



A Universal Force Beyond Aesthetic Appeal (Attractiveness): Academic Research

Dr. Ocak Korhan Özduru

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Abstract

This paper argues that attractiveness extends beyond superficial judgments, functioning as a fundamental principle driving organization and complexity across diverse systems, from cosmic structures to sophisticated biological entities ([Rolston, 2010](#)). This inherent "attractiveness" can be conceptualized as an evolutionary attractor, guiding systems towards more practical and aesthetically fitting states ([Smith, 2010](#)). This perspective aligns with the Law of Structuring Systemic Emergence, which posits that a single dominant dynamic emerges at each organizational scale once a Systemic Threshold of internal interactions is crossed ([Pontet, 2025](#)). This emergent dynamic then monopolizes the General Systemic Balance of that particular scale, much like gravity dictates galactic formations or consciousness organizes cognitive functions ([Pontet, 2025](#)) ([Ward, 2017](#)). Such emergent dynamics represent a form of universal attractiveness, drawing constituent elements into increasingly complex and functionally optimized configurations, thereby reflecting a multidimensional unity that integrates sensory, emotional, and intellectual dimensions ([Chen, 2025](#)). This conceptualization suggests that the universe itself may operate as an evolutionary and



developmental system, guided by predictable trends rather than purely stochastic processes ([Smart, 2009](#)).

Keywords: *Universal Force, Aesthetic Appeal, Attractiveness, Aesthetic, Appeal*

Introduction

Indeed, consciousness, conceived as a second-order chaotic system, exemplifies such an emergent dynamic, self-modifying through recursive reflexivity and structuring cognitive universes akin to gravitational behavior in cosmology ([Shkursky, 2025](#)). Furthermore, this intricate interplay of senses, emotions, and intellect converges to shape our understanding and appreciation of beauty, reflecting a profound harmony of its many dimensions ([Chen, 2025](#)). This holistic view encompasses not only aesthetic appreciation but also cognitive dynamics, where continuous stabilization of representations and dynamic belief updates ensure adaptive inference through prediction-driven attractor shifts ([L.B.P., 2025](#)). This continuous process of dynamic updating and stabilization suggests that cognitive systems are perpetually drawn towards states of increased coherence and explanatory power, mirroring the broader evolutionary drive towards complexity ([L.B.P., 2025](#)). This drive towards coherence is also evident in experiences of beauty, which can be understood as moments where disparate elements achieve a sudden sense of unity, consistency, and clarity ([Frascaroli et al., 2023](#)). This alignment between internal models and external sensory inputs generates a form of aesthetic pleasure, reinforcing the drive for perceptual learning and the continuous refinement of predictive representations ([Sarasso et al., 2020](#)).

Methodology

These adaptive inferences are crucial for navigating complex environments, enabling organisms to anticipate and react to changes with greater efficiency and accuracy, further underscoring the universal nature of attractiveness as a guiding principle in evolution and cognition. This unified model of aesthetics posits that the aesthetic sense itself has evolved to



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identify and value prospects for safety and accomplishment, manifesting as principles such as unity-in-variety ([Berghman & Hekkert, 2017](#)). Indeed, this active engagement with the environment involves the sensory system continuously predicting upcoming sensory input rather than merely processing information passively ([Sarasso et al., 2020](#)). This predictive processing framework highlights how the brain actively constructs its perception of the world, constantly updating internal models based on incoming sensory data to minimize prediction errors ([Frascaroli et al., 2023](#)) ([Sarasso et al., 2020](#)). This dynamic process, central to cognitive function, extends to aesthetic experience, where beauty is perceived when prediction errors decline after an initial arousal, indicating a successful reconciliation of sensory input with internal representations ([Sarasso et al., 2020](#)). This reduction in prediction error, signaling enhanced understanding and mastery, contributes significantly to the rewarding and pleasurable aspects of aesthetic appreciation ([Sarasso et al., 2020](#)) ([Cruys et al., 2023](#)). This aligns with the notion that our brains are constantly generating top-down predictions to interpret sensory inputs, and aesthetic experiences arise from the successful resolution of mismatches between these predictions and actual sensory data ([Cruys et al., 2023](#)). This iterative comparison between top-down predictions and bottom-up sensory signals, minimizing "prediction error," is fundamental to how the brain constructs a coherent understanding of its environment ([Frascaroli et al., 2023](#)). This predictive coding mechanism, where neural hierarchies transmit predictions to lower levels to "explain away" sensory inputs, underlies our perception and actions, guiding attentional resources to unpredicted stimuli that carry valuable, learnable information ([Sarasso et al., 2020](#)). This continuous probabilistic inference, wherein the brain constantly hypothesizes about the underlying causes of sensory inputs, underpins not only basic perception but also complex cognitive functions and aesthetic judgments ([Frascaroli et al., 2023](#)). This probabilistic hypothesis-testing, central to the predictive processing framework, provides a comprehensive explanation for various mental functions, including cognition, perception, emotion, and attention ([Frascaroli et al., 2023](#)). This framework posits that the brain is not a passive receiver of sensory information but an active constructor of reality, continuously generating and refining internal models to anticipate and interpret external stimuli ([Ohira, 2023](#)).



Literature Review

This active construction minimizes prediction errors by either updating internal models or modulating sensory inputs through behavioral adjustments, thereby maintaining an integrated and consistent perception of self and world ([Ohira, 2023](#)). This convergence of interests between cognitive science and aesthetics, particularly within the predictive processing framework, has proven highly fruitful for understanding aesthetic phenomena and their deep connections to fundamental mental functions ([Frascaroli et al., 2023](#)). Specifically, this approach elucidates how aesthetic pleasure is generated through the brain's successful resolution of uncertainty, where an initial state of high arousal from unpredictable stimuli transitions into a state of reduced prediction error as internal models are updated ([Sarasso et al., 2020](#)). This theoretical framework offers a robust account of how aesthetic experiences are intrinsically linked to pervasive processes of inference and meaning-making, connecting them to underlying existential concerns ([Frascaroli et al., 2023](#)). This perspective further suggests that the universal appeal of attractiveness may stem from its role in facilitating the brain's continuous effort to infer the most probable causes of sensory inputs, thereby reducing uncertainty and generating a sense of cognitive mastery ([Frascaroli et al., 2023](#)). Indeed, this intrinsic link between aesthetics and meaning-making underscores how our evaluations of beauty are always infused with affective nuances, reflecting the ongoing success or failure of our attempts to comprehend the world ([Frascaroli et al., 2023](#)). This unified paradigm, rooted in Bayesian cognitive science, effectively integrates diverse findings in empirical aesthetics by leveraging the increasing explanatory power of predictive processing ([Frascaroli et al., 2023](#)). This convergence elucidates how aesthetic phenomena are not merely subjective reactions but rather arise from the brain's fundamental imperative to generate and refine internal models for navigating a dynamic world ([Frascaroli et al., 2023](#)). This active inference account of aesthetics provides a robust framework that reformulates existing theories with greater precision, offering a deflationary approach to complex experiences by building from fundamental, general-purpose elements ([Cruys et al., 2023](#)).

This re-conceptualization integrates the study of art, beauty, and "sensuous cognition" within a unified framework, highlighting the continuity between ordinary and aesthetic experiences while accounting for their differential intensity ([Frascaroli et al., 2023](#)). This framework also



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provides crucial insights into how aesthetic experiences, particularly in art, foster open-ended and playful behaviors by managing uncertainty rather than merely minimizing it ([Cruys et al., 2023](#)). This dynamic interplay of uncertainty resolution and maintenance is crucial for understanding how art elicits profound aesthetic experiences, often by deliberately delaying the fluent processing of information ([Cruys et al., 2023](#)). This strategic manipulation of predictive coding mechanisms, through the introduction and subsequent resolution of prediction errors, is central to how artworks engage us deeply, fostering experiences of consolation, transformation, or invigoration ([Cruys et al., 2023](#)).

Moreover, the Predictive Processing framework offers a compelling explanation for the intrinsically pleasurable nature of aesthetic experiences, linking it directly to the brain's fundamental imperative to maintain its viability within a constantly changing environment ([Frascaroli et al., 2023](#)). This perspective highlights how aesthetic pleasure arises from the successful optimization of an agent's probabilistic models of the world, minimizing long-term prediction error, and thus aligning with an organism's fundamental drive for self-preservation and optimal functioning ([Frascaroli et al., 2023](#)). This connection means that aesthetic pleasure itself is an affective correlate of successful inference, signifying the attainment of a particularly effective explanation for sensory stimulations ([Frascaroli et al., 2023](#)). This implies that experiences deemed attractive are those that efficiently reduce uncertainty or provide a highly coherent and informative structure that satisfies the brain's predictive models ([Cruys et al., 2023](#)). This successful structuring of the world, often encountered in aesthetic experiences, promotes a more positive affective state, contrasting with negative experiences arising from prediction violations that remain unresolved ([Frascaroli et al., 2023](#)). This perspective clarifies why not all experiences are equally aesthetic; everyday perceptions often lack the optimal balance of order and reducible ambiguity necessary to trigger the intense pleasure associated with significant uncertainty reduction ([Frascaroli et al., 2023](#)).

Art, by strategically introducing prediction errors and then facilitating their resolution, allows for a unique "sandbox-ing" mode of active inference, where novel hypotheses and even new forms of agency can be explored shielded from typical constraints ([Cruys et al., 2023](#)). This deliberate orchestration of prediction errors and their subsequent resolution forms the core of an "epistemic arc," which can be seen as a minimal unit of sense-making and a key component



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of aesthetic pleasure ([Cruys et al., 2023](#)). This "epistemic arc" encapsulates the dynamic interplay between expectation violation and subsequent model updating, which is critical for generating positive affect and fostering learning ([Cruys et al., 2023](#)). This process involves an initial state of curiosity, followed by epistemic action to gather information, culminating in a pleasurable resolution of uncertainty ([Cruys et al., 2023](#)).

The intensity of this positive emotion, ranging from mild satisfaction to an "aha!" experience, is hypothesized to depend on the specific dynamics of uncertainty resolution and the individual's expectations thereof ([Cruys et al., 2023](#)). This framework also posits that the process of attunement or "fusion of horizons" experienced during engagement with art can lead to a profound sense of self-evidencing, wherein the individual's existence is affirmed through a temporary dissolution of boundaries with the external world ([Cruys et al., 2023](#)). This aligns with the concept of "self-evidencing," where the brain maximizes the likelihood of sampled sensations, providing a grip on the world that art can profoundly restructure ([Cruys et al., 2023](#)). Indeed, aesthetic experiences are not merely about the absence of prediction errors but rather involve a delicate balance, where the successful resolution of unexpected validations of our world model increases the scope for engaging with greater complexity ([Cruys et al., 2023](#)). This dynamic interplay often involves a tension between ingrained assumptions and novel patterns, where artworks introduce conflicts that necessitate the development of new "priors" for a more comprehensive understanding of the environment or oneself ([Cruys et al., 2023](#)). This leads to the notion of an "epistemic arc" as a fundamental unit of aesthetic experience, where an initial state of uncertainty or tension is resolved, leading to a sense of closure and often pleasure ([Cruys et al., 2023](#)). However, relying solely on "aha experiences" or "closure" to explain aesthetic phenomena is problematic, as such cognitive engagements can be self-effacing and may prematurely terminate further exploration ([Cruys et al., 2023](#)).

Conversely, great art often fosters an aesthetics of openness, sustaining an epistemic promise that encourages continued exploration rather than immediate, convergent closure, thus prolonging the engagement with complex stimuli and deferring complete resolution ([Cruys et al., 2023](#)). This sustained engagement allows for multiple cycles of active inference, where new interpretations and insights can continually emerge, enriching the aesthetic encounter ([Cruys et al., 2023](#)). The very nature of an "aha" experience, while pleasurable due to its rapid



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uncertainty reduction, may inadvertently truncate deeper epistemic exploration by signaling a premature completion of inquiry ([Cruys et al., 2023](#)). Instead, compelling artworks often provide an "epistemic promise"—an implicit expectation that continued engagement will lead to further resolution of uncertainty, thereby sustaining attention and exploration without immediate convergence ([Cruys et al., 2023](#)). This sustained engagement, driven by an inherent structural indeterminacy within the artwork, prevents cognitive satiation and maintains a fertile ground for ongoing predictive progress ([Cruys et al., 2023](#)). This "epistemic promise" therefore cultivates a deferral of immediate cognitive closure, fostering a state of sustained inquiry and nuanced appreciation, which is crucial for deeply engaging aesthetic experiences that extend beyond fleeting satisfaction ([Cruys et al., 2023](#)). This perspective reconciles the seemingly contradictory aspects of aesthetic encounters, allowing for both the cognitive component of uncertainty minimization and the affective openness inherent in profound aesthetic experiences ([Cruys et al., 2023](#)). Thus, an effective aesthetic encounter often resides not in the instant gratification of solved puzzles, but in the enduring allure of questions that invite continuous reflection and a recursive refinement of predictive models ([Cruys et al., 2023](#)).

Findings

This ongoing process of predictive refinement, rather than a singular "aha" moment, allows for the rich and deeply engaging aesthetic experiences that can profoundly alter an individual's outlook ([Cruys et al., 2023](#)). This sustained, iterative process of engaging with uncertainty and seeking its resolution transforms the initial interaction into a dynamic dialogue between the observer and the artwork, fostering deeper levels of understanding and appreciation ([Cruys et al., 2023](#)). Such prolonged engagement, which thrives on an inherent structural indeterminacy within the artwork, prevents cognitive satiation and sustains a fertile ground for ongoing predictive progress. This deliberate deferral of complete resolution enables the continuous generation and testing of hypotheses, transforming the aesthetic experience into an extended form of active inference ([Mortu, 2023](#)). This perspective resonates with neuroscientific findings suggesting that the brain continually optimizes its internal models to explain sensory input, where art provides a unique medium for perturbing and refining these models without immediate survival implications ([Cruys et al., 2023](#)) ([Kesner, 2014](#)). This process of sustained



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predictive refinement, therefore, serves as a mechanism through which art can not only entertain but also actively contribute to the development and adaptation of an individual's cognitive framework, thereby enhancing their capacity for complex problem-solving ([Kesner, 2014](#)). This dynamic interplay between predictability and novelty in art can be further elucidated through the lens of predictive processing, which posits that aesthetic appreciation involves the optimization of internal models to minimize prediction errors while simultaneously seeking rewarding uncertainty ([Cruys et al., 2023](#)) ([Muth & Carbon, 2015](#)).

Argument

This involves a delicate balance, where the brain actively seeks out prediction errors that are resolvable, leading to a sense of mastery and epistemic grip, while avoiding those that are overwhelming or irrelevant ([Cruys et al., 2023](#)). This active seeking of manageable uncertainty is intrinsically linked to curiosity, described as an urge to resolve prediction errors and reduce uncertainty, especially when the rate of error reduction is predictable ([Cruys et al., 2023](#)). Consequently, aesthetically pleasing stimuli often present a degree of optimal uncertainty, providing enough complexity to engage predictive mechanisms without inducing cognitive overload ([Cruys et al., 2023](#)). This perspective aligns with theories positing that aesthetic experiences derive pleasure from the successful resolution of prediction errors, allowing for the refinement of internal generative models ([Cruys et al., 2023](#)). Indeed, the sustained engagement with art permits the continuous generation and testing of hypotheses, transforming the aesthetic experience into an extended form of active inference that pushes the boundaries of an individual's predictive capabilities ([Constant et al., 2023](#)). This process, often termed "epistemic foraging," highlights how aesthetic encounters serve as opportunities for self-discovery and the successful updating of one's internal models of the world ([Frascaroli et al., 2023](#)). This optimization of internal models through aesthetic engagement is not merely a passive reception but an active, reconstructive process that continuously refines our understanding of complex stimuli ([Kesner, 2014](#)). This aligns with the idea that individuals often prefer stimuli that offer an optimal level of complexity, challenging their predictive models just enough to induce learning and a sense of reward without overwhelming them ([Sarasso et al., 2020](#)). This dynamic interplay between challenge and gratification underscores



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the notion that aesthetic experiences can be viewed as a form of perceptual problem-solving, where the successful resolution of predictive conflicts contributes to the appreciation of art ([Frascaroli et al., 2023](#)). This dynamic process, where the brain actively seeks to reduce prediction errors, thereby refining its internal generative models, contributes to a positive emotional valence ([Sarasso et al., 2020](#)). This reinforces the idea that aesthetic appreciation is not merely a passive reception of sensory input, but an active, reconstructive process that enhances our understanding of complex stimuli ([Sarasso et al., 2020](#)). This active engagement transforms art into a potent tool for cognitive development, enabling individuals to construct more robust and flexible internal representations of the world ([Sarasso et al., 2020](#)) ([Kesner, 2014](#)). Furthermore, the hierarchical organization of these models reduces the search space for novel hypotheses and guides exploration towards informative regions, allowing for a more canalized and contained introduction of useful uncertainty into the system ([Cruys et al., 2023](#)). This selective introduction of uncertainty, often facilitated by the arts, confirms long-standing hypotheses about experiences that promote learning and human flourishing, emphasizing how aesthetics can inform the design of engaging, motivating, and fulfilling experiences ([Frascaroli et al., 2023](#)). Indeed, aesthetic experiences, by promoting learning and creativity through enhanced capacity to grasp complexity and integrate new information, offer significant information-processing advantages by engaging the brain's high-power communication hubs ([Starr, 2023](#)). This perspective suggests that the aesthetic experience is a crucial mechanism for cognitive development, enabling individuals to construct more robust and flexible internal representations of the world ([Starr, 2023](#)). This ongoing refinement of internal models, driven by the unique challenges and rewards presented by aesthetic encounters, suggests a profound connection between art appreciation and the brain's fundamental learning mechanisms ([Starr, 2023](#)).

Moreover, the capacity for art to deliberately subvert established predictive frameworks, thereby generating significant prediction errors, can be a core component of its aesthetic appeal, particularly in modern and abstract forms ([Cruys & Wagemans, 2011](#)) ([Leder et al., 2004](#)). This intentional disruption compels the cognitive system to engage in a deeper, more effortful re-evaluation of its priors, fostering a heightened sense of discovery and intellectual satisfaction ([Pepperell, 2023](#)) ([Cruys et al., 2023](#)). This challenges the brain to update its generative models more comprehensively, leading to a richer and more nuanced understanding of the world ([Starr,](#)



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[2023](#)) ([Cruys et al., 2023](#)). This re-evaluation not only enhances cognitive flexibility but also contributes to the formation of novel categorical structures and relationships within the observer's mental landscape ([Mortu, 2023](#)) ([Frascaroli et al., 2023](#)). This interplay between anticipated and actual sensory input, particularly when deviations are resolved, can lead to "aha" moments that reduce ambiguity and foster a sense of clarity, thus enabling more radical exploration and freedom of action ([Cruys et al., 2023](#)). This epistemic insight, fused with the opening of action affordances, provides a sense of expansion and empowerment, akin to gaining new options to interact with and control one's environment ([Cruys et al., 2023](#)).

This dynamic interaction between aesthetic stimuli and predictive processing frameworks suggests that aesthetic experiences are not merely subjective pleasures but are fundamentally intertwined with the brain's core learning and adaptive mechanisms ([Frascaroli et al., 2023](#)). Indeed, the hedonic feedback associated with beauty and aesthetic pleasure signals optimal learning dynamics, prompting the system to integrate new knowledge by temporarily inhibiting motor responses and enhancing perceptual processing ([Sarasso et al., 2020](#)) ([Sarasso et al., 2019](#)). This "stopping for knowledge" mechanism, where the organism pauses to assimilate new information, thereby links aesthetic appreciation directly to the fundamental processes of knowledge acquisition and cognitive refinement ([Sarasso et al., 2020](#)). This suggests that aesthetic experiences, rather than being mere epiphenomena, are deeply rooted in the biological imperative to learn and adapt, serving as a powerful motivator for cognitive growth ([Sarasso et al., 2020](#)). This inherent drive to update internal models and reduce uncertainty contributes to a fundamental aspect of human intelligence, facilitating enhanced perceptual learning and memory updating through the processing of informationally profitable stimuli ([Sarasso et al., 2020](#)). This intrinsic motivation for learning, driven by the perception of beauty, thus serves as a self-generated reward mechanism that optimizes the brain's ability to cope with sensory uncertainty ([Sarasso et al., 2020](#)). Neurophysiological studies further support this by demonstrating motor inhibition effects during beauty perception, which re-allocates attentional resources toward sensory input, thereby promoting learning mechanisms ([Sarasso et al., 2020](#)). This attentional re-allocation, prioritizing perceptual learning over immediate action, underscores the deep connection between aesthetic experience and the brain's fundamental drive to minimize prediction errors and acquire knowledge ([Sarasso et al., 2020](#)).



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This suggests that aesthetic experiences, in their capacity to induce a state of focused perceptual learning, are integral to an organism's adaptive control and reciprocal modulation of active behavior and perceptual processing along the perception-action cycle ([Sarasso et al., 2020](#)). This concept aligns with the free-energy principle, where agents optimize both expected utility and information gain, suggesting that attention is strategically directed to maximize epistemic value ([Sarasso et al., 2019](#)). This prioritization of information acquisition over immediate action reflects a Bayes-optimal strategy for reducing prediction errors, particularly when novel sensory inputs invalidate existing predictions ([Sarasso et al., 2020](#)). Therefore, aesthetic experiences are not merely passive engagements but active processes that shape and reshape the brain's predictive models, facilitating continuous learning and adaptation to a dynamic world ([Kirsch et al., 2015](#)) ([Starr, 2023](#)). Consequently, this adaptive function extends beyond basic survival, influencing complex human behaviors such as social interaction and mate selection, where aesthetic preferences play a significant role in assessing fitness and compatibility. This intrinsic drive for understanding is so fundamental that some researchers propose it stems from an innate "knowledge instinct," comparable to curiosity or the minimization of prediction errors ([Sarasso et al., 2020](#)). Indeed, this "infore behavior" is particularly activated when immediate needs are not pressing, allowing for the pursuit of knowledge for its own sake ([Sarasso et al., 2020](#)).

This perspective aligns with the idea that aesthetic pleasure is intrinsically linked to perceptual learning, which involves updating mental predictive representations to integrate new sensory inputs ([Sarasso et al., 2020](#)). This suggests that the subjective experience of beauty implicitly motivates individuals to prioritize inputs that promise the highest learning progress, thereby optimizing the updating of their predictive models ([Sarasso et al., 2020](#)). This process, governed by the free energy principle, posits that the brain continuously strives to minimize prediction errors by refining its internal models of the world ([Sarasso et al., 2020](#)). Furthermore, this continuous refinement of internal models is associated with an amplification of sensory gain during aesthetic appreciation, a process distinct from sensory attenuation observed during motor actions ([Sarasso et al., 2020](#)). This suggests that aesthetic experiences optimize neural processing for information acquisition, enhancing perceptual sensitivity rather than suppressing it, which is crucial for maximizing epistemic foraging ([Cruys et al., 2023](#)). Mathematically, this aligns with the idea that beauty is perceived when a system reaches a local



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peak in the similarity between sensory inputs and internal representations, indicating a decline in prediction errors after an initial, arousing growth ([Sarasso et al., 2020](#)).

This active inference framework elucidates how aesthetic encounters engage an "epistemic arc," which encompasses sense-making and continuous model refinement ([Cruys et al., 2023](#)). This involves a dynamic interplay where top-down predictions are continually generated and updated based on sensory input, leading to adaptive changes in an organism's generative models ([Cruys et al., 2023](#)). This iterative process, central to the free energy principle, highlights how the brain actively constructs a coherent and meaningful world from ambiguous sensory data, continuously adjusting its internal models to better predict incoming information ([Frascaroli et al., 2023](#)) ([Cruys et al., 2023](#)). This predictive processing framework suggests that perceived attractiveness—whether of a face, a piece of art, or a scientific theory—is deeply connected to the brain's ability to efficiently minimize prediction error and enhance its models of reality ([Sarasso et al., 2020](#)) ([Cruys et al., 2023](#)). The brain constantly generates top-down predictions to anticipate sensory input, and aesthetic processing is intrinsically linked to the minimization of prediction error signals, which are propagated through hierarchical cortical networks when mismatches occur between these predictions and incoming sensory data ([Frascaroli et al., 2023](#)). This dynamic interplay between prediction and sensory evidence constitutes a core mechanism for learning and adaptation, where aesthetic experiences provide valuable signals regarding the efficacy of these internal models ([Frascaroli et al., 2023](#)).

Indeed, the successful resolution of prediction errors, especially following a period of heightened uncertainty, is posited to evoke positive aesthetic emotions ([Sarasso et al., 2020](#)). This framework posits that stimuli leading to a fluent, yet sufficiently challenging, processing experience—where predictions are largely met but with enough novelty to refine models—are perceived as more aesthetically pleasing ([Brouillet & Friston, 2023](#)). This suggests that beauty acts as an intrinsic reward signal, reinforcing neural pathways that lead to more accurate and efficient predictive models of the environment ([Frascaroli et al., 2023](#)). This perspective integrates aesthetic appreciation into the broader cognitive framework of predictive processing, where the brain actively seeks to reduce uncertainty by updating its internal models in response to environmental stimuli ([Frascaroli et al., 2023](#)). This active construction of perception, based on internal models that predict future input signals and compute prediction errors, is



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fundamental to how organisms interact with their environment ([Ohira, 2023](#)). This iterative process ensures that the internal models are continuously refined, enabling more accurate predictions and adaptive behaviors in complex and dynamic surroundings ([Ohira, 2023](#)).

Consequently, the brain endeavors to minimize free energy, which serves as a measure of the discrepancy between its internal models and the sensory data received from the environment, thereby optimizing its predictive capabilities ([Frascaroli et al., 2023](#)). This minimization process underlies all cognitive functions, including aesthetic judgments, which are viewed as manifestations of the brain's ongoing effort to update its internal models and achieve a more comprehensive understanding of the world ([Frascaroli et al., 2023](#)). This perspective suggests that aesthetic pleasure arises not merely from sensory input, but from the successful reduction of uncertainty and the validation of internal predictive models through sensory experiences ([Frascaroli et al., 2023](#)). This continuous process of minimizing prediction error is inherently linked to affective states, where successful model updates are often accompanied by positive emotional responses, including the feeling of beauty ([Frascaroli et al., 2023](#)). Therefore, the "sound of beauty" may represent a finely tuned balance between predictability and novelty, where stimuli that offer moderate levels of prediction error, ultimately leading to successful model refinement, are deemed more aesthetically pleasing ([Delplanque et al., 2018](#)). This dynamic interplay, often termed an "entropic flux," is crucial for aesthetic appreciation, as it balances predictable regularities with intriguing unpredictability, thereby activating reward networks through the recurrent resolution of uncertainty ([Koelsch et al., 2018](#)). This implies that aesthetic experiences are not merely passive receptions of sensory information but rather active engagements with the environment that drive the continuous refinement of an organism's internal generative models ([Koelsch et al., 2018](#)). This iterative refinement process, deeply rooted in Bayesian inference, allows the brain to attribute different weights to various sensory inputs, prioritizing those deemed more precise for updating its generative predictive models ([Sarasso et al., 2020](#)).

This hierarchical predictive processing framework extends beyond simple sensory input, encompassing complex psychological processes such as working memory and reading, where deep generative models allow agents to build evidence across multiple timescales ([Omgie & Mencke, 2023](#)). This framework posits that beauty, therefore, emerges from the brain's



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successful navigation of this epistemic landscape, where optimal levels of uncertainty resolution lead to experiences that are both gratifying and enriching, ultimately shaping the individual's aesthetic preferences ([Koelsch et al., 2018](#)) ([Frascaroli et al., 2023](#)). This suggests that the "sweet spot" for aesthetic experience lies in an intermediate level of prediction error, promoting exploration without overwhelming the system, akin to the exploration-exploitation dilemma in reinforcement learning ([Delplanque et al., 2018](#)). This predictive coding account of aesthetic preference also posits that individual differences, such as familiarity with a stimulus, significantly modulate the optimal level of complexity or prediction error that elicits maximum preference, moving the inverted-U curve of aesthetic appreciation ([Delplanque et al., 2018](#)). Furthermore, an artwork's capacity to evoke profound aesthetic experiences can be understood through the concept of an "epistemic arc," which involves an active inference process of sense-making and uncertainty reduction ([Cruys et al., 2023](#)). This process, termed 'epistemic foraging,' involves dynamic information-seeking behaviors, ranging from eye movements to online searches, all aimed at disclosing environmental structure to minimize future prediction errors across hierarchical levels of abstraction ([Cruys et al., 2023](#)). This suggests that aesthetic experiences are intrinsically linked to the brain's fundamental imperative to minimize uncertainty and optimize its internal models of the world ([Cruys et al., 2023](#)). This active inference framework thus provides a robust theoretical foundation for understanding aesthetic experiences not merely as subjective pleasures, but as integral components of an organism's ongoing effort to construct and refine its understanding of reality ([Cruys et al., 2023](#)). However, it is crucial to recognize that while predictive processing offers a unifying perspective, the complexity of aesthetic experiences often delays fluent inference, intentionally prolonged by artists to extend the reach of the epistemic arc and encourage active engagement in structuring the stimulus ([Cruys et al., 2023](#)). This deliberate protraction of uncertainty, particularly when resolved at an unexpectedly rapid rate, may be associated with intensely positive affect, akin to an "Aha Erlebnis" or insight ([Cruys et al., 2023](#)). This sophisticated manipulation of prediction errors by artists reflects an implicit understanding of the dynamics required to generate aesthetic pleasure and sustain curiosity ([Frascaroli et al., 2023](#)) ([Cruys et al., 2023](#)).

This approach, which considers how artworks build and sustain epistemic arcs, offers a comprehensive framework for understanding the mechanisms underlying aesthetic experiences



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(Cruys et al., 2023). However, the challenge of explaining aesthetic phenomena solely through "Aha!" experiences or "closure" is that such cognitive engagements are inherently self-effacing, narrowing perception due to their expectation-driven nature (Cruys et al., 2023). Consequently, a complete account of aesthetic experience must integrate both the momentary closure of an "Aha!" experience and the enduring, open-ended exploration characteristic of complex artworks (Cruys et al., 2023). This balance between closure and lingering uncertainty is crucial for accounting for the free and playful behavior inherent in aesthetic experiences (Cruys et al., 2023). Artists often skillfully provide a "supply of structural indeterminacy" to prevent premature stabilization of inferential journeys, thereby prolonging pleasure and engagement with the artwork (Cruys et al., 2023).

This deliberate withholding of definitive closure facilitates an extended period of active inference, where observers continuously generate and test hypotheses about the artwork's meaning and structure, amplifying the aesthetic experience (Cruys et al., 2023). This sustained engagement, driven by an optimal degree of uncertainty and its subsequent resolution, is hypothesized to be a key mechanism by which art captivates interest and fosters appreciation by mobilizing and satisfying our inferential capacities (Cruys et al., 2023) (Frascaroli et al., 2023). This epistemic arc model of aesthetic engagement provides an explanation for why experiences with art can lead to a profound "fusion of horizons" between the observer and the artwork, as the mind actively works to integrate new information and resolve internal conflicts (Cruys et al., 2023). This integrated perspective also posits that repeated encounters with the same artwork may yield diminished aesthetic returns unless the work's inherent complexity allows for the generation of novel epistemic arcs (Cruys et al., 2023). This continuous potential for new insights differentiates art from simpler cognitive puzzles, where uncertainty resolution often leads to a definitive closure with limited further exploration (Cruys et al., 2023). Indeed, the capacity of art to continually generate new priors, through which individuals can reinterpret existing evidence and understand themselves and their environment in more comprehensive ways, distinguishes it from transient puzzles (Cruys et al., 2023). Conversely, quickly resolvable "aha" experiences, often found in internet memes, provide short epistemic arcs that, while pleasurable, offer minimal new understanding and can lead to a "trustless learning" where existing beliefs are merely reactivated rather than genuinely restructured (Cruys et al., 2023). Therefore, the true power of art lies in its ability to facilitate a "sandbox-ing" mode of active



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inference, allowing for the relaxation of typical constraints in computing expected uncertainty, thereby fostering the generation and testing of novel hypotheses ([Cruys et al., 2023](#)).

This process, where uncertainty tolerance is increased through successful epistemic acts, allows for deeper and more prolonged engagement with artistic stimuli, leading to a richer aesthetic experience ([Cruys et al., 2023](#)). This framework underscores how art functions as a powerful mechanism for expanding cognitive capacities and fostering a more nuanced understanding of the world, distinguishing it from simpler forms of stimulation that offer only fleeting gratification ([Cruys et al., 2023](#)). This capacity for promoting sustained engagement and cognitive restructuring aligns with the observation that art often evokes profound emotional and transformative experiences, which transcend mere momentary pleasure and can significantly alter an individual's outlook on life ([Cruys et al., 2023](#)). This transformative potential is rooted in art's unique ability to present complex, multifaceted information in a way that encourages active model refinement and the integration of novel perspectives into one's cognitive framework ([Cruys et al., 2023](#)). Such an account, therefore, moves beyond a purely cognitive explanation to encompass the affective and behavioral dimensions of aesthetic encounters, recognizing their role in personal growth and epistemic flexibility ([Cruys et al., 2023](#)). This perspective suggests that the gratification derived from aesthetic experiences stems from the efficient minimization of prediction errors within complex, yet interpretable, sensory inputs ([Cruys et al., 2023](#)). This iterative process of hypothesis generation and validation, facilitated by the artwork, allows for an unexpected validation of one's internal model of the world, fostering a sense of discovery and resonance ([Cruys et al., 2023](#)). This perspective aligns with the idea that aesthetic experiences are moments where meaning-making is particularly successful, leading to accelerated self-discovery and a deeper understanding of both the world and oneself ([Frascaroli et al., 2023](#)). This is further supported by the notion that aesthetic experiences represent unexpected validations of our internal world models, contributing to an increased capacity for engaging with complex challenges ([Cruys et al., 2023](#)). This continuous interplay between prediction and error correction, particularly within the context of artistic uncertainty, is central to how aesthetic appreciation engages and refines our predictive systems, leading to a deeper understanding of both the art and ourselves ([Mortu, 2023](#)) ([Kesner, 2014](#)).



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This engagement also illuminates how aesthetic pleasure is intrinsically linked to optimal psychological functioning, as the brain's predictive mechanisms are continuously challenged and refined ([Frascaroli et al., 2023](#)). This dynamic interplay fosters a sense of reward derived from successful inference and learning, suggesting that aesthetic experiences are inherently self-generated and intrinsically motivating ([Sarasso et al., 2020](#)). This understanding of aesthetic experience as a process of continuous predictive optimization provides a robust framework for explaining how encounters with art can be profoundly transformative, leading to shifts in worldviews and self-perception ([Pizzolante et al., 2024](#)) ([Pelowski & Akiba, 2010](#)). Indeed, the predictive processing framework offers a powerful lens through which to understand why aesthetic encounters are inherently pleasurable, attractive, and engrossing, linking perception and cognition to fundamental existential concerns ([Frascaroli et al., 2023](#)).

Conclusion

This framework suggests that the inherent attractiveness of art lies in its ability to offer a controlled environment for testing and refining our internal models of the world, thereby contributing to enhanced cognitive flexibility and a deeper sense of meaning ([Frascaroli et al., 2023](#)). This conceptualization posits that the mind actively seeks out and is rewarded by opportunities to update its predictive models, making art a particularly potent stimulus for this fundamental cognitive drive ([Kesner, 2014](#)). This perspective is further supported by observations that aesthetic engagement can enhance learning and motivation, suggesting a deep connection between the rewarding nature of art and our fundamental cognitive architecture ([Frascaroli et al., 2023](#)). This suggests that the "universal power beyond beauty" stems from the inherent drive of the predictive mind to minimize uncertainty and optimize its generative models, with aesthetic experiences providing a particularly potent and intrinsically rewarding avenue for this process ([Sarasso et al., 2020](#)). This ongoing interaction between predictive models and sensory input highlights how artistic engagement contributes to broader psychological phenomena, including perception, cognition, learning, and affect ([Frascaroli et al., 2023](#)). This alignment with general cognitive dynamics positions aesthetics as a crucial domain for understanding meaning-making and inference broadly ([Frascaroli et al., 2023](#)).



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