COGNITIVE GRAVITY:
FROM ECONOMIC MODEL TO
CONSCIOUSNESS ARCHITECTURE

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Abstract Cognitive gravity has appeared across disciplines, each adapting the metaphor of gravitational pull to its own domain. In economics, it modeled trade flows as attraction shaped by mass and distance. In computational science, it became algorithmic, with information treated as mass clustering into data structures. In psychology and philosophy, it described the inertia of thought, where biases and memories anchor judgment, while organizational studies showed how accumulated success entrenches practices and inhibits innovation. Physics-inspired approaches extended the idea further, casting gravity as a structural analogue of consciousness or a unifying principle of mind and matter. Together, these uses suggest a shift toward a cognitive-first model, where gravity is understood as a principle intrinsic to experience itself. Evidence from geometric cognition, neurogeometry, and conceptual spaces are arguments in favour of the hidden geometry binding perception, memory, and meaning into coherent fields, offering the basis for a new science of mind grounded in structures long present but unrecognized.

Keywords Cognitive Gravity, Consciousness, Geometric Cognition, Attractor Dynamics, Philosophy of Mind

1 ORIGINS

The concept of gravity has initially leapt from physics into social science as a powerful analogy.

In economics, the gravity model of international trade was introduced in 1962 by Jan Tinbergen, framing bilateral trade flows as analogous to Newton's law of gravitation. The model explains trade flows between two countries as positively influenced by the economic sizes (GDP) of both countries and negatively influenced by the distance between them (Tinbergen, 1962).

The concept of "space" in this model refers to the geographical and economic distance factors that affect trade flows, highlighting how distance acts as a proxy for transportation costs and trade barriers, which reduce the volume of trade between countries (Anderson and van Wincoop, 2003).

This model posits that trade between two countries (the "gravitational force") increases with their economic "mass" (GDP sizes) and decreases with greater distance or frictions. Thanks to its intuitive appeal and empirical success, the trade gravity equation became a workhorse model, applied in thousands of studies over the past six decades. The enduring popularity of the trade gravity metaphor, encapsulating how size and proximity determine interaction, set a precedent for borrowing the gravity concept to describe other complex systems beyond physics.

The mechanics of the model are straightforward. Imagine two economies as planets: the larger they are, the stronger the pull between them. At the same time, the farther apart they sit, whether in geography, culture, or policy, the weaker that pull becomes. Trade volumes, in other words, rise with the size of each economy and fall with the distance or barriers between them. Researchers later refined the model by adding other "frictions": tariffs, border controls, different currencies, or even the absence of a common language. Each of these makes trade more difficult, much as friction slows down motion in the physical world.

What is striking is how well this simple gravitational logic works in practice. Despite the complexity of global markets, the model consistently explains much of the real pattern of trade flows. Big economies trade more with each other, neighbors trade more than distant partners, and barriers like borders or tariffs sharply reduce flows.

By transposing gravity from physics into economics, the model captured a structural truth: interaction (whether between countries, firms, or people) tends to follow the invisible logics of mass and distance.

This cross-disciplinary migration of "gravity" reflects a broader pattern: researchers often use physical metaphors to illuminate abstract relations.

By the early 21st century, it was perhaps inevitable that cognition and consciousness, domains replete with invisible forces and structural regularities, would get their own "gravity" analogy. The term "cognitive gravity" thus emerged from a lineage of metaphorical gravity models, aiming to capture the "pulls" and "weights" within mental life in a similar way.

2 EARLY USES

One of the earliest academic uses of a gravity-like principle in mind science can be traced to computational models. For example, Wen et al. (2013) proposed a "cognitive gravitation model" for classifying noisy data. This machine-learning algorithm literally applied Newton's law: data instances were treated as "particles" with self-information as mass, attracting each other in feature space to improve clustering and classification While rooted in pattern recognition (not in human cognition per se), this work shows how the gravity metaphor started permeating the "cognitive" realm by name, by using gravity's mathematics to impose structure on information. Such technical adaptations were more about computational geometry than human cognitive processes, but they foreshadowed the term's later, more broader applications.

The mechanism of the "cognitive gravitation model" can be understood as a way of organizing messy data by simulating gravitational attraction. Each data point is assigned a kind of "mass," determined by how much information it carries about itself. Points with greater informational weight exert a stronger pull, drawing nearby points toward them in the feature space. Over time, clusters of points form, much like celestial bodies coalescing under gravity. In this way, the algorithm sorts noisy, scattered data into recognizable groups without requiring strict rules in advance.

What makes this approach distinctive is how it leverages the dynamics of gravity rather than just its metaphor. Instead of a static distance measure, the model creates a moving landscape where data points shift positions under mutual attraction until stable clusters emerge. This process naturally reduces noise, because weak or outlying points are pulled into stronger centers, allowing meaningful structures to stand out. While this method was aimed at computational efficiency rather than human cognition, it illustrates how gravitational principles can serve as an organizing logic, thus, turning chaos into coherence. It also foreshadows how later accounts of cognitive gravity would describe beliefs, memories, and perceptions as carrying their own "mass," drawing other thoughts into orbit.

Outside of AI, researchers in cognitive psychology and philosophy began using "cognitive gravity" in a metaphorical sense to describe mental inertia and bias (Wei, 2023). The idea was that minds, like massive objects, develop attractive forces that pull thoughts in particular directions. In short, cognitive gravity became a vivid shorthand for the stubborn pull of established thought patterns that keeps our minds orbiting in the same grooves. This notion builds on longstanding observations in psychology (e.g. schema theory or mental set) but packages them in the gravity metaphor, conveying the sense of an invisible yet pervasive force holding our thinking in place.

3 ADJACENT COGNITIVE USES

The idea of "gravity" has also surfaced in several adjacent frameworks that shaped how cognition is conceptualized. One prominent example is "mental gravity" (Kent, 2023), where physical gravity serves as a mental model for how individuals orient themselves in relation to the world. Research in this vein has explored how emotional states, particularly depression, are experienced through metaphors of "heaviness" or being pulled "downward", with subjective time and affect warping under the weight of this mental field.

Kent's proposal of mental gravity begins with a simple observation: human beings rely on physical gravity as a constant reference frame for orientation. The brain's vestibular system continuously encodes the pull of "down" relative to the body, anchoring balance, movement, and spatial awareness. Kent suggests that this bodily grounding does not stay confined to motor control but is extended metaphorically and cognitively. People use gravity as a template to interpret their inner states, speaking of feeling "low," "weighed down," or "crushed by pressure", expressions that reflect how gravity itself functions as a mental model for the structuring of experience.

Building on this foundation, Kent applies the idea to depression. In his view, depression operates like an increase in mental gravity: affect becomes heavy, thought slows, and subjective time dilates. Just as strong gravitational fields warp spacetime, a depressive state warps the lived structure of consciousness. Individuals under this heightened mental gravity report sensations of being pinned down, unable to escape the pull of negative affect or to move freely into alternative perspectives. This model understands depression as a fundamental reconfiguration of experiential spacetime, expressed through neurochemical shifts and altered patterns of cognition.

Kent's approach also carries implications beyond pathology. By treating gravity as a simulacrum (a physical principle recruited as a mental model) he offers a way of understanding how consciousness anchors itself in the world. Mental gravity becomes a bridge between embodiment and phenomenology, showing how a universal physical constant shapes the architecture of lived experience. This opens avenues for empirical exploration: if depression is akin to intensified gravity, could therapies work by "lightening" the field, restoring flexibility in temporal and affective flow?

In neuroscience and cognitive science, the idea of attractor dynamics further extends the gravitational analogy. Stable patterns of neural activity (so-called attractor states) act like basins in a landscape, pulling trajectories of thought and memory into recurring configurations. These provide a computational metaphor closely aligned with gravity, describing how cognition achieves stability amid complexity.

Fakhoury and colleagues (2025) treat neural activity as movement across a dynamic landscape. In this view, the brain is constantly shifting through countless possible states, but some regions of this landscape are deeper or more stable than others. These are the attractor basins—zones where activity naturally settles and tends to return after perturbation.

The gravitational analogy is useful here: just as a ball placed on a hilly surface will roll into the nearest valley, neural activity drifts toward these attractors, creating recurring patterns that underpin memory, perception, and even habits of thought.

Their approach emphasizes how attractors balance flexibility and stability. Without attractors, cognition would be chaotic, with mental states constantly dissolving into noise. But with too rigid or dominant attractors, the system risks getting “stuck,” leading to pathological fixations or ruminations. By conceptualizing these dynamics as gravitational basins, the model highlights the invisible forces that shape the brain’s trajectory; forces that are not deterministic but probabilistic, gently pulling activity back into familiar grooves.

What makes this framework especially powerful is its scalability. Attractor states have been applied widely across both cognitive science and artificial intelligence, from explaining how working memory maintains information to modeling decision-making processes and even designing recurrent neural networks (Spisak et al., 2022; Gilbert, 2024). Their success in these domains makes the gravitational analogy more than a poetic image, pointing to a clear computational mechanism by which stability emerges in complex systems. Neural and artificial agents alike rely on these basins of attraction to anchor activity, avoid chaos, and generate coherent patterns. This cross-domain applicability strengthens the case for treating attractor dynamics as a compelling step toward a more grounded theory of cognitive gravity, one where the metaphor is tied directly to demonstrable mechanisms of thought and computation.

Current research and writtings

Concurrently, the metaphor gains popular traction in blogs and media, often with little or no reference to earlier academic work. In many cases, writers even present cognitive gravity as an original theory, a pattern of reinvention without attribution which reflects both the natural appeal of the metaphor and the absence of a consolidated scholarly framework.

It also contributes to a proliferation of loosely connected definitions, ranging from attention as gravitational pull, to beliefs as black holes, to environments matching the “weight” of mental states. While these popular accounts broaden visibility, they also risk diluting the concept, underscoring the need for a rigorous and unified approach, as the term now spreads so widely that multiple overlapping and competing “explanations” circulate online.

4 GAP AND OPPORTUNITY

As we’ve seen, despite a rich enough history of gravitational thinking across disciplines, cognitive gravity remains fragmented. Each field has bent the metaphor toward its own purposes: economics to model flows of trade, psychology to describe the inertia of thought, neuroscience to explain depression, and organizational theory to capture paradigmatic collapse.

What is missing is a unified framework: a model that treats gravity as a principle capable of grounding the architecture of cognition itself. Without such a synthesis, the concept remains scattered, its explanatory power diluted across isolated domains.

This is because most current uses of cognitive gravity remain metaphorical rather than foundational, leaving an unresolved tension: the metaphor is powerful enough to keep reappearing, yet too weakly specified to transform into theory. Bridging this gap requires rethinking gravity as a structural feature of experience and a first principle, capable of grounding the architecture of cognition itself.

No prior account has provided such a perceptual foundation for cognitive gravity. Without rooting the concept in the basic structure of perception the metaphor cannot fully mature into a science of its own.

Matters of geometry

Within the architecture of cognitive gravity, cognition is portrayed as a relational space: a topological manifold shaped by gradients of salience, meaning, and attention. Certain ideas or experiences carry greater cognitive weight, bending phenomenal space and pulling attention toward them, just as mass is said to curve spacetime.

Here, cognitive gravity becomes a measure of centrality and integrative density within awareness, quantifying how strongly particular structures warp the cognitive spacetime of an individual.

This architecture is informed by embodied and embedded principles of geometric cognition, cognitive geometry, and neurogeometry, grounding cognitive gravity in established research on how perception and thought take form in spatial structures.

The origins of geometric perception can be traced back to the pioneering work of Gestalt psychologists such as Max Wertheimer (1880), Wolfgang Köhler (1887), and Kurt Koffka (1886). Their central insight was that perception is organized through holistic patterns—Gestalten—that emerge from the mind's intrinsic structuring principles, rather than through isolated sensory inputs. Shapes, symmetry, and continuity were shown to be fundamental to how the visual field is parsed, suggesting that cognition is already geometric at its perceptual root.

Earlier contributions anticipated this trajectory across multiple domains. Hermann von Helmholtz (1821) explored the geometry of vision through optical illusions and color perception, arguing that unconscious inferences shape how we interpret space. Ewald Hering (1834) emphasized opponent processes in both color and spatial orientation, revealing underlying geometric constraints in sensory coding. In physics, Ernst Mach (1838) studied motion, acceleration, and frame-of-reference effects, proposing that perception of space is tied to relational dynamics rather than absolute positions. Henri Poincaré (1854), bridging mathematics and philosophy, argued that geometric intuition underlies scientific reasoning and that our sense of space is actively constructed. In experimental psychology, David Katz (1884) examined depth and surface perception, highlighting how spatial form and texture guide cognition.

Further evidence comes from Rudolf Arnheim (1954), who argued in “Art and Visual Perception” that aesthetic experience relies on perceptual forces (balance, symmetry, and tension) that follow Gestalt principles. In neurophysiology, Hubel and Wiesel's discovery of orientation-selective neurons in the visual cortex (1962) revealed biological mechanisms that support Gestalt organization, encoding lines, edges, and angles as primitives of perception. In developmental psychology, Jean Piaget (1952) showed that children construct spatial schemas in stages, gradually learning to coordinate perspective and scale, thereby embedding geometry into cognition itself. Even in modern computational neuroscience, David Marr's theory of vision (1982) described perception as a process of constructing geometric representations at multiple levels, from primal sketch to 3D models.

Taken together, these and many other contributions demonstrate that perception organizes sensory data through geometric order, shaped by biological circuitry and cognitive principles. The Gestalt of perception is thus more than an historical school: it reflects a deep continuity across psychology, biology, and neuroscience, where geometry is revealed as the hidden architecture through which experience is made coherent.

More recently, researchers such as Giovanna Citti and Alessandro Sarti have advanced the field of neurogeometry (2019), exploring how the brain encodes orientation, contours, and association fields through geometric structures. Their studies show that the connectivity of neurons in the visual cortex can be modeled using differential geometry, with perceptual grouping arising from the geometry of neural pathways themselves. In this way, neurogeometry links the phenomenology of perception with the mathematical description of brain architecture, offering a natural bridge between cognitive gravity and the physical implementation of geometry in the nervous system.

Complementary work in conceptual and cognitive geometry reinforces this view. George Lakoff's theory of embodied metaphors (1980), for instance, shows how abstract concepts are grounded in bodily experience, often structured through geometric schemas such as containers, paths, and forces that serve as templates for reasoning. This indicates that cognition is inseparable from the geometries implicit in perception and movement. Likewise, research into natural geometry and the origins of geometric cognition (Hohol, 2019) demonstrates that humans possess an innate sensitivity to shapes, symmetries, and spatial relations. Such evidence implies that the brain evolved with geometric primitives as part of its core architecture for interpreting the world (Spelke, 2010).

Similarly, Peter Gärdenfors' geometry of thought (2000) frames concepts and categories as regions in a multidimensional conceptual space, where similarity and difference are mapped geometrically. These contributions collectively demonstrate that cognition, from perception to abstraction, unfolds within geometric structures, lending further weight to an architectural model of consciousness that treats gravity as a principle shaping relational space.

At the computational level, semantic embeddings and word vector models reveal that language itself can be mapped into geometric spaces, where meanings cluster, stretch, and align along dimensions that mirror conceptual relations (Grand, Blank, Pereira, and Fedorenko, 2022). Similar principles operate in pattern detection and sequence learning, where the brain identifies structure through repeated geometric regularities in time and space (Konovalov and Krajbich, 2018). Studies of geometric reasoning further show that problem-solving often relies on spatial analogies and transformations, even in domains that appear abstract (Lupyan et al., 2018).

All these seemingly disparate researches point toward a "hidden in plain sight" science of cognitive gravity: a body of evidence that already exists across psychology, linguistics, neuroscience, and computational modeling, yet has not been unified under a single framework. The common thread is the role of geometry in structuring cognition and biological processes, suggesting that gravity as a cognitive principle is only the natural generalization of what is already being observed.

One reason gravity has eluded cognitive science for so long lies in the conceptual split between mind and body. Classical science, shaped by Cartesian dualism, treated the mental as secondary, subjective, or metaphorical, while reserving principles like gravity for the physical world (Descartes, 1641). As a result, when gravity appeared in cognitive contexts, it was almost always as metaphor: a borrowed image to explain bias, inertia, or stability, but never as a candidate first principle in its own right. Even when evidence accumulated, from Gestalt patterns to neurogeometry to semantic spaces, the gravitational logic embedded in these findings remained hidden behind the assumption that the mind could only be described analogically.

This limitation is inherent to the frameworks used to interpret them. The insistence on a strict separation of cognition and physics made it difficult to see that the gravitational qualities of clustering, attraction, and curvature were signatures of how cognition itself organizes experience. The consequence has been a proliferation of partial theories without the conceptual courage to treat gravity as fundamental to mind.

A cognitive-first approach alters the picture. By beginning within perception itself, rather than treating it as derivative of external matter, gravity can be reframed as a first principle of organization. Once freed from the classical separation of body and mind, perception unfolds in curved relational spaces, much as physical matter arranges itself under gravitational forces.

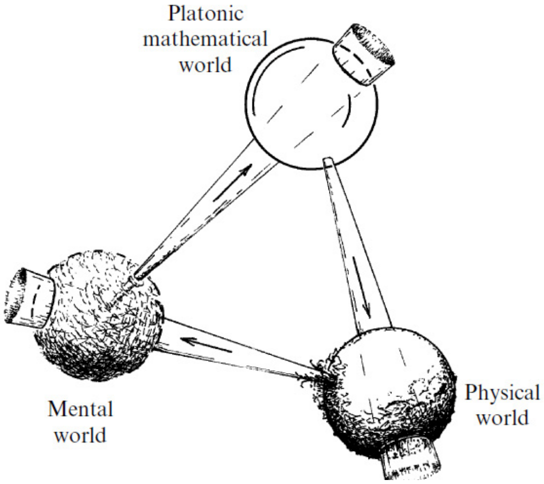

Fig.1 Three 'worlds'— the Platonic mathematical, the physical, and the mental—and the three profound mysteries in the connections between them. © Roger Penrose, The Road to Reality, p. 18

The platonic realm

Dealing with cognition and cognitive processes inevitably draws philosophy of science, theory of mind, and the intangible into view: the idealistic dimension of what is being processed. Geometry, form, and meaning allude to realities that cannot be reduced to mechanism alone. This is the territory of the Platonic realm, the domain of eternal and unchanging forms that Plato regarded as more real than the material world itself. In this view, the objects of perception are mere shadows, while the true essence of things exists in the ideal geometries, numbers, and principles that govern them.

Plato articulated this through his famous triad of Truth, Beauty, and Goodness, a constellation of values he believed were reflections of the same ultimate order. Truth represented the correspondence of thought to reality, Beauty the harmonious manifestation of form, and Goodness the ethical dimension of alignment with the higher order. Together, they formed a framework for understanding both knowledge and existence, a vision in which geometry and ideals were first principles shaping the world.

Roger Penrose has argued for this position. "To me, the world of perfect forms is primary (as was Plato's own belief) — its existence being almost a logical necessity — and both the other two worlds are its shadows." (2004) For Penrose, the physical world is a shadow in the sense that the laws of physics derive from mathematical structures in the Platonic realm. Consciousness, too, is a shadow: our uncanny ability to grasp mathematical truths points to a deep connection between mind and ideal forms, possibly mediated by quantum processes within the brain that "interface" with these geometric realities.

Buckminster Fuller extended Platonic insight into systems thinking. In his Tetrahedral Analysis of Plato's Triad (1979), he reimagined Plato's triad by pointing out its omission of the observer. Fuller proposed the tetrahedron as the minimal system of interrelations, a geometry embodying synergy. Systems, in his view, exhibit emergent behaviors greater than the sum of their parts, inviting us to tune our awareness toward higher-order patterns. This orientation is less about static forms than about becoming conscious of the systemic geometry of experience.

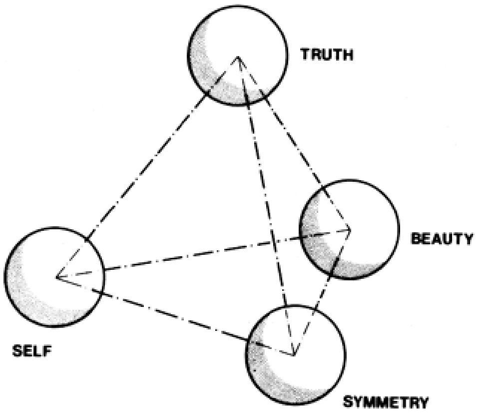

Fig.2 Tetrahedral Analysis of Plato's Triad: The triadic concept of Beauty, Symmetry, and Truth inadvertently omitted the function of the observer. The tetrahedron is the unique symmetrical set of minimum interrelationships. Copyright © 1979 Estate of R. Buckminster Fuller

Other scientific giants similarly reached into this idealist terrain. John Wheeler (1990) proposed "it from bit," suggesting that information underlies physical reality, a view that places mind-like abstraction at the foundation of the cosmos. David Bohm (1980) spoke of the implicate order, where the manifest world unfolds from deeper, enfolded structures resembling Platonic forms. Werner Heisenberg (1958) openly invoked Plato in describing quantum states as potentia, possibilities that only become actual through observation. Erwin Schrödinger (1944) insisted on the unity of mind and matter, arguing that consciousness is a fundamental feature of the universe, not reducible to physical interactions. Niels Bohr (1935), through his principle of complementarity, gestured toward a reality where opposites coexist in superposition, only resolving into form through the act of measurement.

Taken together, these figures show that the Platonic realm appears as a recurring intuition among the most rigorous thinkers of modern science. Each, in their own way, broke the boundary between physics and metaphysics, suggesting that consciousness and the structures of thought are inseparable from the laws of nature.

The loop

In order to grasp gravity's proposed cognitive architecture we must turn to the notion of the loop, as the recursive relation between "now" and "observation within time and space". While traditionally regarded as linear, cognition is viewed here as circular integration, where perception folds back on itself, stabilizing experience through self-reference.

This looping dynamic has been explored across diverse writings. Douglas Hofstadter (1979) described consciousness as "a strange loop", where the mind arises from self-referential patterns that loop across levels of abstraction. Rupert Sheldrake (1981) proposed morphic resonance, a form of memory as resonance across time, linking present patterns with prior ones through recurrence. Laukkonen (2025) articulated "a beautiful loop" to capture the aesthetic and systemic dimensions of recursive processes. Donald Hoffman (2025) has introduced N-cycles, models of perceptual loops where consciousness cycles through nested layers of observer–observed relations. Earl K. Miller (2018) demonstrated how cognitive waves (oscillatory loops in the brain) organize working memory and flexible attention.

Other major accounts reinforce this centrality of looping. Francisco Varela (1991), in "The Embodied Mind", framed cognition as enactive, a constant loop between organism and environment. Humberto Maturana and Varela (1980) introduced autopoiesis, describing life and mind as self-producing, self-closing loops. Gerald Edelman (1987) theorized neural Darwinism, where looping reentrant circuits bind perception into unified experience. Walter Freeman (1995) studied chaotic brain dynamics, showing perception as emergent from recursive attractor loops. Karl Friston (2010) advanced the free energy principle, where cognition is a loop of prediction and error correction minimizing surprise. Anil Seth (2014) emphasized predictive loops in interoception, showing how bodily feedback loops shape conscious experience. György Buzsáki (2006) highlighted hippocampal oscillatory loops as the basis of memory and navigation. Andy Clark (2016) proposed an extended loop of mind, embedding cognition in external tools and environments.

This inevitably brings us to the intrinsic toric construct of the loop, which unflods into toroidal geometry: a surface without beginning or end, where "inside" and "outside" fold seamlessly into one another. Such a construct embodies the recursive movement of cognition itself. Perception progresses forward in time while also circling back, re-entering, and stabilizing itself, much as trajectories on a torus return in endlessly varying yet bounded paths.

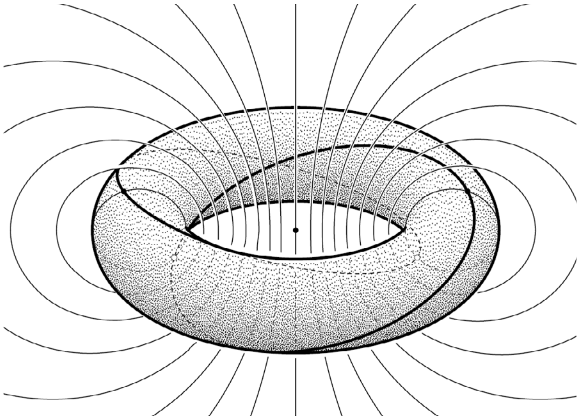

Fig.4 A toroidal structure with field lines depicting recursive flow. The geometry illustrates loops that curve back into themselves while coupling inner and outer domains, modeling the toric logic of cognitive recursion. Image: personal.psu.edu

The torus arises naturally from the recursive architectures discussed earlier and continues the emphasis on geometry from the previous chapter. Here, geometry functions as a method that models cognition as self-organizing curvature, with pathways of thought, memory, and attention bending into recurrent patterns.

Geometry is also isomorphic with cognition itself, since the toroidal loop reflects the structural dynamics of perception together with the qualities of consciousness such as continuity, self-reference, and the integration of "inside" and "outside".

5 A POLYNONIAL ARCHITECTURE

Amid these converging threads, the polynonial approach synthesizes "cognitive gravity" within philosophy of mind and systems architecture. It builds a geometric model of consciousness centered on the gravity analogy, aiming to move the concept beyond metaphor and establish it as a foundational principle of mind.

The polynon itself functions as a conceptual geometric entity, a manifold of interrelated vertices and structures through which an observer's cognitive processes are mapped (Roibu, 2025). Within this framework, gravity describes the relations among these processes, curving them into coherent patterns of experience. The architecture is grounded in an idealist ontology, beginning from the premise that consciousness is fundamental rather than an emergent byproduct of matter. From this standpoint, the difficulty of reconciling gravity with quantum theory is reinterpreted as a clue that gravity has a cognitive origin.

Nonetheless, for progress in science, academia, and technology, a neutral approach is necessary. Any account that draws on cognitive aspects must be treated primarily as a vehicle for producing testable outputs, not as a metaphysical closure. In practice, this means using the framework to clarify potential neural correlates of consciousness, while refraining from presuming a definitive mechanistic account of consciousness itself.

The construct

While the geometric nature of this architecture has previously been established conceptually, the postulates of how these structures bind together (whether as force, as substance, or as a hybrid dynamic) remain to be tested. Cognitive gravity may not operate like a physical field in the strict sense, yet its effects suggest an attractor-like mechanism that confers both stability and salience. The construct unfolds experience (and with it, the now) into its phenomenal and noumenal gradients, ranging from the simple, almost mechanical capture of attention to the multi-dimensional processes through which coherence, beauty, and ultimately truth are disclosed.

Testing these postulates requires translating the geometry of cognition into operational models that can generate measurable outputs, whether in neural signatures, behavioral dynamics, or artificial cognitive systems:

Attention illustrates the first gravitational gradient: eye-tracking studies reveal how gaze is consistently drawn to areas of contrast, balance, or salience in a visual field, demonstrating how perception bends toward relevance rather than just a recording of stimuli.

Perceptual pleasure appears when patterns are processed fluently, as in experiments showing reward activation during exposure to symmetry, rhythm, or fractals, where the brain's opioid and dopaminergic systems reinforce structured perception.

Beauty emerges at a higher-order level, evidenced by neuroimaging studies of the default mode network, which integrates disparate sensory inputs into unified aesthetic judgments, whether the object is an artwork, a human face, or a natural landscape.

And, *truth* is encountered when cognition orients toward coherence, as in experiments where even subliminal cues bias truth assessments, or when logical consistency and empirical verification exert gravitational weight in shaping belief systems. (Roibu, 2025)

Space and time

The construct of cognitive gravity cannot be separated from the way space and time themselves are conceived. In general relativity, Albert Einstein (1915) demonstrated that space and time are relative properties shaped by mass and energy. Gravity, in this formulation, is the curvature of spacetime itself. Hermann Minkowski (1908) had already formalized the idea of a four-dimensional manifold where time is inseparable from space, making relativity a geometric theory of the cosmos.

The relativity of space and time is proposed, here, as a precursor for a cognitive-first approach in understanding gravity. Both dimensions are always relative to an observer's perspective, even one that does not posses any account of consciousness: velocity, simultaneity, and even duration depend on the frame of reference. As Niels Bohr (1928) emphasized in the quantum domain, the act of observation is inseparable from what is observed, introducing complementarity as a principle that ties epistemology to ontology. Werner Heisenberg (1927), with the uncertainty principle, likewise showed that the limits of observation are structural. These insights converge on a paradox: while physics often attempts to bracket out the observer, its own deepest revolutions return to the inescapability of perspective.

Epistemologically, it is tempting to dismiss the observer as secondary, treating space and time as objective scaffolds that cognition merely inhabits. Yet when retracing the origins of what we call space and time, they lead back to phenomena, the "things as they appear to us". This direction was articulated by Immanuel Kant (1781), who argued that space and time are a priori forms of intuition. Space provides the order of coexistence, time the order of succession, and together they make perception possible. From this standpoint, noumena remain beyond direct apprehension, as things-in-themselves that cannot be fully known.

Cognitive gravity accounts here as a proposal that these structuring conditions are curving experience into coherence. In this sense, the gravitational architecture of cognition shapes the fabric of reality as it is lived, binding observer, space, and time into a single dynamic topology.

Ontologically, this opens the path to reconsidering space and time as conditions of "appearance", where cognitive gravity can be seen as the principle that bends these conditions into ordered perception. What emerges, via a holographic mechanism and within a perceptual construct, is a view in which reality is more than a partitioned reality between independent noumena and dependent phenomena.

This constitution unfolds with cognition and extends beyond the senses, encompassing modes of intuition and prehension that operate independently of direct perception. Prehension indicates that relations among entities are fundamental features of reality, functioning as the primary mode through which experience is constituted. Even basic processes can thus be understood as instances of this relational awareness, grounding consciousness in the structure of the self and the non-self (Fichte, 1794) as parts of the same being; postulated in the noumenal ontology as a measure of the imaginary and non-imaginary waveform, of which conceptual device articulates the interplay between what is apprehended directly (via sense) and what is inferred or intuited, suggesting that consciousness is structured by the oscillatory relations that bind them together.

Within noumenal ontology, this dual measure functions as a generative schema, mapping how potentiality and actuality interpenetrate to form coherent experiential wholes. The result is a view of cognition as intrinsically relational and gravitational: relations exert weight, shaping trajectories of awareness and embedding the subject in a field where self and world co-arise as structured possibilities.

The now

Within the first-person construct proposed here, the Observer is the function of self-reflection for consciousness, situated within a relativity of space and time. Thus, the axis along which measurements are treated shifts from the traditional Minkowski space-time, to reflect a closed trajectory, previously described as a "loop". The toric structure is therefore invoked as an isometric expression of self-reflection itself.

The term "reflection" itslef, derived from the Latin *reflectere*, literally means "to bend back" or "to curve." This etymology upholds the structural aspect of the process: reflection is a folding of experience back onto itself, a curvature that produces both continuity and differentiation. In the present model, this bending back is expressed geometrically through a toric architecture, where the curving trajectory allows consciousness to encounter itself as both subject and object, origin and return.

The first torus models the phenomenal domain, the second the noumenal. Their conjunction conveys both the architecture of what is measured and the gravitational aspects inherent to measurement.

This structure is gravitational in a broader sense, insofar as it conditions the stability of what can appear, while remaining irreducible to appearance itself. Together, the phenomenal and noumenal tori articulate a bidimensional architecture of reflection, in which the now is bridging the thing and the thing-in-itself.

In this respect, the noumenal torus opens onto a realm that can be understood as akin to the Platonic domain beyond cognition and knowledge, the domain of Forms, where relations are structures of possibility, providing the ontological backdrop against which cognition unfolds, situating consciousness within an order that exceeds its own operations.

6 CONCLUSION

The cognitive construct upon which gravity is observed constitutes both embodied and embedded aspects of cognition, demanding a new understanding of their significance once the depth of their intrinsic connections is recognized across fields that previously appeared disparate.

As such, experience, as argued through the concept of cognitive gravity, is fundamentally structured by geometric cognition, wherein cognition and experience follow pathways shaped by internal gravitational dynamics. These gravitational structures map shades and depths of experience, engaging internal architectures that shape perceptual and cognitive landscapes.

Yet, if cognitive gravity is to advance beyond metaphor, its conceptual scaffolding must be translated into testable forms.

The transition from geometric philosophy to empirical science remains underdeveloped, requiring specific strategies for operationalization. Experimental paradigms could measure the gravitational "pull" of salience in eye-tracking studies or quantify decision biases as attractor-like tendencies in behavioral tasks. Neuroimaging may reveal gravitational signatures in EEG coherence patterns, MEG oscillatory couplings, or fMRI analysis. Computational simulations, meanwhile, can generate predictions of gravitational dynamics prior to biological validation, offering a bridge between abstract architecture and measurable data.

Longitudinal designs might further capture how gravitational fields of cognition shift over time, tracing the stability or plasticity of these attractors across learning, development, or pathology. In this way, the framework maintains its philosophical depth while opening avenues for empirical investigation.

Positioning cognitive gravity alongside established accounts of mind clarifies both its convergences and its departures. Predictive processing and the free energy principle describe cognition as minimizing dissonance or surprise, while attractor dynamics show how stability arises from recurrent basins.

Cognitive gravity resonates with these models but reframes the grounding principle: rather than beginning from inference, thermodynamics, or dynamics alone, it posits geometry as the primary field through which coherence emerges. Its role is to complement these theories, providing the overarching spatial logic in which their mechanisms operate. A comparative mapping of these relations would help specify whether cognitive gravity serves as foundation, supplement, or meta-framework.

The dual torus construct articulates how experience is structured across appearance and potentiality. The phenomenal torus encodes the empirical (perception, salience, coherence, affect, memory, attentional flow, and projected possibility), while the noumenal torus encodes the geometry of the abstract, relations that remain irreducible to perception yet shape its contours.

Measurements on the phenomenal torus may take the form of neural coherence patterns, behavioral attractor signatures, or computational reconstructions, while the noumenal torus remains accessible only through structural modeling and vectorial topologies, standing as ontology rather than empirical data. This duality is both metaphorical and topological: a geometry that mirrors recursion, bending the inside and outside into continuity while preserving the distinction between appearance and ontological ground, thereby establishing a coupled system of field-like dynamics that condition the stability of experience itself.

In education, cognitive gravity implies that learning is optimized when materials align with perceptual attractors of symmetry, coherence, and fluency, thereby increasing engagement and retention. Each of these applications could demonstrate how adopting a gravitational lens would shift practice: from linear causality to curved architectures of cognitive processes.

Moreover, cognitive gravity invites future extensions across various theoretical and practical domains, from fundamental cognitive science to applied frameworks in decision-making, social dynamics, linguistic structures, aesthetics, foresight or architecture. Its integrative potential positions cognitive gravity as a versatile analytical lens capable of illuminating cognitive architectures in diverse human experiences, enriching both theoretical and practical explorations of consciousness.

And, as consciousness science increasingly gravitates toward a paradigm shift recognizing consciousness as fundamental, cognitive gravity offers significant conceptual advancements, proposing novel research avenues and methodological frameworks that transcend traditional dichotomies of observer versus observed, phenomenal versus noumenal.

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