimension denoted as ψ. This coordinate reflects the degree of informational integration accessible to a system without implying spatial or temporal positioning.

Thus, we express the ontological state of a system as shown in Equation 2:

$$S^2=x^2+y^2+z^2-c^2t^2+\alpha\psi^2 \quad (2)$$

Where:

- α: is a coupling constant regulating the relative influence of the informational dimension;
- ψ is the informational coordinate, assumed to be zero for inanimate matter (ψ=0) and non-zero for cognitive systems engaged in thought processes (ψ>0).

In this framework, we conceive thought not as an emergent product generated solely by neural activity but as a dynamic interaction with informational states that exist independently of biological processing and classical spacetime coordinates. This interaction allows cognitive systems to access complex informational configurations—such as abstract concepts, anticipatory knowledge, or non-local associations—that cannot be entirely explained by neural correlates or conventional information processing architectures.

Importantly, assigning ψ=0 for inanimate matter does not imply the absence or non-existence of the informational dimension itself. Rather, it reflects the system's intrinsic lack of cognitive structures capable of accessing or coupling with the informational field. The informational dimension remains ontologically present even when inaccessible. Cognitive systems, by contrast, possess self-referential awareness and intentional capacities that permit partial coupling to pre-existing informational structures, thus yielding non-zero values of ψ that reflect degrees of informational integration.

The informational dimension proposed here operates orthogonally to spacetime, implying that informational access may occur independently of physical proximity or chronological ordering. This framework may explain historical phenomena such as simultaneous discoveries, intuitive breakthroughs, and extraordinary anticipatory insights that emerge across individuals and civilizations.

At this initial stage, the model adopts a scalar formalism for ψ, representing the system's aggregate level of informational access. This simplification serves as a foundational framework while remaining open to future elaboration into multidimensional, topological, or tensor-based informational manifolds as empirical techniques for measuring informational complexity evolve. Such extensions may eventually enable the quantification of degrees of cognitive access, individual variability, and the potential evolutionary trajectories of informational coupling.

Dimensional localization of thought events

We recognize that the scalar formulation of ψ captures only the magnitude of informational access but fails to specify the informational content itself. To address this limitation, we expand the

dimensional framework by introducing an informational state vector that enables us to locate particular thought events more precisely within the extended structure. In this formulation, we define the state vector $\Psi=(x,y,z,t, \psi, I_1, I_2,..., I_n)$, where each component represents a specific dimension contributing to the full ontological description of the thought event.

We assign the coordinates (x,y,z,t) to localize the physical instantiation of the cognitive agent in classical spacetime. We define ψ as the overall depth of informational coupling, reflecting how strongly the cognitive system interacts with the informational dimension. In addition, we introduce the parameters I_i (for i=1...n) to describe the internal informational attributes that characterize the content being accessed. These attributes may include the knowledge domain, level of abstraction, semantic complexity, or degree of epistemic novelty associated with the thought.

We acknowledge that informational access does not occur in isolation but is further modulated by the agent's intentional state V and historical-cognitive background H. The agent's intentional vector V defines the active cognitive trajectory or search orientation, while H integrates the agent's accumulated knowledge, cultural environment, and individual cognitive structure. We express the total informational coupling as a scalar value $A=f(\psi, Ii, V, H)$, , which quantifies the effective degree of access to specific informational contents.

By incorporating these additional factors, the model can explain how different agents may access distinct informational configurations even when sharing similar levels of informational coupling ψ. This divergence arises from intentional focus and variations in historical context, which modulate the subspace of informational content retrieved during cognitive access.

At this initial stage, we adopt a scalar simplification for ψ to provide a tractable starting point for formalizing the model. However, we anticipate that future extensions may involve more complex structures, such as multidimensional topological representations of informational manifolds, tensor formulations that capture higher-order coupling dynamics, and evolutionary models describing longitudinal variability in access capacities across individuals and civilizations.

Although current technologies do not allow for direct measurement of either ψ or I_i, we envision several empirical strategies that may offer indirect validation of the model. Neurocognitive studies on spontaneous insight and extraordinary creative cognition may reveal distinctive correlates of dimensional informational access. Comparative historiographical analyses may uncover recurring patterns of anticipatory discoveries across different cultural epochs. Computational modeling could simulate cognitive-intentional dynamics under varying parameters, while predictive simulations may explore how informational accessibility shifts under controlled cognitive and experimental conditions. Future research may develop operational tools capable of quantifying informational complexity and cognitive coupling mechanisms within this extended dimensional framework through these interdisciplinary approaches.

Dimensional model of informational access

In this section, we structure the hypothesis that thought acts as a coupling mechanism with an informational dimension ontologically independent of classical spacetime. We conceive the dimension as a non-local domain that houses all possible informational configurations accessible through cognitive keys shaped by the agent's internal variables.

We assume this as a coupling constant, indicating that the dimension's influence is real and effective in configuring the ontological state of cognitive systems. For inanimate objects, although the informational dimension continues to exist ontologically, it remains inaccessible without a conscious entity capable of establishing coupling.

We propose that any information accessed by consciousness can be formally represented as a vector of semantic attributes:

$$Ii = (Di, Ai, Ki, Ni, Si, Ti, \tau i)$$

Where:

- D: epistemic domain (e.g., mathematics, art, engineering);
- A: level of abstraction;
- K: structural-semantic complexity;
- N: degree of novelty for the agent;
- S: symbolic codifiability;
- T: the temporality of manifestation in spacetime;
- τ: semantic topology (relations with other concepts).

Access to *Ii*, is regulated by a cognitive coupling key χ, defined as:

$$\chi = f(V, H, E, L)$$

Where:

- V: intentional vector (thought direction);
- H: cognitive and cultural history of the agent;
- E: emotional and attentional state;
- L: available language (symbolic or expressive).

The key χ acts as a projective filter on the domain C, determining the accessible informational subsets:

$$Ii \in C: \text{if } \chi \cap Ii \neq 0$$

Additionally, we formalize the complete ontological state of a cognitive event as Ψ:

$$\Psi = (x, y, z, t, \psi, I_1, I_2, \ldots, I_n)$$

where (x, y, z, t) represent coordinates in spacetime, *C* is the depth of coupling, and the *Ii*, is the activated informational vectors.

To distinguish thought events that effectively access the informational dimension ψ from those confined to conventional internal processing, we introduce the notion of a "key thought." This type of thought is characterized by an alignment of intentionality, attention, and historical-cognitive readiness

that activates the coupling function χ. Only thoughts endowed with a clear cognitive direction (V), high attentional focus (E), a compatible cognitive-cultural repertoire (H), and an available symbolic language (L) can establish meaningful intersections with domain ψ. In contrast, diffuse, automatic, or unstructured thoughts fail to activate χ, rendering the informational dimension inaccessible despite its ongoing ontological presence.

Results

Although we cannot directly observe the informational dimension C proposed in this model using conventional physical instruments, we can indirectly infer its potential influence from historical patterns of cognitive phenomena. Several recurring empirical observations suggest that cognitive access to pre-existing informational structures may indeed occur across individuals and civilizations in ways not wholly explicable by linear cultural accumulation or isolated intellectual effort.

Historical cases of anticipatory thought

Throughout history, certain civilizations have demonstrated technological and scientific capabilities that exceed the cumulative cultural knowledge expected for their historical periods, suggesting possible anticipatory access to informational structures.

The ancient Egyptians, for instance, developed highly advanced architectural, astronomical, and mathematical knowledge, as evidenced by the precise construction of the pyramids, their alignment with stellar and solar cycles, and the mathematical sophistication implicit in their engineering feats (Lehner, 1997; Belmonte, 2001). Modern analyses reveal precision in the Great Pyramid of Giza's orientation that would require instruments or methods not fully accounted for by the documented technological means of the time (Spence, 2000). The Egyptian calendar, closely synchronized with the heliacal rising of Sirius, also reflects advanced astronomical observation techniques (Clagett, 1999).

Similarly, Roman engineering accomplishments—including aqueduct systems, concrete formulations, road networks, and large-scale urban infrastructures—demonstrate the technological mastery that, in some aspects, rivaled or even surpassed specific engineering capabilities rediscovered only centuries later (Lancaster, 2005; Oleson, 2008). For example, Roman concrete (opus caementicium) exhibits self-healing properties due to its unique volcanic composition, a material science principle that modern concrete engineering has only recently begun replicating (Jackson et al., 2017). These examples suggest technical ingenuity and possible interaction with informational structures that provided advanced conceptual insights far ahead of their formal scientific articulation.

Throughout history, specific individuals have exhibited anticipatory insights that appear significantly ahead of the formal knowledge available in their respective periods. Among the most notable cases is Leonardo da Vinci, whose notebooks document advanced anatomical, mechanical, and aerodynamic concepts centuries before the empirical or technological infrastructure existed to fully realize or validate these ideas (Capra, 2007). Under the proposed dimensional model, such anticipatory

cognition may reflect partial access to informational structures within the ψ dimension, enabling the organization of knowledge not derivable solely from the thinker's immediate cultural context.

Srinivasa Ramanujan (1887–1920) provides an illustrative example of how individuals may access informational structures beyond conventional cognitive processing. Throughout his life, Ramanujan described how he received many mathematical discoveries through dreams and visions, often mediated by the Hindu goddess Namagiri (Berndt & Rankin, 1995). He reported that complete equations appeared spontaneously, without requiring formal deductive reasoning, suggesting that a source of information may exist beyond ordinary neural activity. These accounts resonate with theoretical models that propose interactions with informational dimensions independent of classical spacetime constraints.

In this framework, we interpret cases like Ramanujan's as instances where individuals selectively access pre-existing informational states. Rather than attributing such cognitive outputs solely to neural computation, we suggest that they reflect interactions with ontologically independent informational fields. This interpretation aligns with current theoretical physics and cognitive science discussions exploring non-local aspects of consciousness and creativity (Penrose, 1994; Hameroff & Penrose, 2014). Although empirical validation remains challenging, historical cases such as Ramanujan's encourage us to consider knowledge acquisition processes that transcend conventional neurobiological explanations.

The phenomenon of simultaneous discoveries

Another recurring empirical phenomenon that supports the hypothesis is the frequent historical occurrence of simultaneous scientific discoveries by independent researchers. Classical examples include:

- The independent development of calculus by Newton and Leibniz;
- The concurrent articulation of evolutionary theory by Darwin and Wallace;
- The parallel formulations of the conservation of energy principle by Mayer, Joule, and Helmholtz;
- The nearly simultaneous discovery of oxygen by Priestley and Lavoisier.

Such patterns suggest that rather than arising strictly from linear knowledge progression; these discoveries may reflect multiple cognitive agents independently accessing informational structures already present within the informational dimension C. The recurrence of these events across multiple scientific domains reinforces the plausibility of an underlying informational field accessible to human cognition under certain conditions.

Variability of informational access across civilizations

We may also interpret historical variability in civilizational achievements as fluctuations in collective access to the informational dimension. For example, the ancient Egyptians demonstrated

advanced astronomical, architectural, and mathematical knowledge whose origins remain only partially explained by known cultural transmission (Lull & Belmonte, 2006). The model suggests that collective cognitive systems may transiently achieve enhanced informational coupling. Such states can lead to periods of accelerated knowledge integration, which may later stagnate or regress when access to the informational dimension deteriorates due to sociopolitical, environmental, or cultural disruptions.

Dimensional analysis of Leonardo da Vinci's cognitive event

We apply the proposed formal model to the classic case of Leonardo da Vinci's drawing of the helicopter as a case study of anticipatory access to domain ψ .

In this case, we write:

$$\Psi_{helicoidal} = (x, y, z, t, \psi_{high}, I_{helicoidal}, V, H)$$

The vector $I_{helicoidal}$ presents the following attributes:

$I_{helicoidal}$=(D = engineering, A = high, K = complex, N = very high, S = graphical, T = Renaissance, τ = vertical flight)

Leonardo's cognitive system, through a key thought $\chi_{Leonardo}$ enabled effective coupling with dimension ψ, despite the absence of scientific or technological substrates capable of supporting the actualization of such a design in his time. This supports the hypothesis that dimension ψ contains structured informational content whose manifestation in spacetime can occur with historical delay, modulated by sociotechnical readiness.

Moreover, the model helps explain why different cognitive agents, even with access to dimension ψ, retrieve distinct informational content: this variability lies in the vectors V (cognitive direction) and H (historical-cultural horizon), which modulate the nature and scope of the intersection with ψ.

Therefore, equation Ψ not only encodes the spatiotemporal coordinates of the cognitive event but also its dimensional coupling profile, reinforcing the hypothesis that exceptional cognitive outputs may derive from access—not generation—of latent informational structures.

Discussion

The dimensional formulation of consciousness presented by Hudetz (2024) offers a valuable foundation to support the existence of multiple dimensions involved in conscious experience. Hudetz critically evaluates whether consciousness is unidimensional or inherently multidimensional, concluding that most current models fail to provide ontologically independent dimensions. Traditional frameworks — such as awareness versus wakefulness — often conflate subjective and objective components, preventing the apparent isolation of constitutive dimensions of consciousness (Hudetz, 2024).

While Hudetz proposes criteria for a true dimension of consciousness — namely, that such dimensions must be subjective, non-behavioral, and independent — his model remains primarily

concerned with mapping variations within conscious states based on neurofunctional, cognitive, and behavioral markers. Our proposal diverges from this approach by shifting the ontological focus from states of consciousness to the origin and accessibility of informational content. Specifically, we posit that thought operates as a modulation of conscious state variables and as a direct interface with pre-existing informational structures outside conventional spacetime coordinates.

Furthermore, Hudetz's discussion of cognitive, abstract, and neurofunctional dimensions acknowledges that current multidimensional proposals remain primarily descriptive rather than constitutive (Hudetz, 2024). Similarly, he observes that models like Integrated Information Theory (IIT) or Global Neuronal Workspace Theory (GNWT) collapse dimensions into single integrated metrics or fail to separate levels and content as distinct dimensions. Our hypothesis addresses this critical gap by proposing that the informational dimension ψ represents an orthogonal ontological axis—not yet incorporated into existing theories—along which thought can access informational states independently of neurophysiological complexity or arousal.

Hudetz's work highlights the ongoing difficulty in empirically isolating true dimensions of consciousness, particularly those independent of behavioral correlates. This difficulty reinforces the need for theoretical frameworks that entertain the possibility of non-Euclidean informational dimensions, capable of accounting for phenomena such as anticipatory thought, simultaneous discovery, and cross-generational knowledge access—phenomena that are suggestive of an informational field external to both neural correlates and conventional spacetime (Hudetz, 2024).

Conclusion

This work proposes a theoretical framework in which thought is conceptualized as a transient interface with a fifth dimension—ψ—composed of informational structures independent of classical spacetime. Unlike models that locate cognition entirely within neural causality, this hypothesis suggests that certain cognitive phenomena arise from selective access to pre-existing informational content.

Historical cases—such as the foresight of Leonardo da Vinci or the mathematical intuition of Ramanujan—are interpreted here not as anomalies, but as expressions of intermittent coupling with the ψ dimension. Cultural context, volition, and intentionality function as filters guiding such access, without diminishing the ontological autonomy of the informational domain.

Rather than refuting current neuroscientific theories (e.g., IIT, GNWT), the ψ model seeks to complement them by addressing gaps related to creativity, anticipatory knowledge, and simultaneous discoveries. While empirical confirmation remains pending, the model offers a formal basis for interdisciplinary investigation into cognition as a non-local, informational phenomenon.

Crucially, accessing information does not imply comprehension. Translation into coherent thought depends on both neurobiological architecture and semantic-cultural scaffolding. Future research should thus explore not only the conditions of access to ψ, but also the mechanisms of cognitive integration and meaning-making.

Future Research Directions

Advancing the dimensional hypothesis requires the development of robust mathematical formulations capable of supporting the physical and ontological plausibility of a non-local informational dimension. Models based on non-Euclidean geometries, such as extensions of the Minkowski metric, may offer a foundation to describe the properties of this dimension and the mechanisms of cognitive coupling.

From a neuroscientific perspective, it is necessary to identify the brain regions activated during unconventional informational access—such as in episodes of extreme creativity, novel problem-solving, or the conception of ideas ahead of their time. Neuroimaging and electrophysiological studies can contribute significantly in this regard.

Additionally, a genetic analysis of individuals with a history of exceptional cognitive production is proposed, aiming to identify potential genetic markers associated with the ability to access this dimension. This may help clarify whether such aptitude is partly linked to biological predispositions.

Another line of investigation should focus on characterizing cognitive profiles capable of establishing more frequent or intense informational coupling, including intentional, educational, and cultural factors. Simultaneously, efforts are needed to develop ethical, accessible, and humanized strategies for interacting with this informational domain.

Referências

Albantakis, L., Findlay, G., Marchman, M., Owen, A., Ruffini, G., Sarasso, S., Wang, H., & Tononi, G. (2023). Integrated information theory 4.0: Formulating the properties of phenomenal existence in physical terms. *PLoS Computational Biology*, *19*(5), e1011465.

Baars, B. J. (1988). *A cognitive theory of consciousness*. Cambridge University Press.

Belmonte, J. A. (2001). *Sacred landscape: The ancient Egyptian star temples*. The American University in Cairo Press.

Berndt, B. C., & Rankin, R. A. (1995). *Ramanujan: Letters and commentary*. American Mathematical Society / London Mathematical Society.

Capra, F. (2007). *The science of Leonardo: Inside the mind of the great genius of the Renaissance*. Doubleday.

Chalmers, D. J. (1996). *The conscious mind: In search of a fundamental theory*. Oxford University Press.

Clagett, M. (1999). *Ancient Egyptian science: A source book. Volume 2: Calendars, astronomy, and astronomy*. American Philosophical Society.

Cogitate Consortium, Owen, A. M., et al. (2025). Adversarial collaboration to test IIT and global neuronal workspace theories of consciousness. *Nature*, 628, 1123–1131.

Einstein, A. (1923). *The meaning of relativity*. Princeton University Press.

Foschini, L. (2013). *Where the 'It from Bit' come from?* ResearchGate. https://www.researchgate.net/publication/237000569

Greiner, W. (2004). Classical electrodynamics. Springer.

Hameroff, S., & Penrose, R. (2014). Consciousness in the universe: A review of the 'Orch OR' theory. *Physics of Life Reviews*, *11*(1), 39–78.

Holyoak, K. J., & Morrison, R. G. (2012). *The Oxford handbook of thinking and reasoning*. Oxford University Press.

Hudetz, A. G. (2024). Does consciousness have dimensions? *Journal of Consciousness Studies*, 31(7–8), 55–73.

Jackson, M. D., Mulcahy, S. R., Chen, H., Li, Y., Li, Q., Cappelletti, P., & Wenk, H. R. (2017). Phillipsite and Al-tobermorite mineral cements in Roman marine concrete. *American Mineralogist*, *102*(7), 1435–1450.

Kanigel, R. (1991). *The man who knew infinity: A life of the genius Ramanujan*. Scribner.

Lancaster, L. (2005). *Concrete vaulted construction in imperial Rome: Innovations in context*. Cambridge University Press.

Lehner, M. (1997). *The complete pyramids: Solving the ancient mysteries*. Thames & Hudson.

Lull, J., & Belmonte, J. A. (2006). The constellations of ancient Egypt. *Journal for the History of Astronomy*, *37*(3), 373–392.

Mediano, P. A. M., Rosas, F. E., Carhart-Harris, R., Seth, A. K., & Barrett, A. B. (2021). *Integrated information decomposition: A unifying framework for the quantification of dynamical complexity in consciousness and beyond*. arXiv preprint.

Merton, R. K. (1961). Singletons and multiples in scientific discovery. Proceedings of the American *Philosophical Society*, *105*(5), 470–486.

Minkowski, H. (1908). Raum und Zeit. *Jahresberichte der Deutschen Mathematiker-Vereinigung*, 18, 75–88.

Misner, C. W., Thorne, K. S., & Wheeler, J. A. (1973). *Gravitation*. W. H. Freeman and Company.

Nemirovsky, D., Roquet, D., Rufener, K., Sarasso, S., Storm, J. F., & Lee, M. H. (2023). An implementation of integrated information theory in resting-state fMRI under sedation. *Communications Biology*, *6*(1), 270.

Oleson, J. P. (2008). *The Oxford handbook of engineering and technology in the classical world*. Oxford University Press.

Penrose, R. (1994). *Shadows of the mind: A search for the missing science of consciousness*. Oxford University Press.

Rindler, W. (2006). *Relativity: Special, general, and cosmological* (2nd ed.). Oxford University Press.

Simonton, D. K. (2004). *Creativity in science: Chance, logic, genius, and Zeitgeist*. Cambridge University Press.

Souza, G. C. de, Halfpap, D. M., Min, L. S., & Alves, J. B. M. (2007). Study of consciousness and the embodied cognition. *Ciências & Cognição*, *15*(2), 111–122.

Spence, K. (2000). Ancient Egyptian chronology and the astronomical orientation of pyramids. *Nature*, 408(6810), 320–324.