Quantum Collapse as a Model of Creative Insight: A Formal Framework for Emergent Cognition

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Abstract. Creative insight often emerges as a sudden shift in mental representation, shaped by ambiguity and context. Classical cognitive models struggle to capture this non-linear, indeterminate process. Building on prior work in quantum cognition, in this research paper we propose a formal framework that models creative insight as a quantum-like collapse of a conceptual state. Ideas are represented as superpositions within a structured semantic space, and contextual cues act as observables that trigger representational collapse. This process accounts for emergent meaning, contextual sensitivity, and interference between latent interpretations. We illustrate the model through cognitive scenarios such as metaphor reinterpretation and insight problem solving. By extending quantum-inspired models of conceptual dynamics with a formal account of collapse, our approach provides a mathematically grounded, generative model of ideation and restructuring. The framework opens new directions for modeling cognitive emergence and may inform both psychological theory and brain-inspired AI systems.

Keywords: Creative cognition · Quantum cognition · Insight · Cognitive modeling · Emergent representation · Contextual collapse

1 Introduction

Creative insight is a central component of human cognition, marked by the sudden restructuring of mental representation that yields novel and coherent ideas. It plays a crucial role across diverse domains—from scientific discovery and problem solving to metaphor creation and artistic ideation [17,3,19]. Yet, despite decades of empirical and theoretical investigation, the cognitive mechanisms driving insight remain difficult to capture in a unified framework, especially in relation to their non-linear, ambiguous, and context-sensitive dynamics.

Classical models, including associative theories [15], symbolic problem solving frameworks [16], and dual-process accounts [10,18], have provided valuable perspectives on creative ideation. Associative models portray creativity as the ability to traverse remote links in a semantic network. Symbolic and heuristic approaches frame creative thought as rule-based search within structured problem spaces. Dual-process theories distinguish between intuitive (System 1) and analytical (System 2) cognition, attributing insight to interactions between these systems. Evolutionary models like Blind Variation and Selective Retention (BVSR) [17] and the Geneplore framework [11] emphasize generative and evaluative cycles.

However, each of these approaches faces limitations when applied to insight phenomena. Associative models often presuppose that solutions preexist and can be accessed through spreading activation, failing to capture genuinely emergent ideas. Symbolic approaches rely on fixed representations and deterministic transitions, which do not account for ambiguity or conceptual fluidity. Dual-process theories offer only coarse-grained explanations for transitions between competing mental states, while BVSR and Geneplore models often overlook the internal representational dynamics and the role of semantic context in shaping ideation.

A persistent challenge for classical models is their inability to model the high degree of contextual modulation observed in creative cognition. Subtle perceptual, linguistic, or task-based cues can drastically alter representational outcomes—a phenomenon not easily accommodated by frameworks based on fixed taxonomies or static similarity metrics [4,8]. Such observations suggest that insight involves representational states that are ambiguous, fluid, and highly sensitive to contextual influence.

These challenges have prompted growing interest in alternative paradigms. Quantum cognition offers one such framework. This research program applies mathematical tools from quantum theory—not physical quantum processes—to cognitive phenomena marked by ambiguity and context sensitivity [6,1,14]. It has been successfully used to model decision-making and semantic shifts.

In quantum cognition, mental states are modeled as vectors in a complex Hilbert space, encoding a superposition of conceptual possibilities. Contextual evaluation—such as interpreting a metaphor or solving a problem—is formalized as a measurement process that collapses this superposition onto a determinate outcome. This collapse is probabilistic and shaped by the measurement basis, which represents contextual constraints.

This formalism naturally accommodates non-classical phenomena such as interference, ambiguity, and context-driven reconfiguration. Insight, under this view, is not the deterministic combination of predefined elements but the actualization of latent cognitive potentialities triggered by contextual cues. Recent applications of quantum formalism to creativity and semantic emergence [12,9,7] provide a foundation for such modeling efforts.

In this paper, we extend previous applications of quantum formalisms to cognition [6,1,12], proposing a framework that models creative insight specifically as a context-driven collapse of a latent cognitive state. While prior work has applied quantum structures to concept combination, decision making, and emergent meaning, our approach formalizes insight as a dynamic restructuring process grounded in measurement-like contextual interactions. This framework aims to offer a principled, mathematically coherent account of the discontinuity, ambiguity, and contextual sensitivity that characterize creative ideation, with potential applications in computational creativity, cognitive modeling, and brain-inspired AI.

Author(s)	Phenomena Modeled	Quantum Formalism	Formal.	Relation to This Work
Gabora [13,?] (2000,2010)	Creative restructuring, potentiality	Metaphoric analogy	Low	Introduces key cognitive ideas; lacks operational formalism
Aerts and Gabora [2] (2005)	Concept combination	Hilbert space states	Medium	Models contextuality; anticipates quantum-like semantics
Busemeyer and Bruza [6] (2012)	Decision making, ambiguity	Quantum probability	High	Provides tools for cognition; not focused on insight
Khrennikov [14] (2010)	Generalized quantum cognition	Structural isomorphism	High	Abstract framework; not tailored to creative phenomena
This work (2025)	Creative insight, restructuring	Collapse in Hilbert space	High	Offers a formal and simulable model of insight as quantum-like collapse

Table 1. Positioning of the present work with respect to related quantum-inspired models

Table 1 summarizes how our framework relates to key contributions in the quantum cognition literature. While inspired by earlier work on conceptual ambiguity and interference, our model introduces a specific formalization of creative restructuring as a collapse process, targeting insight phenomena with computational applications.

Specifically, while prior contributions laid the groundwork for applying quantum structures to cognition, they fall short of addressing insight phenomena directly. Gabora's pioneering work [13,12] emphasized the role of potentiality and restructuring in creative thought, but its treatment remained largely metaphorical, without a formal mechanism to capture how contextual cues precipitate a sudden reorganization. Aerts and Gabora's Hilbert-space approach [2] introduced a powerful way to represent concept combinations and contextuality, yet their focus was on semantic coherence and conceptual ambiguity rather than on the discontinuous transitions that characterize creative breakthroughs.

Busemeyer and Bruza [6] advanced the field by developing a rigorous quantum probabilistic framework for decision-making, demonstrating the explanatory power of interference and context effects. However, their models center on judgment and choice, not on representational restructuring. Khrennikov's generalized quantum cognition [14] provides a highly abstract formalism applicable across domains, but its breadth comes at the cost of specificity: it does not supply a concrete account of how cognitive states undergo collapse-like transformations during creative episodes. In contrast, our framework explicitly targets insight as a collapse-driven restructuring process, filling a gap between metaphorical accounts and general-purpose quantum models.

2 Mapping Thought in Hilbert Space

Quantum cognition is an emerging research program that applies the mathematical formalism of quantum theory to model cognitive processes characterized by ambiguity, contextual sensitivity, and emergent meaning [6,1,14]. Crucially, this approach does not assume that cognition operates according to the physical laws of quantum mechanics. Instead, it uses the abstract structure of quantum theory as a modeling toolkit—employing notions such as superposition, measurement, and Hilbert space to describe cognitive phenomena that elude classical symbolic or probabilistic accounts.

At the core of this framework is the idea of a *cognitive state* represented by a vector $|\Psi\rangle$ in a complex Hilbert space $\mathcal{H}$. This state encodes a superposition of conceptual possibilities:

$$|\Psi\rangle = \sum_{i=1}^{n} \alpha_i \, |c_i\rangle \,, \qquad \sum_i |\alpha_i|^2 = 1, \tag{1}$$

where $\{|c_i\rangle\}$ is a basis of cognitively meaningful vectors (e.g., memory traces, semantic units), and the complex amplitudes α_i encode activation and interference patterns. The superposed state $|\Psi\rangle$ represents a condition of cognitive potentiality, where multiple configurations coexist prior to resolution.

Cognitive *contexts*—such as prompts, tasks, or environmental cues—are modeled as observables, i.e., self-adjoint operators O_C on $\mathcal{H}$, associated with spectral decompositions into orthogonal projectors:

$$O_C = \sum_j \lambda_j P_j, \qquad P_j = |\phi_j\rangle \langle\phi_j| \,, \tag{2}$$

where $\{|\phi_j\rangle\}$ is an orthonormal set of eigenstates representing context-relevant outcomes. When a cognitive agent engages with context C, a measurement-like process is triggered: the state $|\Psi\rangle$ collapses probabilistically onto one of the eigenstates $|\phi_j\rangle$, with probability given by the Born rule:

$$\mathbb{P}(\phi_j \mid \Psi, C) = |\langle\phi_j|\Psi\rangle|^2, \tag{3}$$

and post-measurement state:

$$|\Psi'\rangle = \frac{P_j \, |\Psi\rangle}{\| P_j \, |\Psi\rangle \|}. \tag{4}$$

This collapse mechanism captures the dynamics of context-driven idea generation. The outcome $|\phi_j\rangle$ need not coincide with any of the original basis states $|c_i\rangle$, but may emerge from interference effects, yielding a novel and coherent configuration. This property allows the model to represent genuinely creative restructuring events, where new meanings arise through the contextual reorganization of latent conceptual structure. The formalism thus accommodates core features of creative cognition: representational ambiguity (through superposition), sensitivity to framing or task constraints (via the measurement basis), and the generation of non-trivial outcomes (enabled by interference and projection). It provides a mathematically principled account of how latent ideational states evolve and actualize under contextual interaction.

It is worth emphasizing once more that the use of quantum formalism in this framework is analogical, not ontological. The aim is not to claim that the brain exhibits quantum coherence or entanglement, but to employ a structurally suitable language for modeling cognitive phenomena that involve non-commutativity, context-dependence, and probabilistic emergence. This position is widely shared in the quantum cognition literature [6,14], where the focus is on explanatory power and predictive adequacy, rather than physical substrate.

Although quantum-theoretic tools have been applied to cognitive modeling in various domains, such as decision theory [6], semantic processing [1], and creative association [12], these models often focus on the probabilistic structure of cognitive judgments or the representation of conceptual combinations. Our framework builds upon these foundations, but shifts the focus to the modeling of creative insight as a state collapse that reorganizes representational structure under contextual constraints. In the following section, we apply this formalism to characterize the emergence of novel ideas through collapse-like dynamics in structured conceptual spaces.

3 A Quantum-Inspired Model of Creative Collapse

While the general structure of quantum cognition models a mental state as a vector $|\Psi\rangle$ in a Hilbert space $\mathcal{H}$, it is crucial to specify how this space is cognitively grounded and what its basis vectors represent. In our framework, $\mathcal{H}$ is constructed over a set of conceptually meaningful dimensions $\{|c_i\rangle\}_{i=1}^{n}$, which correspond to semantic primitives, memory traces, or abstract features activated by the task context or prior knowledge. Fig. 1 provides a conceptual overview of the quantum-inspired insight process that this section formalizes.

The coefficients α_i in (1) encode more than just activation strengths: they reflect the potential for *interference and combination* between conceptual elements. Importantly, the cognitive relevance of a component is not solely tied to its amplitude; even low-weighted vectors may participate in *remote associations or creative recombinations*, especially when amplified by contextual interaction.

Rather than being static or universal, the structure of $\mathcal{H}$ is dynamically shaped by the cognitive domain and task demands. In practice, it may be instantiated from empirical models such as *distributional semantics*, *associative networks*, or *embedding spaces* derived from large-scale language data. These implementations provide a flexible yet principled way to anchor abstract Hilbert spaces in data-driven cognitive representations.

This view captures a core assumption of our model: *the latent cognitive state prior to insight is neither determinate nor unstructured*, but reflects a highly organized potentiality landscape. The superposition $|\Psi\rangle$ encodes a readiness for meaning, in which numerous partially activated conceptual patterns coexist, awaiting collapse into a coherent insight under contextual pressure.

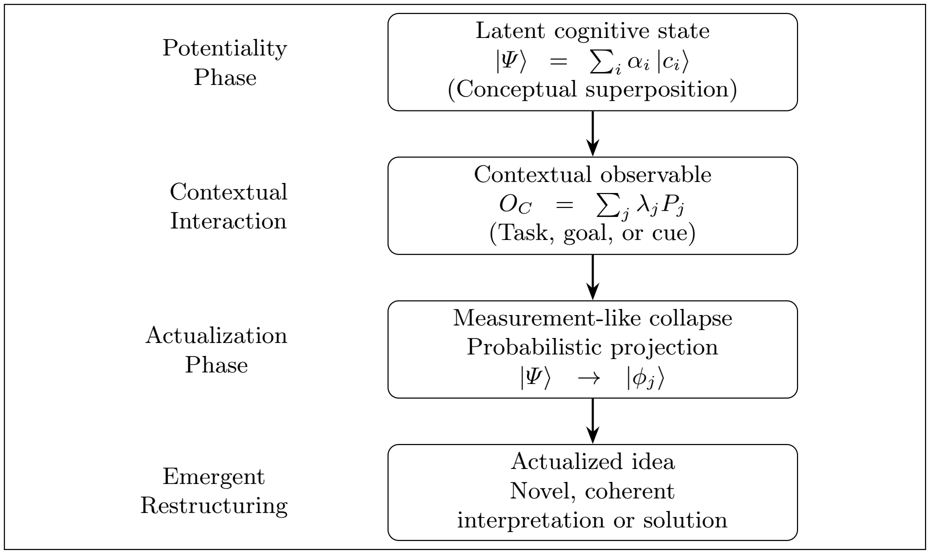

Fig. 1. Conceptual model of creative insight as quantum-like collapse.

The Role of Context

In our framework, the role of context is formalized as a measurement operator that shapes the actualization of insight. Rather than merely influencing the salience of pre-existing representations, the context actively determines the structure of cognitive resolution by defining the conceptual dimensions along which the latent state is projected.

Specifically, each contextual stimulus, whether linguistic, perceptual, or task-related, is associated with a self-adjoint operator O_C acting on the Hilbert space $\mathcal{H}$. This operator admits the spectral decomposition (2), where each $P_j = |\phi_j\rangle\langle\phi_j|$ projects onto an eigenstate $|\phi_j\rangle$ that encodes a contextually coherent outcome. These eigenstates represent not simply stored concepts, but emergent configurations aligned with the semantic and pragmatic constraints imposed by the situation.

Engaging with a context triggers a measurement-like process in which the cognitive state $|\Psi\rangle$ collapses probabilistically onto one of these eigenstates. The probability of collapse into $|\phi_j\rangle$ is given by (3).

This mechanism formalizes how subtle variations in framing or prompt can produce divergent cognitive outcomes from the same initial state. It also captures the core idea that context does not merely filter latent content, but reconfigures the interpretive landscape, highlighting novel combinations, suppressing irrelevant paths, and enabling emergent conceptual patterns. Such a view is essential for explaining the context sensitivity and unpredictability that characterize moments of creative insight.

Emergent Insight

In the proposed framework, creative insight is modeled as a probabilistic collapse of the latent cognitive state $|\Psi\rangle$ onto one of the eigenstates $|\phi_j\rangle$ defined by the contextual observable O_C. This transition formalizes the sudden actualization of a coherent idea from a condition of conceptual potentiality.

A key feature of this process is its *non-determinism*: repeated engagement with the same context may lead to different actualizations, reflecting the subjective unpredictability and discontinuity often reported in moments of insight. Unlike rule-based selection or search, the collapse does not follow a traceable trajectory of incremental steps, but instantiates a qualitatively new configuration.

This mechanism also accounts for *emergence*: the actualized state $|\phi_j\rangle$ need not correspond to any single preexisting basis vector $|c_i\rangle$, but may result from constructive interference among latent components. The outcome may thus transcend the mere recombination of prior elements, giving rise to genuinely novel interpretations or solutions.

Importantly, collapse entails a representational *restructuring.* By projecting the cognitive state onto a new subspace defined by the context, it reorganizes previously incompatible or weakly activated elements into a coherent and meaningful configuration, resolving ambiguity and opening new inferential possibilities.

In sum, this model of insight captures several defining features of creative cognition: *Suddenness:* insight emerges as an abrupt, non-incremental shift; *Novelty:* the result may not be derivable from initial components; *Contextual modulation:* different contexts induce distinct actualizations.

This formal abstraction is not intended as a physical analogy but as a cognitive model that captures how contextual interaction precipitates conceptual reconfiguration. In the following section, we explore the broader cognitive properties that this collapse mechanism entails.

Key Cognitive Effects

The proposed framework accounts for several hallmark features of creative cognition that are difficult to model within classical paradigms. By leveraging the formalism of quantum theory, it enables a principled treatment of ambiguity, contextual sensitivity, and interaction among conceptual components.

First of all, the latent state $|\Psi\rangle$, by construction, captures the coexistence of multiple conceptual possibilities. Rather than preselecting among discrete alternatives, the superpositional structure maintains a distributed configuration of partially activated elements, allowing for cognitive flexibility and delayed commitment.

Also, the contextual operator O_C dynamically defines the representational perspective from which the cognitive system interacts with $|\Psi\rangle$. This mechanism naturally models the context-dependent nature of insight: small variations in task framing or environmental cues can reorient the collapse toward distinct, and potentially novel, outcomes.

In addition, unlike classical mixture models, the quantum formalism incorporates interference effects through the complex amplitudes of $|\Psi\rangle$. Constructive and destructive interference modulates the salience of conceptual patterns, accounting for both suppression of dominant but unproductive ideas and the amplification of remote or unexpected associations.

Finally, the proposed framework accounts for transitions in thought that defy classical constraints of linearity and compositionality. Even minimal changes in context can lead to substantial reconfigurations of mental content, highlighting the system's *non-linear* sensitivity to external cues. Furthermore, the outcomes of these transitions often exhibit *non-compositional* characteristics: rather than being reducible to straightforward combinations of preexisting components, they emerge as novel configurations shaped by interference and contextual alignment. Central to this dynamic is the transformation from a *latent* state of cognitive potentiality to an *actualized* representation, a discontinuous yet structured process that lies at the core of creative insight.

Altogether, the model provides a compact and expressive formalism for representing creative cognition as a process of structured emergence. Its emphasis on interaction, ambiguity, and context responsiveness makes it particularly suitable for modeling insight phenomena and for guiding the design of generative artificial systems.

4 Illustrative Cognitive Scenarios

To illustrate the applicability of the proposed framework, we describe two representative scenarios in which creative insight plays a central role. These examples highlight how a cognitive state can evolve under contextual influence and collapse into an emergent idea. While simplified, they aim to capture key features of insight, including superposition, contextual modulation, and sudden representational restructuring.

Metaphor Reinterpretation

Consider the interpretation of the metaphorical expression *"Silence is a wall"*. Prior to encountering this metaphor, the concept of "silence" can be modeled as a cognitive state $|\Psi\rangle$ residing in a Hilbert space $\mathcal{H}$, where each basis vector $|c_i\rangle$ represents a distinct construal of the concept. In this space, the state $|\Psi\rangle$ takes the form of the superposition given in (1), where the amplitudes $\alpha_i \in \mathbb{C}$ encode latent activation levels and potential phase relations among semantic features.

Possible basis states might include:

$$
\begin{aligned}
|c_1\rangle &= |\textsf{Silence as tranquility}\rangle\,, \\
|c_2\rangle &= |\textsf{Silence as repression}\rangle\,, \\
|c_3\rangle &= |\textsf{Silence as emptiness}\rangle\,, \\
|c_4\rangle &= |\textsf{Silence as respect}\rangle\,, \\
|c_5\rangle &= |\textsf{Silence as isolation}\rangle\,, \\
&\vdots
\end{aligned}
$$

When the metaphor *"Silence is a wall"* is introduced, it acts as a contextual perturbation, modeled by a self-adjoint operator $\hat{O}_{\text{metaphor}}$ on $\mathcal{H}$. This operator has a spectral decomposition:

$$\hat{O}_{\text{metaphor}} = \sum_j \lambda_j P_j,$$

where each projector $P_j = |\phi_j\rangle\langle\phi_j|$ identifies a contextually coherent interpretation aligned with the metaphorical frame. The eigenstates $\{|\phi_j\rangle\}$ define a basis over the metaphor space in which features from the "wall" domain (e.g., barrier, protection, separation) are projected onto "silence".

The interpretation process is modeled as a measurement-like collapse modelled by (3) and (4), resulting in the actualization of a specific construal, such as $|\phi_j\rangle = |\textsf{Silence as barrier}\rangle$, depending on the alignment between the initial cognitive state and the metaphorical observable.

Importantly, this collapse reflects not merely a selection from pre-encoded meanings, but a restructuring of conceptual space. In a psychological or therapeutic context, for instance, the metaphor may elicit a dominant eigenstate like:

$$|\phi_k\rangle = \frac{1}{\sqrt{2}}(|\textsf{Silence as repression}\rangle + |\textsf{Silence as isolation}\rangle),$$

indicating constructive interference between emotionally charged construals.

In contrast, within an architectural or aesthetic context, the same metaphor might privilege a different interpretation:

$$|\phi_{k'}\rangle = |\textsf{Silence as protective boundary}\rangle\,,$$

showing how the same latent state $|\Psi\rangle$ can yield divergent outcomes under different contextual observables. [1]

[1] This framework naturally extends to bidirectional mappings: while "wall" provides structural features such as division, containment, or support, these may retroactively reshape the understanding of "silence". Such bidirectional influence can be modeled through entanglement-like correlations or via tensor product structures between conceptual domains.

Problem Restructuring in Insight Tasks

Consider the classic insight problem: *"A man is looking at a portrait. Someone asks, 'Whose picture are you looking at?' He replies, 'Brothers and sisters, I have none. But that man's father is my father's son.' Who is in the picture?"*

Initially, many solvers represent the problem using a surface-level interpretive frame, often driven by syntactic complexity rather than semantic analysis. This leads to a cognitive state $|\Psi\rangle$ expressed as a superposition over an initial interpretive basis $\mathcal{B} = \{|c_i\rangle\}$, such as:

$$|\Psi\rangle = \beta_1 \left|\textsf{Speaker is uncle}\right\rangle + \beta_2 \left|\textsf{Speaker is cousin}\right\rangle + \beta_3 \left|\textsf{No relation}\right\rangle + \cdots ,$$

where each $\beta_i \in \mathbb{C}$ reflects the degree of latent support for each hypothesis, influenced by heuristic misparsing and semantic overload.

Over time—through internal reanalysis, incubation, or external prompting—a *representational shift* occurs. This can be formalized as a unitary transformation $U : \mathcal{H} \to \mathcal{H}$ that rotates the cognitive basis to a new set of interpretive vectors:

$$\mathcal{B}' = \{\left|\textsf{Speaker is father}\right\rangle, \left|\textsf{Speaker is son}\right\rangle, \left|\textsf{Speaker is self}\right\rangle, \ldots\}.$$

In this transformed basis, latent components like $\left|\textsf{Speaker is self}\right\rangle$ gain amplitude as the ambiguous phrase "my father's son" is correctly parsed as referring to the speaker himself. The measurement question—"Who is in the picture?"—now functions as an observable $\hat{O}_{\text{query}}$ defined in the new basis $\mathcal{B}'$. This observable induces a collapse:

$$|\Psi\rangle \longrightarrow \left|\textsf{Speaker's son}\right\rangle,$$

as the correct referential mapping is actualized: "that man's father" = "myself" implies the man in the picture is the speaker's son.

From a quantum-theoretic standpoint, the insight is modeled as a *context-triggered projection* of the rotated state $U\,|\Psi\rangle$ onto the eigenspace of $\hat{O}_{\text{query}}$ associated with the correct solution. This projection was initially inaccessible in the untransformed basis due to representational misalignment. Only after reconfiguration does the relevant subspace become visible to the measurement dynamics. This formulation captures key phenomenological features of insight, such as its sudden emergence once the appropriate interpretive frame is adopted, its non-linear nature, where a minimal shift in framing can produce a major reinterpretation, and its emergent quality, as the solution arises not through incremental reasoning but through a reorganization of mental representation.

Additionally, the model accounts for the contribution of initially low-salience components, such as $\left|\textsf{Speaker is self}\right\rangle$, which can become central once the representational basis shifts. This underscores the strength of the quantum-like approach in modeling cognitive restructuring as a probabilistic and geometrically grounded transition within a structured semantic space.

5 Implications and Theoretical Integration

The framework developed in this work offers a formal account of creative insight as a contextualized collapse within a structured space of conceptual potentialities. This perspective enables the modeling of key cognitive phenomena, such as ambiguity, context sensitivity, and restructuring, that are difficult to capture within classical paradigms.

While quantum cognition has been previously applied to model ambiguity and conceptual combination [2,5], its explicit application to insight remains relatively underexplored. Our contribution lies in formalizing creative restructuring as a measurement-like process, driven by context and governed by a non-classical representational geometry.

Previous models, such as Gabora's theory of creative cognition [**?**], describe insight as a transition from associative to evaluative modes, often metaphorically connected to quantum phenomena. Aerts and colleagues [1] have used Hilbert space models to represent concept combinations and contextual dynamics. Busemeyer and Bruza [6] formalized decision-making using interference and contextual collapse. Unlike these approaches, our framework provides an explicit and tractable formalization of insight as a projection within a structured conceptual space, allowing us to model abrupt restructuring, representational emergence, and context-guided selection in a unified mathematical system.

The framework aligns with and extends several strands of cognitive theory. In dual-process models [10,18], it offers a formal structure for implicit and intuitive operations typically associated with System 1, modeling them not as heuristic shortcuts but as evolutions of latent conceptual states modulated by contextual constraints. Similarly, it complements generative-evaluative theories of creativity, such as the Geneplore framework and BVSR [11,17], by modeling both the generative superpositional phase and the context-driven actualization of ideas, while introducing the novel capacity to capture interference and emergent structure.

The use of Hilbert spaces provides a principled way to represent concept combinations, metaphor, and analogy in a context-dependent manner. This complements prior quantum-inspired approaches in decision theory and semantic processing [6,1], while extending their reach to the domain of creative insight.

In computational creativity, this formalism enables the development of generative models that simulate evolving superpositional states and context-sensitive actualizations. Unlike rule-based or search-driven systems, such models may exhibit fluid restructuring and emergent novelty. This opens potential applications in creative AI, metaphor generation and insight-oriented problem solving.

The framework also suggests testable predictions. Subtle contextual manipulations, such as priming or framing, may significantly influence the trajectory of ideation, while interference effects may modulate the salience of competing alternatives. These dynamics may be empirically investigated through behavioral measures, neurocognitive correlates, or process-tracing techniques.

Importantly, the model is not intended as a physical theory of the brain, but as a formal abstraction. The quantum formalism serves as a mathematical toolkit to express non-deterministic and context-sensitive transitions in thought, without invoking physical quantum mechanisms. This interpretive stance is consistent with the broader literature in quantum cognition [14].

6 Conclusion and Future Work

We have presented a formal framework that models creative insight as a quantum-like collapse from a superposed conceptual state into a context-dependent interpretation. This approach captures key features of creative cognition that often elude classical models.

By drawing on mathematical structures from quantum theory, the model provides a principled representation of representational dynamics during insight. Through illustrative cases in metaphor interpretation and problem solving, we have shown how context acts as a measurement-like operator, driving the transition from potentiality to determinate understanding.

Rather than replacing classical or existing quantum cognitive models, this framework aims to extend the theoretical landscape by introducing a formalism specifically tailored to processes of non-deterministic restructuring. The quantum-like abstraction is intended not as a physical claim, but as a functional and generative tool to bridge descriptive theories of insight with mathematically grounded simulations.

Future work should address empirical validation, computational implementation, and integration with existing cognitive architectures. More broadly, the model opens new directions for theorizing about mental processes characterized by indeterminacy and emergence, offering a contribution to the growing intersection between cognitive science and quantum-inspired modeling.

Looking ahead, this framework could also inspire new generations of cognitive models and intelligent systems, where creativity is not programmed, but emerges as a dynamic interplay between latent structure and contextual force, bridging minds and machines in the shared pursuit of meaning.

Beyond these general directions, several concrete avenues for development can be outlined. A first step is the integration of the proposed framework with computational models grounded in semantic embeddings, such as word2vec or transformer-based models like BERT. These systems provide empirically derived high-dimensional spaces of meaning that could serve as cognitively plausible instantiations of the Hilbert space. Embedding-based implementations would allow the simulation of collapse, like dynamics on realistic linguistic data, bridging formal theory with data-driven cognitive modeling. A second line of development concerns empirical validation through cognitive experiments. The model predicts that subtle contextual manipulations, such as semantic priming, framing effects, or variations in problem presentation, can drastically alter the actualization of insight. Designing behavioral studies that manipulate these variables would provide testable predictions, allowing the model to be evaluated against human performance in metaphor interpretation, problem solving, or creative association tasks.

Finally, the framework has implications for the design of creative AI systems. Unlike rule-based approaches, which generate novelty through explicit search or recombination, a collapse-based system could simulate emergent restructuring by projecting latent states into context-sensitive outcomes. Such an architecture could support generative tools for metaphor creation, problem restructuring, or ideation support, offering a principled alternative to heuristic-based computational creativity.

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