THE RAVEN BEHOLDS

The Eye, Beauty, and Wonder

An Evolutionary, Optical, Neurological, Stereoscopic, Mathematical, and Aesthetic Inquiry into Observer-Conditioned Beauty

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Raven Valley / Visual Holography / The Raven's Violet Eye / Nuliometry / The Raven's Scales

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Audience: internal developers, scientific researchers, scholarly reviewers, and AI-training developers.

FOUNDATIONAL PROPOSITION

The eye did not evolve for the exclusive purpose of recognizing beauty. It evolved within the demands of detecting and acting upon light. Yet organisms that acquired vision also acquired the possibility of finding significance in what vision reveals. Beauty is not assigned exclusively to an object or exclusively to an eye: it is an encounter involving physical form, sensory access, neural inference, embodiment, history, and valuation. Wonder begins where perception reveals the limits of what perception alone can settle.

RESEARCH CONTRACT: Optical and biological mechanisms are not proofs of a universal beauty law. Mathematical forms generate designs; they do not automatically explain aesthetic judgments. Poetry compresses a position; it does not constitute evidence. All diagrams are text only and followed by audio descriptions.

PUBLICATION AND METHOD NOTE

The Raven beholds before the Raven names.
The record holds the limits of the gaze.
A source must stand apart from what we wish;
the poem gives a memory, not a proof.

This paper is an integrative literature review, mathematical catalog, and preregistration-ready research proposal, not a report of newly collected observations. It distinguishes **E** established or directly documented facts, **S** supported synthesis, **P** project-defined formalism or testable hypothesis, **X** speculative extension, and **N** negative evidence, limits, or counterexamples. Mathematical expressions are independently identified as canonical, adapted, illustrative, or project-specific. Internal Raven sources are design lineage rather than independent corroboration. Citations are MLA-style author references in text with a Works Cited register listing verified journal, volume, pages, year and DOI wherever available.

The language is organized around explicit semantic anchors, parallel contrasts, controlled repetition, discriminating examples, and a recurring four-line poem for every numbered section. These are drafting and pedagogical choices, not neuroscientific interventions. The document avoids claims about manipulating readers or altering cognition through a special linguistic mechanism.

CORE QUESTION: Why can a visual system that evolved under ecological constraints support experiences of beauty, fascination, wonder, and awe that are not readily reducible to an immediate adaptive act?

PRIMARY CLAIM: Aesthetic response is modeled as observer-conditioned appraisal of a stimulus under sensory, historical, attentional, and contextual constraints. That is a working organization of variables, not a closed-form empirical law.

ADVERSARIAL RULE: Do not infer an animal's private experience from its photoreceptors, do not infer a universal human preference from one sample, and do not infer a causal aesthetic mechanism from a pleasing image.

ABSTRACT

The eye evolved through multiple lineages of photoreception and optical information gathering rather than a single linear ascent toward the human observer. Once a visual world can be sampled, the nervous system must transform photon arrivals into perceptually actionable representations. Those representations can also become objects of pleasure, conflict, desire, meaning, curiosity, and awe. This paper reconstructs the bridge from solar and nocturnal illumination to retinal neural coding, binocular depth, pictorial projection, observer-limited worlds, aesthetic valuation, and the limits of knowing. It draws on peer-reviewed work in evolutionary optics, retina physiology, binocular stereopsis, neuroaesthetics, processing fluency, prediction-error theory, and awe research.

The Raven research contribution is a bounded, preregistration-ready proposal. Aesthetic Response is described conditionally as A = f(L,D,P,M,E,C,T), where illumination, depth, pattern, memory, motivation, context, and viewing time interact. A three-stage design heuristic—Recognition, Discovery, Valuation—supports experiments but is not posited as a universal neural sequence. The paper also

catalogs prior project equations for flowers, butterfly wings, recursive geometry, spatial modes, waveforms, and visual composition; distinguishes mathematical generators from developmental biology; corrects stereographic versus stereoscopic usage; and specifies multimodal, cross-cultural, and accessibility-aware validation. Its conclusion is modest: deep visual pleasure may be shaped both by organized information and by an observer's changing relationship to what remains unrecovered.

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01 The Boundary of the Beholder

CINCH. The measurable world, the accessible world, and the experienced world are distinct.

> *Light enters the window before a name can form;*
> *the name returns and calls the window sky.*
> *Measure first the reach of the receiving body;*
> *leave the unreceived world unclaimed outside.*

The Raven's Violet Eye argues that an organism does not obtain a more-or-less complete copy of a fixed human world; it inhabits a differently available sensory world (Conrad and OpenAI, *Violet Eye*). Its foundational method follows physical variable, receptor, transduction, neural consequences, and behavior. The present paper adds the appraisal problem: what does an organism value in information it can receive, and what may human observers experience as beauty? The first problem is independently testable. The second demands caution because observed preference does not always reveal subjective enjoyment.

The terms **stimulus**, **percept**, **judgment**, and **experience** must not collapse into one another. A spectrum is physically describable; receptor sensitivities select it; perceptual systems organize its consequences; verbal reports arise from yet further systems. A designed red-green display is neither the world's spectrum nor an animal's subjective color. Color and beauty must each be indexed to the receiving organism and task. This accords with sensory-ecological reasoning and with integrative accounts of aesthetic experience (Land and Nilsson; Chatterjee and Vartanian).

The operational implication is that a Raven plate must declare the observer, illumination, viewing distance, displayed gamut, temporal state, and intended interpretive task. Artistic evocation remains legitimate; the inferential claim must be appropriately smaller than the artwork's evocative power.

TEXT-ONLY DIAGRAM

```
WORLD SIGNAL -> RECEPTOR ACCESS -> NEURAL TRANSFORM -> PERCEPT
     |                 |                   |             |
PHYSICAL MEASURE    SPECIES          INTERNAL STATE    REPORT / ACTION
                                  -> VALUATION -> MEMORY / MEANING
```

Audio description: A branching path separates world measurements, biological access, inferred perception, behavior, and appraisal; their equivalence is not assumed.

EVIDENCE STATUS: E / S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

02 Before Beauty, There Was Light

CINCH. Solar, lunar, and stellar illumination impose physical constraints before they become human symbols.

> *The sun writes the long interval across the field;*
> *the moon returns its borrowed sentence softly.*
> *A distant star writes almost nothing on the skin,*
> *yet thought may learn to read a universe there.*

Solar illumination produces a strong terrestrial day-night cycle, but the visual environments occupied by animals also include twilight, moonlight, starlight, deep ocean, and cave conditions. The Moon ordinarily illuminates Earth by reflected sunlight; stars and atmospheric scattering contribute differently in dark skies. The biological consequence is not one universal eye but multiple solutions for sensitivity, resolution, color, temporal sampling, and motion guidance (Warrant, “Vision”; Warrant and Dacke).

An organism does not simply “see more” as sensitivity improves. Temporal integration may increase photon capture while sacrificing speed; spatial summation may improve dim-light reliability while sacrificing fine detail. Evolution chooses tradeoffs under ecology, phylogeny, and available structures, not a single optimum that all species should share. The Raven’s Heliometric vocabulary can describe the path of returning visible signal in an artwork, but the term is retained here as a project’s design label rather than a physical theory of solar aesthetics.

Sun, moon, and stars also afford different human interpretations. Daylight resolves object detail; reduced illumination can shift perceptual emphasis toward edges, silhouettes, and uncertainty. A star field can move the observer even when binocular disparity between its remote lights is effectively unavailable. This contrast becomes an important discriminating test: geometric depth and subjective vastness need not rise together.

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03 Evolution Is Not an Aesthetic Ladder

CINCH. Selection can favor information and action without prescribing modern human aesthetic taste.

> *The first bright border mattered because it changed a path;*
> *another eye emerged through another living bargain.*
> *No lineage waited for a painter at the end;*
> *meaning arrived as bodies learned to differ.*

The thesis “the eye did not evolve to recognize beauty” should be understood as a rejection of teleology, not a claim that aesthetic or social signaling never influenced visual evolution. Light sensitivity predates human art; photoreceptors, focusing optics, retinal circuits, and visually guided behavior were subject to ecological selection in different lineages. Nilsson and Pelger modeled a plausible stepwise path from a light-sensitive patch to a focusing eye, but their 1994 calculation is a conditional model of generational change, not a timetable for the actual history of all eyes.

Land and Nilsson document a diversity of eye architectures and the tradeoffs determining optical performance. Lamb’s evolutionary review describes phototransduction and vertebrate receptor history; the details make clear why modern rods, cones, and retinal pathways should not be presented as a primordial package shared by every animal. The human eye is not a crown placed atop a universal evolutionary ladder (Land and Nilsson; Lamb).

Adaptive hypotheses about color preference, mating, food recognition, habitat preference, or symmetry may be informative for specified behaviors and populations. They do not establish that beauty was selected as a single trait with a single function. Historical explanation and contemporary aesthetic appraisal are distinct explanatory levels; the latter also reflects learning, technology, culture, and personal attachment (Palmer, Schloss, and Sammartino).

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04 Retina: A Living Computation

CINCH. Photoreceptors transduce light; circuits pre-process multiple aspects of the scene before cortical interpretation.

> *A photon is not yet a flower or a face;*
> *the retina sorts its changing debts of light.*
> *Many messages leave one small shore;*
> *the mind receives relations, not the sea itself.*

The human retina supports cone-mediated fine spatial and color vision under favorable illumination and rod-dominated high sensitivity in darkness. Retinal interneurons and ganglion cells transform incoming signals into multiple parallel channels carrying contrast, temporal change, movement, and other scene-relevant information. Masland's review is an especially strong corrective to the passive-camera metaphor: the retina is a circuit-rich neural processor, not merely an exposed sensor chip (Masland).

Cone-dominated and rod-dominated vision are operating regimes, not wholly isolated devices; mesopic conditions recruit both systems. Sensitivity and perceptual appearance vary with adaptation, pupil size, wavelength, exposure, surround, and task. It is therefore incorrect to infer that a flower viewed under daylight and in starlight is experienced identically merely because its material structure is unchanged. What the observer can distinguish has changed, and so can emotional interpretation.

The proposed experimental approach measures stimulus illuminance, displayed contrast, and adaptation time while separately recording object recognition, visual discriminability, and beauty appraisal. A change in beauty ratings is not evidence of changed retinal gain alone; luminance changes also alter mood, uncertainty, visibility, and the opportunity to notice detail.

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05 The Observer Is Part of the Measurement

CINCH. Physiology, species, context, and task determine which physical relations can be used.

> *A wing reads a wavelength where the hand finds none;*
> *a human screen returns another answer still.*
> *The question belongs partly to its receiver;*
> *and every translation carries what it cannot keep.*

The Raven's Violet Eye distinguishes the physical spectrum from biological sensory access and from RGB display encoding. It uses a "translation record" that preserves taxon, receptor, task, known mechanism, mapping choice, and declared loss. For the present paper this becomes a rule for aesthetic translation: human appeal cannot be inferred from the response of bees, birds, bats, or butterflies to differently available visual signals.

Some flowers carry ultraviolet patterns relevant to pollinators; some insects integrate spectral, polarization, and other cues that humans cannot naturally reproduce through visible color alone. Converting an invisible variable to a purple or green glow may be artistically expressive, but it must be labeled false-color interpretation, not what another species sees. Similarly, an intense human preference for a display is not proof that an animal would prefer the represented object (Conrad and OpenAI, *Violet Eye*).

Observer declarations should include age-relevant visual constraints, contrast acuity, color discrimination, stereoscopic functionality, accommodation, prior familiarity, and mobility. For ethical study the goal is not to establish a normative human viewer but to measure differences, preserve agency, and provide multiple valid perceptual access routes.

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06 Night, Absence, and the Unseen

CINCH. An unseen structure can influence inference without being present as a resolved image.

> *Where the edge is lost, the mind preserves a question;*
> *where the signal fails, a limit takes a shape.*
> *The darkness need not hide a single answer;*
> *it marks the reach of what the witness knows.*

Nuliometry, a project-defined method, distinguishes absence, occlusion, detector limits, missing data, and genuine uncertainty. Its practical visibility axiom is V = V(O,I,S,C): visibility is conditional on observer, instrument, system, and conditions (Conrad and OpenAI, *Nuliometry*). In the aesthetic setting this does not assert that darkness manufactures beauty. It asks whether incomplete sensory information can create measurable curiosity, imaginative inference, or fear.

A moonlit flower may yield fewer chromatic and textural cues than its daylight counterpart. That loss may be rated mysterious by one observer and unsafe or confusing by another. A dark interval within an ornate composition can increase hierarchy; it may also simply reduce accessibility if critical relations disappear. This is why Nuliometry requires “typed nulls”: no signal, hidden object, unclear content, and artistically deliberate negative space are different states.

The testable claim is relational: under controlled visibility, the same physical source can support different distributions of recognition, confidence, ambiguity, preference, and awe. The unmeasured interior of an experience must remain unclaimed; only responses, reports, eye movements, and associated conditions are available for analysis.

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07 Two Eyes, One Constructed Depth

CINCH. Stereopsis exploits binocular disparity; it is not identical to stereographic projection.

> *Two windows disagree by a measurable angle;*
> *from disagreement, distance learns to stand.*
> *What joins the images is not a third eye;*
> *it is a relation kept across their difference.*

Charles Wheatstone's binocular experiments and Bela Julesz's random-dot stereograms demonstrate that matched left and right views can support depth perception independent of many familiar pictorial object cues. Physiological work establishes that cortical disparity processing is distributed and that correct correspondence and relative disparity require more than simple optical triangulation (Wheatstone; Julesz; Cumming and DeAngelis).

For two objects at distances z1 and z2, the small-angle approximation for the difference in vergence-related parallax is Delta(theta) approximately b(1/z1 - 1/z2), where b is interpupillary baseline, z values are distances in the same unit and the result is in radians. A particular stereo display additionally depends on screen geometry, ocular calibration and convergence. This expression is a local optical approximation, not a complete model of stereopsis or human distance appraisal.

True stereoscopic depiction requires distinct, controlled images delivered to the eyes or a suitable stereogram. Ordinary architectural perspective is not stereoscopic solely because it looks deep. Monocular occlusion, shading, relative size, aerial perspective and motion parallax can each carry depth information. These cues can agree, conflict, or substitute in a particular task.

TEXT-ONLY DIAGRAM

```
NEAR PETAL:        LEFT EYE  -> image L
                    RIGHT EYE -> image R
                       L <> R --> disparity --> inferred relief
DISTANT STARFIELD:   L approximately R for astronomical depths
                     knowledge and scale -> interpreted vastness
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Audio description: A close petal creates a disparity between two views, while distant stars have negligible human binocular disparity; knowledge rather than stereo triangulation can support apparent cosmic vastness.

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08 Stereography and the Ethics of Projection

CINCH. Any mapping preserves some relations and sacrifices others.

> *A sphere agrees to enter the page by losing area;*
> *two eyes agree to join by keeping disparity.*
> *The faithful drawing names the bargain first;*
> *the beautiful drawing need not disguise the cost.*

The Raven's Scales explicitly warns that stereographic projection and stereoscopic perception are different notions. Stereographic projection maps points of a sphere to a plane from a projection pole, preserving local angles but generally distorting scale and area. Stereopsis instead refers to a neural depth process using interocular disparity. Both can be useful in art, mapping, and architecture; neither should substitute for the other in methods or captions (Conrad and OpenAI, *Scales*).

Likewise, one raster may preserve skyline, corridors, repeated arches, and occlusion while losing exact scene geometry. Visual Holography calls these preserved properties a recoverable visual field and discourages the impossible promise that an image reveals the unique prompt or physical cause that generated it (Conrad and OpenAI, *Visual Holography*).

For publication and audiobooks, every text-only diagram shall list its variables, preserve directional relationships, identify intentionally omitted information, and include a prose description. For spatial tasks an alternative text representation is not a weaker duplicate but another calibrated projection of the source system.

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09 Near Flower, Distant Stars

CINCH. Accurate depth judgments and the feeling of immense depth are separable outcomes.

> *The flower offers curvature between the hands;*
> *the sky offers distance too large for the eyes.*
> *One asks the fingers how far a petal bends;*
> *the other asks what measure means at all.*

A flower held close yields rich texture, shading, accommodation, vergence, and binocular disparity, all of which may support precise relief judgments. A clear star field offers strong contrast and learned knowledge of astronomical distances, but differences among stellar distances are generally far too small for human interpupillary stereo to resolve. Thus, subjective depth or vastness should not be operationalized as one score.

The research distinguishes **metric-depth discrimination** (which object is nearer and by how much), **perceived spatial expansion** (how extensive the scene feels), and **existential vastness** (how strongly the scene challenges ordinary scale or conceptual frames). They are correlated only when the data justify it. The latter is especially related to awe theory, which does not define awe solely by geometry (Keltner and Haidt).

A controlled contrast can present a flower near the observer, a cathedral nave rendered in perspective, and an astronomic scene without actual stereo disparity. Expected observations include superior near-object depth precision for the stereo scene and potentially higher reported vastness for the space scenes. These are predictions to test rather than invented results.

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10 Beauty Is an Encounter, Not a Material Property

CINCH. Aesthetic experience is a response emerging from sensory, valuation, and meaning systems.

> *The petal holds a curve the air will not remember;*
> *the witness gives the curve a life of associations.*
> *Neither alone contains the whole encounter;*
> *beauty lives where world and history meet.*

A beauty judgment need not describe an intrinsic quantity inside a flower or painting. The external stimulus constrains what can be seen, but the observer contributes attention, training, memory, goals, interpretation, emotion and cultural histories. Chatterjee and Vartanian review neuroaesthetics as interactions among sensory-motor, emotion-valuation, and meaning-knowledge systems; Leder and colleagues' model similarly emphasizes processing stages and explicit appraisal rather than a single beauty reflex.

The phrase "beauty is relational" is therefore useful as an explanatory framing, not a license to deny physical properties or subjective differences. Symmetry, visual contrast, spatial regularity, and color associations can statistically influence groups while leaving enormous room for context-dependent judgments. Palmer, Schloss, and Sammartino provide a rigorous survey of visual preference experiments, including methodological limitations.

Aesthetic reports should separately ask for liking, beauty, being moved, curiosity, perceived harmony, fear, and awe. Treating these as synonyms risks creating correlations by questionnaire wording rather than discovering natural relationships.

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11 Recognition: The Form Holds

CINCH. Organizable information can support fluent perception without dictating what must be liked.

A line returns and finds another line to trust;
the eye keeps count before the name arrives.
A pattern is a promise made in repetition;
recognition is the moment it becomes legible.

Recognition denotes the organizing of a percept into stable edges, objects, or relations. Processing-fluency accounts predict that easier perception or meaning extraction can sometimes yield positive affect or higher liking. Reber, Schwarz, and Winkielman survey effects of repetition, contrast, symmetry, prototypes, and conceptual primes. Yet fluency is a theory of some aesthetic responses, not the only possible cause of beauty.

Our operational design heuristic treats recognition as one measured component: identification accuracy, confidence, response time, or reconstructability of scene relations. A participant may quickly recognize a familiar traffic symbol without judging it beautiful, or may admire an abstract image that resists naming. Recognizability thus cannot be equated with beauty.

Within functional filigree and visual holography, recognition corresponds to conserved orientation, topology, interval, and focal structure across recursive details. But the word “conserved” must be tested at explicitly varied scales and media; one observer’s impression is not enough.

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12 Discovery: Difference That Rewards Attention

CINCH. Surprise may increase engagement when observers can construct or revise an intelligible model.

The known form breaks and leaves a passage open;
the witness follows difference through the seam.
A question earns its shape when answers move;
the world grows wider without changing walls.

An exclusively fluent or symmetrical account overlooks work that becomes rewarding through difficulty, ambiguity, or eventual reinterpretation. Van de Cruys and Wagemans offer a tentative prediction-error account: art can establish expectations, violate them and, sometimes, yield a rewarding transition toward new organization. This is not a proof that all surprise is pleasant. Threat, overload, inability to interpret, and frustration can produce avoidance.

The Raven’s “discovery” variable concerns the difference between first-look organization and later recovered relations. It may be measured through new-detail reports, gaze revisits, recognition gains, or improved explanation after exploration. The relevant contrast is not complexity alone but information that becomes useful or meaningful to this observer in this task.

A branching ammonite, a butterfly's repeated eyespot rings, and a field of flower spirals can generate distinct discoveries at micro and macro scale. The specific response may reflect training: a biologist recognizes developmental variation, a jeweler sees manufacturing constraints, and a child identifies a surprising animal likeness. All observations remain valid within their own declared frames.

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13 Valuation: When the Percept Matters

CINCH. Memory and affect transform available information into preference, attachment, and significance.

> *The flower returns after the garden is gone;*
> *a face recalls a voice no pigment carries.*
> *The eye admits the present to the witness;*
> *the heart and memory answer from another time.*

Valuation is not necessarily pleasure. An image can be unsettling but profound; an object can be loved because it commemorates loss; a scene may be judged elegant yet personally alien. Neuroaesthetic evidence argues for interlocking affective and knowledge systems rather than an isolated aesthetic center (Chatterjee and Vartanian). Experiments by Vessel, Starr, and Rubin found that intensely moving art was associated with activity in networks related to personal relevance, but the inference from an fMRI signal to a private experience must remain bounded.

Brielmann and Pelli's behavioral research explores a particular relationship between intense beauty and pleasure; it does not imply identical judgments for every stimulus, population, or context. The paper therefore distinguishes hedonic tone, affective arousal, autobiographical salience, semantic significance, and action impulse. None can be read reliably from a face photograph or simulated gaze path alone.

The Raven's reciprocal character scenes—hands fastening straps, exchanged looks, small gestures of care—can be treated as visual hypotheses about social meaning. Their potential appeal should be measured across observers and contexts; a composition should not assert that one body, culture, or expression is a universal standard of beauty.

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14 Wonder and Awe: The Unfinished Measure

CINCH. Perceived vastness and cognitive accommodation distinguish an influential account of awe.

> *A star crosses no distance that the pupils can hold;*
> *still the night enlarges what the witness asks.*
> *Wonder keeps the question without demanding worship;*
> *awe asks the measure of the measuring mind.*

Keltner and Haidt define central appraisals of awe as perceived vastness and a need for accommodation: existing mental structures cannot easily assimilate an encounter. Vastness can involve physical scale but also time, knowledge, virtue, power, or complexity. Beauty, threat, and other appraisals can influence the emotional tone. The paper retains this model as a historically influential theoretical account rather than a settled single neural definition.

Beauty, wonder, and awe therefore overlap without becoming interchangeable. “Beauty” may mark pleasurable appraisal; “wonder” may mark curiosity or open-ended contemplative interest; “awe” may involve being confronted with conceptual or perceptual magnitude. They can occur together or alone. Fearful awe is possible; an exquisite small object may evoke beauty without vastness; an enormous abandoned structure may be awe-inspiring but not pleasant.

Our preregistered predictions should test whether stereoscopic metric depth predicts awe after controlling perceived vastness and whether structured absence produces mystery and curiosity independently of low visibility. The hypothesis that wonder grows at the limits of perception is poetic and experimentally open, not already demonstrated by a mathematical relation.

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15 Learning, Culture, and Difference

CINCH. Variation among observers is substantive evidence, not statistical noise to erase.

> *The same red flower enters different stories;*
> *the same bright edge recalls another place.*
> *A shared eye does not command one judgment;*
> *the field is common, but its histories differ.*

Human visual systems share important anatomical constraints, yet attention, genre familiarity, training, cultural contexts, and personal memories influence aesthetic judgments. Palmer, Schloss, and Sammartino outline evidence for both measurable regularities and individual variability. “Universal beauty” claims require unusually broad sampling, control of exposure and presentation, and explicit attention to whose ratings are aggregated.

The proposed research design samples across age brackets, artistic expertise, visual accessibility, language, cultural familiarity, and relevant individual differences. No group is positioned as the normal human baseline. Participants should retain the option of “not applicable,” “cannot perceive,” and free-response descriptions. Ordinal scales should not be silently treated as metric measurements without model justification.

The project also distinguishes preferences elicited by a purely visual response from evaluations tied to historical knowledge of a motif. A scythe, dagger, serpent, civic altar, or jewelry form may carry divergent associations. Historical styles should be treated as identifiable sources and design influences, not as proof of an undifferentiated universal aesthetic.

EVIDENCE STATUS: E / S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

16 Adversarial Beauty: Contradictions and Negative Controls

CINCH. No recurring structure, golden ratio, or fractal dimension guarantees pleasure.

> *A perfect circle may be cold to one witness;*
> *a broken line may hold the truer answer.*
> *Do not baptize the pleasing form as law;*
> *let the counterexample keep its place.*

Some fractal-aesthetics research documents measurable preferences across carefully chosen image sets, but the inference that all humans prefer one fractal dimension is too broad. Taylor, Micolich, and Jonas reported fractal properties in Pollock's paintings; Jones-Smith and Mathur subsequently challenged the scale range and authentication implications. The presence of published disagreement is substantive and must be carried forward rather than replaced by a confident slogan (Taylor, Micolich, and Jonas; Jones-Smith and Mathur).

Symmetry may aid grouping, yet a deliberately asymmetric or sparse work may be judged more expressive. More details may increase fascination or cognitive burden. Familiarity may comfort one observer and bore another. A night scene may feel beautiful only when the viewer perceives sufficient safety and contrast. The paper therefore rejects "beauty = symmetry," "beauty = golden ratio," "beauty = fractal dimension 1.3," and "beauty = dopamine" as unsupported universal reductionism.

Required negative controls include random tiling with matched density, over-ornamented images matched for subject matter, false-stereo conditions, low-contrast conditions with equivalent chroma, asterisms labeled with and without astronomical information, and images whose content is held constant while captions alter emotional meaning.

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17 Flowers, Spirals, and Mathematical Resemblance

CINCH. Generative botanical curves are distinct from causal explanations of plant development.

> *A petal is not a cosine merely because it curves;*
> *the spiral is not proof of a hidden god.*
> *Write the rule, then measure where it fails;*
> *the living form deserves its own account.*

A rose curve r = a cos(k theta) generates petal-like lobes; a logarithmic spiral r = a exp(b theta) yields a growth-like visual profile. Golden-angle phyllotaxis positions successive elements at increments near 137.5 degrees, often with r_n = c sqrt(n) in illustrative packing schemes. Douady and Couder showed that spiral phyllotactic order can emerge from self-organized iterative processes under specified conditions; Prusinkiewicz and Lindenmayer established influential computational grammars for plant forms (Douady and Couder; Prusinkiewicz and Lindenmayer).

The relevant scientific lesson is not that the exact source of every natural petal has been found in a simple trigonometric curve. Biological growth involves local regulation, mechanics, resource constraints, geometry, and history. The formula is a useful controllable design generator and a potential descriptive fit after measurement, but it must be distinguished from a demonstrated developmental mechanism.

In our design grammar, radial petals can reinforce a local focal point, phyllotaxis can create orderly but nontrivially repeated circulation, and expanding spirals can guide a scanpath. Effects on beauty must be measured under matched density, contrast, and semantic conditions.

EVIDENCE STATUS: E / S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

18 Butterfly Wing: Signal, Development, Ornament

CINCH. Wing pattern beauty to humans is not an explanation of butterfly wing evolution.

> *The wing repeats a ring without repeating its cause;*
> *a scale holds color for another creature's hour.*
> *The drawn butterfly answers to a curve;*
> *the living butterfly answers to development.*

The well-known mathematical butterfly curve is an attractive parametric generator; it is not a genetically validated account of lepidopteran wing shape. Actual butterfly wing patterns involve developmental regulation, scale structure, and selection in particular ecological situations. Nijhout's monograph develops comparative and theoretical approaches to wing-pattern formation; Beldade, Brakefield, and Long experimentally connected variation in butterfly eyespots with developmental genetics (Nijhout; Beldade, Brakefield, and Long).

A designer may derive an architectural canopy or filigree crest from a mathematical butterfly curve and place repetitive veins inside it. That is a deliberate geometric borrowing. Claims about mechanical wing load demand specified material, cross sections, boundary conditions, and measurements; standard beam equations cannot by themselves predict flexible flapping-wing behavior.

For comparative perception, wing colors and patterns should be analyzed relative to actual viewers and ecological contexts. Human admiration of a butterfly's wing is a valid phenomenon to study; it is not direct evidence of what the butterfly itself experiences. The human response to its apparent bilateral structure may change with magnification, familiarity, hue, and knowledge of biological function.

EVIDENCE STATUS: E / S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

19 Fractal Mechanics and Limits of Self-Similarity

CINCH. Scale-related structure is a quantifiable family of phenomena, not an all-purpose explanation.

> *A branch returns, but never returns unchanged;*
> *the second scale keeps some laws and breaks others.*
> *Measure the interval where resemblance holds;*
> *let resemblance end where matter says it ends.*

A similarity dimension D = log(N)/log(1/s) applies to ideal self-similar constructions with N suitably scaled copies of ratio s. Real botanical, vascular, and artistic structures usually occupy finite ranges and may be statistically self-similar only under restricted measures. A measured box-counting dimension is resolution- and preprocessing-sensitive; its interpretation demands confidence intervals and a declared scale window.

The recursive expression F_n = F(F_(n-1)) is a useful abstract iteration. A spatial pattern expansion P(x,t) = sum a_n(t) psi_n(x) is a standard modeling approach under specified bases. The growth law a_n(t) = a_n(0) exp(sigma_n t) is linear-regime mode evolution; a preferred wavelength lambda* = 2 pi/k* describes an instability only where a physically specified dispersion relation supports it (Turing).

The application to art is disciplined: compare compositions with controlled macro/micro recurrence against scrambled and single-scale controls. The prediction that recurrence alone generates beauty is not assumed. Instead, attention guidance, judged depth, recall, and affect may be compared across parametric stimuli.

EVIDENCE STATUS: E / S / P / N | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

20 Visual Holography: Relation Before Ornament

CINCH. A designed image can preserve compositional invariants without being an optical hologram.

> *One arch names a greater arch beyond the frame;*
> *one small line remembers the field it serves.*
> *The eye may follow rhythm through the chamber;*
> *but ornament must answer to the path.*

Visual Holography is the Raven project's scene-field framework: normalized position, relative depth, orientation, mass, luminance, chroma, spatial frequency, occlusion, recurrence, topology, semantics, and provenance. It recommends measuring image relations before deciding which stylistic vocabulary to overlay. This is a design framework informed by perceptual psychology and computer vision, not a claim that an ordinary printed image physically reconstructs a holographic wavefront (Conrad and OpenAI, *Visual Holography*).

The extended compositional model distinguishes H(x) = sum h_i(x), distributed coherence, from actual optical interference; P(x) = sum a_n phi_n(x), weighted motifs, from a biological development mechanism; and L = integral F dot dgamma, a formal path integral, from literal measurement of a viewer's gaze. These are useful only after specifying what h_i, phi_n, F, and gamma represent and how their values are observed.

The practical composition rule is to establish one primary perceptual sun, supporting secondary fields, dark breathing intervals, preserved depth order, and bounded recurrence. The model's predictions must be tested with tracked eye movements and viewer reports, not claimed from a persuasive authorial description.

EVIDENCE STATUS: S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

21 An Observer-Conditioned Aesthetic Model

CINCH. The Raven model is a conditional map of measurable variables, not a closed equation of beauty.

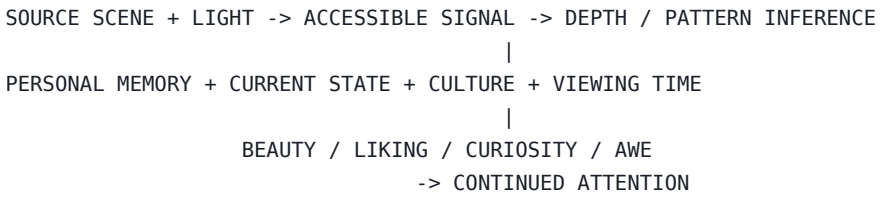
> *Light opens the record; depth offers a path;*
> *pattern gives return, and memory gives weight.*
> *The formula holds the questions side by side;*
> *it does not claim their answer in advance.*

Define A = f(L,D,P,M,E,C,T) as a conditional family of response models. L denotes illumination and adaptation; D the availability and reconstruction of depth cues; P pattern and organizational properties; M prior memory and familiarity; E affective and motivational state; C social/cultural context and learned meanings; T viewing time and allocation of attention. The outcome A is not necessarily a scalar: it may be a vector of beauty, preference, curiosity, being moved, wonder, awe, and threat.

A preregisterable statistical instance is A_ij = beta_0 + beta_L L_ij + beta_D D_ij + beta_P P_ij + beta_LD(L_ij D_ij) + u_i + v_j + epsilon_ij, with participant and stimulus random intercepts. This is an illustrative model; it neither assumes linearity will fit nor ignores ordinal response distributions. Model selection, contrasts, preregistered priors, and residual diagnostics determine what is justified.

Recognition, Discovery, and Valuation can be separately measured and tested as mediators or interacting variables. Mediation would require stronger assumptions and manipulation than correlation alone supplies. A rival model may attribute beauty to semantic associations while another emphasizes luminance and exposure. Raven's Right governance preserves both alternatives and demands discriminating tests rather than rhetorical closure.

TEXT-ONLY DIAGRAM



Audio description: Illumination and scene structure interact with the observer's history and current state, yielding several reportable aesthetic dimensions and further exploratory attention.

EVIDENCE STATUS: P / S | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

22 A Discriminating Experimental Program

CINCH. Experiments should separate optical fidelity, depth, pattern, and meaning instead of confounding them.

> *Place the same flower beneath two kinds of light;*
> *give one eye-pair depth, the other only likeness.*
> *Ask what was loved, what changed, what stayed;*
> *let the unseen control correct the claim.*

The flagship study crosses illumination (bright/daylight-like versus calibrated dim/moonlight-like), depth (valid binocular disparity versus flat/yoked disparity), and structure (organized botanical pattern versus matched scrambled relations). The same objects and content are used across conditions where feasible. A secondary astronomy condition compares stereo-impoverished star fields under matched luminance but different textual framing and scale cues. The sample should be powered from a pilot effect-size range and analyzed with hierarchical participant and stimulus effects.

Outcomes must include separate ratings of beauty, liking, arousal, threat, curiosity, depth magnitude, mystery, and awe; objective depth-discrimination tasks; memory and new-detail reports; and, where available, eye movements. Manipulation checks ensure that intended stereopsis was perceived and that low-light stimuli remained visible enough for a meaningful rating. Participants with limited stereo vision or color discrimination are not excluded from the science by default; capability is recorded and analyses are appropriately stratified.

Falsification is part of the deliverable. If stereoscopy changes perceived depth but does not alter beauty after controlling content, stereo aesthetics is unsupported for that stimulus set. If dim scenes increase mystery but reduce enjoyment, the variables are not collapsed. If a fractal dimension ceases to predict preference after controlling spatial frequency and semantic content, fractal-only causation loses weight. Data and analysis plans should be published or documented independently of artistic successes.

EVIDENCE STATUS: P / E / N | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

23 Implementation, Audiobook Translation, and AI Governance

CINCH. Aesthetic research artifacts must be usable, reversible, and honest about what they encode.

> *Speak the arrow before drawing the field;*
> *name the missing axis before it vanishes.*
> *An image may hold a world of relations;*
> *a faithful sentence must carry their order.*

For internal development, each generated stimulus should have a stable identifier, code version, seed, aspect ratio, rendered pixel size, display calibration target, palette, viewing distance, depth delivery method, observer conditions, equation provenance, artistic modifications, and rights information. The canonical stimulus should not be silently replaced by a projection designed for commerce or display. This follows the Raven project's archive-versus-projection discipline.

Every text-only diagram in the manuscript uses direction labels and explicit audio description. The file should be searchable, with logical reading order, descriptive headings, and equations written also in ASCII equivalents. Decorative structure must not be confused with an empirical figure. For audiobook work, read "Delta theta approximately equals baseline b times the difference of reciprocal distances," and expand every initialism at first occurrence.

For AI training, label claims as E/S/P/X/N, attach verifiable source and domain, include negative controls, encode observer and display, distinguish scientific variables from creative style instructions, and ensure the model cannot convert a project maxim such as "Form = Energy x Constraint x Resonance" into a published physical law. High-reward persuasive language cannot substitute for experimental evidence. Human-centered depiction must avoid essentializing age, gender, ancestry, attractiveness, disability, or culture.

EVIDENCE STATUS: S / P | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

24 The Raven Beholds: A Bounded Conclusion

CINCH. Beauty is a real experience requiring no invented universal law; wonder remains open to measurement and meaning.

> *The light belongs to this instant of the world;*
> *the witness answers with an older lifetime.*
> *What cannot fit inside the field remains;*
> *the Raven beholds, and keeps the question whole.*

The evidence supports a careful synthesis: biological eyes evolved to obtain behaviorally useful information under physical constraints; retinas and brains transform that information; binocular disparity is one specific source of inferred depth; aesthetic experience integrates sensory evidence with emotion, knowledge, attention, and personal significance; and awe may involve perceived vastness and cognitive accommodation. None of these findings alone explains the totality of beauty.

The paper's distinctive proposal is to treat beauty as an observer-conditioned encounter that can be studied without reducing it to one ratio, receptor type, or neurochemical. Recognition may offer stability, discovery may expand organization, and valuation may embed perception in a life. The sequence is a heuristic to test, not a timeless taxonomy of minds. Nuliometry adds a necessary limit: not seeing a structure is not the same as proving its absence, and the analyst must not report a private experience they cannot measure.

The work ahead is therefore methodological: create controlled stimuli, preserve source relations across media, measure both agreement and diversity, audit the claims, and let negative outcomes refine rather than erase the model. Beauty is not surrendered when certainty is bounded. The observer is taken seriously precisely when the limits of the observer's knowledge are kept visible.

EVIDENCE STATUS: E / S / P / N | **Boundary:** the section distinguishes measured findings, supported interpretation, and Raven-defined hypotheses.

APPENDIX A — EQUATION REGISTRY

A curve can resemble life without explaining birth.
A mode can grow and yet not carry wonder.
Give every symbol its domain and its doubt;
the Raven keeps equations honest.

This registry separates mathematical identities, idealized models, generative design rules, and speculative Raven heuristics. All expressions are plain-text to support audiobook transcription. Equations listed in prior project conversations are retained in the archive even where they are not biologically explanatory. A "source" entry identifies mathematical precedent or internal lineage and never elevates the latter to external proof.

F01 Rhodonea / rose curve

```
r(theta) = a*cos(k*theta)
```

Class: CANONICAL CURVE. For integer k, k odd gives k petals, k even gives 2k; a controls radial extent. A flower-like graphic is not evidence of flower ontogeny.

F02 Polar-Cartesian conversion

```
x = r(theta)*cos(theta); y = r(theta)*sin(theta)
```

Class: CANONICAL MAPPING. Turns any planar polar shape into Cartesian points; geometry only.

F03 Growing rose-like motif

```
r(theta) = a*cos(k*theta) + b*theta
```

Class: PROJECT GENERATOR. Combines petal recurrence with an Archimedean expansion term; may overlap or cross origin.

F04 Logarithmic spiral

```
r(theta) = a*exp(b*theta)
```

Class: CANONICAL CURVE. For constant b, the growth ratio per full revolution is exp(2*pi*b). Descriptive, not a universal growth law.

F05 Golden-angle placement

```
theta_n = n*pi*(3-sqrt(5)); r_n = c*sqrt(n)
```

Class: ADAPTED BOTANICAL MODEL. The golden angle is about 137.507764 degrees; sqrt(n) is a common packing heuristic, not obligatory in all plants.

F06 Time-dependent radius

```
r(theta,t) = a*exp(b*theta) + c*t^p
```

Class: PROJECT GENERATOR. Adds a time term without specifying biological mechanics, anisotropy or resource constraints.

B01 Mathematical butterfly

```
q(t) = exp(cos(t)) - 2*cos(4*t) - sin(t/12)^5; x=sin(t)*q; y=cos(t)*q
```

Class: CANONICAL PARAMETRIC ART CURVE. A recognizable procedural butterfly outline, not a biological wing development equation.

B02 Alternate radial wing

```
r(t) = 2*exp(sin(t))*cos(4*t) + sin(2*pi*t/24)^5
```

Class: PROJECT GENERATOR. Produces complex radial lobes; its use as a “wing” is an artistic analogy.

B03 Curved venation

```
x(t)=a*cos(b*t+c); y(t)=d*sin(e*t+f)
```

Class: PROJECT GENERATOR. A controllable parametric path; not a mechanically optimal venation system.

B04 Euclidean spacing

```
d(i,j)=sqrt((x_i-x_j)^2+(y_i-y_j)^2)
```

Class: CANONICAL GEOMETRY. Distance for point sampling, spacing analysis or Voronoi construction.

B05 Linear beam bending

```
sigma=M*c/I
```

Class: CANONICAL ENGINEERING RELATION. Elastic flexural stress for beams in specified assumptions; not sufficient to model flapping flexible wings.

B06 Uniaxial elastic force

```
F=E*A*(Delta_L/L0)
```

Class: CANONICAL APPROXIMATION. Linear axial force at small strain, homogeneous uniaxial assumptions.

R01 Iterated transformation

```
F_n=F(F_(n-1))
```

Class: CANONICAL ABSTRACT RECURSION. Requires a defined map F and initial state; does not by itself imply fractality.

R02 Self-similar dimension

```
D=log(N)/log(1/s)
```

Class: CANONICAL IDEALIZED FRACTAL. Valid for specified uniform similarities under suitable nonoverlap assumptions.

R03 Homogeneous scaling

```
f(lambda*x)=lambda^k*f(x)
```

Class: CANONICAL SCALING DEFINITION. Degree-k homogeneity; does not necessarily produce a fractal set.

R04 Iterate-weighted pattern

```
P(x)=SUM_n a_n*(phi^n)(x)
```

Class: PROJECT GENERATOR. Here phi^n denotes n-fold composition, unlike a basis function indexed by n.

R05 Bounded nonlinear update

```
Psi_(t+1)=tanh(Psi_t+L[Psi_t])
```

Class: PROJECT DYNAMICAL HEURISTIC. L must be declared; bounded tanh alone guarantees neither convergence nor aesthetic harmony.

R06 Radial harmonic series

```
Psi(r)=SUM_n A_n*sin(k_n*r+phi_n)/r^alpha_n
```

Class: PROJECT FIELD. A designed radial superposition; r=0 requires regularization for positive decay exponents.

R07 Spatial mode expansion

```
P(x,t)=SUM_n a_n(t)*psi_n(x)
```

Class: CANONICAL REPRESENTATION. Modes and inner product depend on geometry and boundary conditions.

R08 Linear instability growth

```
a_n(t)=a_n(0)*exp(sigma_n*t)
```

Class: CANONICAL LINEAR APPROXIMATION. Applicable in linearized regime when growth rates sigma_n are well defined.

R09 Selected mode scale

```
k*=argmax_k sigma(k); lambda*=2*pi/k*
```

Class: CANONICAL CONDITIONAL RELATION. Defines dominant instability mode if a dispersion relation is specified and a maximum exists.

V01 Traveling sinusoid

```
Psi(x,t)=A*sin(k*x-omega*t)
```

Class: CANONICAL WAVEFORM. A plane harmonic wave; a visual rhythm may be analogous without sharing its physical mechanism.

V02 Distributed image composition

```
H(x)=SUM_i h_i(x)
```

Class: PROJECT ANALOGY. A sum of visual layers or cue fields, not automatically an optical hologram.

V03 Observer response

```
R=f(O,S)
```

Class: PROJECT MODEL. Response depends on observer O and stimulus/system state S; not a derived cognitive law.

V04 Feedback to target

```
x_(n+1)=x_n+eta*(target-x_n)
```

Class: CANONICAL ITERATION. For fixed scalar target, converges if 0<eta<2; in design this is an analogy for correction.

V05 Visual motif expansion

```
P(x)=SUM_n a_n*phi_n(x)
```

Class: CANONICAL / ADAPTED. Basis or dictionary atoms phi_n are not iterates phi^n; coefficient choice determines reconstruction.

V06 Weighted scanpath line integral

```
L=integral_gamma F dot d(gamma)
```

Class: CANONICAL OPERATOR / PROJECT USE. A mathematical line integral; gaze field F and path gamma need operational definitions and recorded gaze data.

V07 Meaning / complexity heuristic

```
M=I/C
```

Class: PROJECT INDEX. Requires empirical definitions of information/meaning I and complexity C; divergent at C=0.

V08 Composite aesthetic index

```
U=H*P*R*E
```

Class: PROJECT HEURISTIC. Composite factors must be scaled, justified, and validated; no evidence supports a universal multiplicative law.

V09 Form maxim

```
Form=Energy*Constraint*Resonance
```

Class: PROJECT METAPHOR. Product of undefined heterogeneous quantities is not dimensional physical mechanics.

V10 Spiral circulation path

```
P(n)=((r0+k*n)*cos(2*pi*n/T), (r0+k*n)*sin(2*pi*n/T), c*ln(n))
```

Class: PROJECT SPATIAL CURVE. Three-dimensional helical/logarithmic-height trajectory; require n>0 and specify units.

V11 Fresnel zone boundary radii

```
r_n=sqrt(n*lambda*f + (n*lambda/2)^2)
```

Class: CANONICAL GEOMETRIC OPTICS APPROXIMATION. Conventional on-axis Fresnel-zone radius expression for ideal geometry; f and lambda must be same units; not a universal light-ring aesthetic law.

V12 Conditional visibility

```
V=V(O,I,S,C)
```

Class: PROJECT EPISTEMIC AXIOM. Instrument, observer, system and conditions jointly bound accessible evidence; Nuliometry lineage.

V13 Binocular relative angular disparity

```
Delta(theta) approx b*(1/z1-1/z2)
```

Class: CANONICAL SMALL-ANGLE APPROXIMATION. For eye baseline b and distances z1,z2; sign depends on reference and viewing convention.

V14 Observer-conditioned aesthetic response

```
A=f(L,D,P,M,E,C,T)
```

Class: PROJECT TESTABLE FAMILY. L light, D depth, P pattern, M memory, E emotion, C context, T viewing time; A may be a vector.

V15 Multilevel illustrative regression

```
A_ij=beta0+betaL*L_ij+betaD*D_ij+betaP*P_ij+betaLD*(L_ij*D_ij)+u_i+v_j+epsilon_ij
```

Class: PROJECT ANALYSIS TEMPLATE. For experimental planning only; ordinal measures may require an ordered-link mixed-effects model.

Equation interoperability rule. For each equation store parameter definitions, units, domain, empirical provenance, version, biological versus artistic interpretation, singularities, and falsifying test. The same visual result can arise from different equations; parameter recovery from a final image is generally underdetermined.

APPENDIX B — PREREGISTRATION AND METHODS BLUEPRINT

Two flowers differ by a change we can name.
A third keeps the change we failed to notice.
Measure the question before seeing its answer;
the Raven binds the test before the claim.

B1. Primary question and hypotheses

H1. Valid binocular stereo disparity improves objective relative-depth discrimination compared with matched flat depiction, conditional on usable stereopsis. **H2.** A change from bright to dim illumination changes beauty, curiosity, and mystery responses without requiring a uniform direction. **H3.** Structured recurrence, when density and spatial frequency are controlled, changes exploratory attention and new-detail recognition relative to shuffled structure. **H4.** Perceived vastness predicts awe ratings more consistently than binocular disparity alone. **H5.** Meaningful contextual captions moderate beauty and wonder, potentially independent of optical stimulus.

B2. Factorial conditions

```
2 LIGHT: bright/daylight-like  x  dim/moonlight-like
2 DEPTH: calibrated stereo     x  matched planar control
2 PATTERN: organized recurrence x  scrambled relation control
PLUS: astronomy / high-vastness comparison arm with framing control
```

Calibrate display luminance in physically measurable units where hardware permits, record viewing distance and device, and pretest thresholds for visibility. Simulated “moonlight-like” displays are rendered manipulations and must not be called astronomical lunar illumination unless radiometric conditions match. Randomize order, counterbalance fatigue, and monitor display noncompliance in remote studies.

B3. Stimulus family and matching

Create botanical, wing, architectural, and celestial stimulus sets. Hold high-level content fixed within matched contrasts; log changes to luminance, chroma, spatial frequency, local edge density, silhouette area, depth cue availability, exposure duration, and framing. Include a validation sample for whether viewers perceive the intended control differences. If technical matching is impossible, reduce the causal claim and predeclare the surviving confounds.

B4. Recruitment, ethics, and power

Use an a priori power or Bayesian precision analysis informed by pilot distributions rather than selecting an invented N. Include broad demographic and accessibility strata, record relevant viewing limitations without medical overcollection, and obtain consent. If strong emotional or low-light stimuli may be uncomfortable, allow stopping without penalty. Do not turn aesthetic ratings into moral or ability scores.

B5. Outcome matrix

```
OPTICAL      stereo threshold, disparity sign, relative depth error
COGNITIVE    identification, memory, discovered detail, confidence
AFFECTIVE    beauty, liking, fear, pleasure, curiosity, awe
EXPLORATORY  fixation sequence, revisit count, viewing time
CONTEXTUAL   prior familiarity, expertise, story association, culture
```

Primary endpoint should be declared before data collection (for example, a preregistered beauty contrast or depth-discrimination threshold); treat the remaining outcomes as confirmatory or exploratory as explicitly designated. Where stimulus presentation is within-subject, model participant and stimulus clustering. Report effect sizes, uncertainty intervals, missingness, and null as well as positive results.

B6. Analysis and falsifiers

Use mixed-effects regression with participant and image intercepts; include condition interactions only when supported by design and power. Separate ordinal models for bounded ratings as warranted. Compare alternative models, not only statistical significance. Test whether effects replicate across material types and viewing devices. A mechanism claim fails when its predicted manipulation does not alter its target while manipulation checks remain valid. Negative findings remain in the lineage archive.

B7. Measurement limits

Beauty ratings describe reports under task and language; eye-tracking does not reveal joy; neural activity does not identify subjective content by itself. A well-powered survey cannot distinguish all causal pathways without intervention, nor can one culture’s sample establish a species-wide invariant. Model the observer as a variable, not an inconvenient residual.

APPENDIX C — CLAIM LEDGER AND RAVEN'S RIGHT TEST

An answer keeps its place beside its limits.
The contradicted claim need not be erased.
A false light also teaches where to look;
the Raven records both shadow and correction.

C01 — Eyes and photoreceptors have evolutionary histories across multiple lineages.

Status: E. **Evidence / lineage:** Land and Nilsson; Lamb; Nilsson and Pelger. **Required guard:** Reject a directed ladder ending in human art.

C02 — Retina transforms visual information before cortical reception.

Status: E. **Evidence / lineage:** Masland. **Required guard:** Do not call retinal output a literal copy of photons.

C03 — Rod and cone contributions depend on illumination and adaptation.

Status: E. **Evidence / lineage:** Masland; Warrant. **Required guard:** Do not predict identical appearance between day and night.

C04 — Disparity supplies depth but not all perceived distance or vastness.

Status: E / S. **Evidence / lineage:** Wheatstone; Cumming and DeAngelis; Julesz. **Required guard:** Depth cues must be specified and separately measured.

C05 — Stereographic projection is not stereopsis.

Status: E. **Evidence / lineage:** Mathematical definition; Conrad and OpenAI, Scales. **Required guard:** Methods identify the projection versus binocular measurement.

C06 — Beauty incorporates sensory, affective, and meaning systems.

Status: S. **Evidence / lineage:** Chatterjee and Vartanian; Leder et al. **Required guard:** No beauty center or universal single formula claimed.

C07 — Fluent processing can influence preference.

Status: S. **Evidence / lineage:** Reber, Schwarz, and Winkielman. **Required guard:** Disfluency and novelty can also be liked.

C08 — Prediction violation and resolution can contribute to art appreciation.

Status: S. **Evidence / lineage:** Van de Cruys and Wagemans. **Required guard:** The model is tentative, not an established general causal sequence.

C09 — Awe has been theoretically characterized by vastness and accommodation.

Status: E (model exists) / S. **Evidence / lineage:** Keltner and Haidt. **Required guard:** A model is not proof that all awe follows one mechanism.

C10 — Art preference varies across individuals and contexts.

Status: E / S. **Evidence / lineage:** Palmer et al.; Vessel et al. **Required guard:** Do not declare a single normative observer.

C11 — One fractal dimension universally maximizes beauty.

Status: N. **Evidence / lineage:** Spehar et al.; Jones-Smith and Mathur. **Required guard:** Not accepted as universal; dependent on stimuli and analyses.

C12 — Flower and butterfly design equations explain actual development.

Status: N. **Evidence / lineage:** Douady and Couder; Nijhout; Beldade et al. **Required guard:** Generators alone are not biological mechanisms.

C13 — A=f(L,D,P,M,E,C,T) explains aesthetic behavior.

Status: P. **Evidence / lineage:** Present paper. **Required guard:** Testable template, not validated equation.

C14 — Wonder grows at the limits of perceptual access.

Status: P / X. **Evidence / lineage:** Nuliometry; Keltner and Haidt. **Required guard:** Plausible theme; lacks unique mechanistic validation.

C15 — The Raven image grammar carries a global field across local regions.

Status: P. **Evidence / lineage:** Visual Holography; Visual Equations. **Required guard:** Design construct requiring perceptual tests.

Raven's Right truth conditions. Every released claim must include scope, date, independent support, counterexample, test design, uncertainty, and supersession rule. E/S/P/X/N are project evidence classifications rather than journal grades. A popular or repeated project claim is not promoted by repetition.

APPENDIX D — AI TRAINING AND DATA RECORD

The child of a record must remember its parent.
The copied image must declare what was lost.
A language that mistakes desire for data
will call its brightest fiction evidence.

The following text-only schema is a conceptual archive convention. The values are examples, not measured data or a validation set. Store one canonical source and multiple separate projections; never merge unobserved experience into a generated label.

```
RECORD: RAVEN-BEHOLDS / STIMULUS-01
source_id: immutable UUID or content-addressed identifier
source_type: photograph | generated image | physical artifact
observer: consented cohort | specified species and task
light: spectral/luminance regime; adaptation; uncertainty
depth: stereo method | disparity | monocular cues | none
pattern: generator; seed; density; spatial-frequency features
semantics: known label; cultural/historical qualifiers
report: beauty | liking | awe | curiosity | threat | no-response
method: protocol version; device; viewing distance; order
claims: E/S/P/X/N; author-year citation; alternative hypotheses
accessibility: text alternative; audio narration; display note
lineage: original -> derivative -> viewer study -> analysis
limitations: lost information and unmeasured variables
review: human check; source verification; supersession record
```

A training item should ask an assistant to tell the difference between “this image has a logarithmic spiral,” “spiral geometry causes aesthetic pleasure,” and “this observer rated a spiral image highly under these conditions.” The first can be a geometric observation, the second is a causal hypothesis, and the third is an empirical report requiring provenance. Never train a response to infer gender identity, ethnicity, psychopathology, morals, or intimate preferences from face attractiveness judgments.

A well-structured negative set includes matched cases where the same form is not liked, where visual illusion fails, where the viewer cannot perceive stereo, where a pattern’s apparent fractal dimension changes with thresholding, and where a caption shifts reported meaning. Model uncertainty and context, rather than replacing negative cases with confident positive examples.

APPENDIX E — TEXT-ONLY DIAGRAM ATLAS

Speak first the arrow, then the shape of motion.
Name every node by what it does and knows.
The picture may be silent to the listener;
its relations need not disappear.

E1. Ecological Vision

```
ILLUMINATION -> RECEPTOR -> RETINAL/NEURAL CODING -> ACTION
      ^                                               |
      +--------------- ENVIRONMENTAL FEEDBACK ---------+
```

Audio description: An organism obtains information from illumination, acts, and thereby changes its subsequent sensory sample.

E2. Observer-Conditioned Image

```
SCENE -> OPTICS -> RETINA -> PERCEPTUAL INFERENCE
                                    |
                  MEMORY + AFFECT + CONTEXT
                                    |
                 AESTHETIC REPORT / ACTION
```

Audio description: The scene is transformed through optics and neural coding; observer state participates in aesthetic reporting.

E3. Depth Versus Vastness

```
GEOMETRIC PARALLAX -> DEPTH PRECISION
SEMANTIC / COSMIC KNOWLEDGE -> VASTNESS INFERENCE
       BOTH MAY CONTRIBUTE -> WONDER / AWE
```

Audio description: Objective parallax and conceptually inferred vastness are distinct predictors of a possible aesthetic response.

E4. Three-Condition Heuristic

```
RECOGNITION <--> DISCOVERY <--> VALUATION
       ^                            |
       +---- ATTENTION / MEMORY -----+
```

Audio description: The three proposed aesthetic processes can recur and alter one another; the arrows do not impose a fixed brain sequence.

E5. Project Equation Audit

```
PROPOSED EQUATION -> DOMAIN / UNITS / ASSUMPTIONS
              -> MEASUREMENT -> TEST / CONTROL
              -> EVIDENCE CLASS -> RETAIN / REVISE
```

Audio description: Every equation is checked for defined terms, valid application, comparison to data, and transparent status.

E6. Manuscript-to-Audio Chain

```
TEXT EQUATION -> SPOKEN EQUIVALENT -> RELATION AUDIT
DIAGRAM -> NODE ORDER + ARROW MEANING -> AUDIO PARAGRAPH
CITATION -> AUTHOR + TITLE + YEAR -> RETRIEVAL
```

Audio description: Equations and diagrams are translated into spoken explanations that preserve structure and provenance.

APPENDIX F — WORKS CITED

A claim must leave a path to where it started.
A book must stand apart from its admirer.
Where two accounts disagree, preserve both trails;
the Raven builds its trust from retrievable ground.

MLA 9 aligned: author, “article title,” journal, volume, issue, year, pages or article number, DOI. The list privileges publisher pages, PubMed, major repositories, and verified bibliographic records. Internal white papers are cited separately and explicitly marked as project lineage. Accessed 24 Oct. 2026 for electronic journal verification.

Beldade, Patrícia, Paul M. Brakefield, and Anthony D. Long. “Contribution of Distal-less to Quantitative Variation in Butterfly Eyespots.” *Nature*, vol. 415, no. 6869, 2002, pp. 315–18. https://doi.org/10.1038/415315a.

Brielmann, Aenne A., and Denis G. Pelli. “Beauty Requires Thought.” *Current Biology*, vol. 27, no. 10, 2017, pp. 1506–13.e3. https://doi.org/10.1016/j.cub.2017.04.018. Note: published erratum, vol. 27, no. 11, p. 1706.

Brielmann, Aenne A., and Denis G. Pelli. “Intense Beauty Requires Intense Pleasure.” *Frontiers in Psychology*, vol. 10, 2019, article 2420. https://doi.org/10.3389/fpsyg.2019.02420.

Chatterjee, Anjan, and Oshin Vartanian. “Neuroaesthetics.” *Trends in Cognitive Sciences*, vol. 18, no. 7, 2014, pp. 370–75. https://doi.org/10.1016/j.tics.2014.03.003.

Cumming, Bruce G., and Gregory C. DeAngelis. “The Physiology of Stereopsis.” *Annual Review of Neuroscience*, vol. 24, 2001, pp. 203–38. https://doi.org/10.1146/annurev.neuro.24.1.203.

Douady, Stéphane, and Yves Couder. “Phyllotaxis as a Physical Self-Organized Growth Process.” *Physical Review Letters*, vol. 68, no. 13, 1992, pp. 2098–2101. https://doi.org/10.1103/PhysRevLett.68.2098.

Graham, Daniel J., and Christoph Redies. “Statistical Regularities in Art: Relations with Visual Coding and Perception.” *Vision Research*, vol. 50, no. 16, 2010, pp. 1503–09. https://doi.org/10.1016/j.visres.2010.05.002.

Jones-Smith, Katherine, and Harsh Mathur. “Revisiting Pollock’s Drip Paintings.” *Nature*, vol. 444, 2006, pp. E9–E10. https://doi.org/10.1038/nature05398.

Julesz, Bela. “Binocular Depth Perception of Computer-Generated Patterns.” *Bell System Technical Journal*, vol. 39, no. 5, 1960, pp. 1125–62. https://doi.org/10.1002/j.1538-7305.1960.tb03954.x.

Keltner, Dacher, and Jonathan Haidt. “Approaching Awe, a Moral, Spiritual, and Aesthetic Emotion.” *Cognition and Emotion*, vol. 17, no. 2, 2003, pp. 297–314. https://doi.org/10.1080/02699930302297.

Lamb, Trevor D. “Evolution of Phototransduction, Vertebrate Photoreceptors and Retina.” *Progress in Retinal and Eye Research*, vol. 36, 2013, pp. 52–119. https://doi.org/10.1016/j.preteyeres.2013.06.001.

Land, Michael F., and Dan-Eric Nilsson. *Animal Eyes*. 2nd ed., Oxford UP, 2012. https://doi.org/10.1093/acprof:oso/9780199581139.001.0001.

Leder, Helmut, et al. “A Model of Aesthetic Appreciation and Aesthetic Judgments.” *British Journal of Psychology*, vol. 95, no. 4, 2004, pp. 489–508. https://doi.org/10.1348/0007126042369811.

Masland, Richard H. “The Neuronal Organization of the Retina.” *Neuron*, vol. 76, no. 2, 2012, pp. 266–80. https://doi.org/10.1016/j.neuron.2012.10.002.

Nijhout, H. Frederik. *The Development and Evolution of Butterfly Wing Patterns*. Smithsonian Institution Press, 1991.

Nilsson, Dan-Eric, and Susanne Pelger. “A Pessimistic Estimate of the Time Required for an Eye to Evolve.” *Proceedings of the Royal Society B: Biological Sciences*, vol. 256, no. 1345, 1994, pp. 53–58. https://doi.org/10.1098/rspb.1994.0048.

Palmer, Stephen E., Karen B. Schloss, and Jonathan Sammartino. “Visual Aesthetics and Human Preference.” *Annual Review of Psychology*, vol. 64, 2013, pp. 77–107. https://doi.org/10.1146/annurev-psych-120710-100504.

Prusinkiewicz, Przemyslaw, and Aristid Lindenmayer. *The Algorithmic Beauty of Plants*. Springer-Verlag, 1990. https://doi.org/10.1007/978-1-4613-8476-2.

Reber, Rolf, Norbert Schwarz, and Piotr Winkielman. “Processing Fluency and Aesthetic Pleasure: Is Beauty in the Perceiver’s Processing Experience?” *Personality and Social Psychology Review*, vol. 8, no. 4, 2004, pp. 364–82. https://doi.org/10.1207/s15327957pspr0804_3.

Spehar, Branka, et al. “Universal Aesthetic of Fractals.” *Computers & Graphics*, vol. 27, no. 5, 2003, pp. 813–20. https://doi.org/10.1016/S0097-8493(03)00154-7.

Taylor, Richard P., Adam P. Micolich, and David Jonas. “Fractal Analysis of Pollock’s Drip Paintings.” *Nature*, vol. 399, 1999, p. 422. https://doi.org/10.1038/20833.

Turing, Alan M. “The Chemical Basis of Morphogenesis.” *Philosophical Transactions of the Royal Society of London. Series B*, vol. 237, no. 641, 1952, pp. 37–72. https://doi.org/10.1098/rstb.1952.0012.

Van de Cruys, Sander, and Johan Wagemans. “Putting Reward in Art: A Tentative Prediction Error Account of Visual Art.” *i-Perception*, vol. 2, no. 9, 2011, pp. 1035–62. https://doi.org/10.1068/i0466aap.

Vessel, Edward A., G. Gabrielle Starr, and Nava Rubin. “The Brain on Art: Intense Aesthetic Experience Activates the Default Mode Network.” *Frontiers in Human Neuroscience*, vol. 6, 2012, article 66. https://doi.org/10.3389/fnhum.2012.00066.

Warrant, Eric. “Vision in the Dimmest Habitats on Earth.” *Journal of Comparative Physiology A*, vol. 190, no. 10, 2004, pp. 765–89. https://doi.org/10.1007/s00359-004-0546-z.

Warrant, Eric J., and Marie Dacke. “Vision and Visual Navigation in Nocturnal Insects.” *Annual Review of Entomology*, vol. 56, 2011, pp. 239–54. https://doi.org/10.1146/annurev-ento-120709-144852.

Wheatstone, Charles. “Contributions to the Physiology of Vision.—Part the First. On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision.” *Philosophical Transactions of the Royal Society of London*, vol. 128, 1838, pp. 371–94.

Zeki, Semir, et al. “The Experience of Mathematical Beauty and Its Neural Correlates.” *Frontiers in Human Neuroscience*, vol. 8, 2014, article 68. https://doi.org/10.3389/fnhum.2014.00068.

INTERNAL RAVEN SOURCES — UNPUBLISHED PROJECT LINEAGE

Conrad, Noel Michael, and OpenAI. *The Raven’s Violet Eye: Translational Primers for Nonhuman Sensory Worlds*. Raven Valley / Arch Opus I, white paper version 1.0, 29 Sept. 2026.

Conrad, Noel Michael, and OpenAI. *The Raven’s Scales*. Raven Valley, white paper version 1.0, 7 Sept. 2026.

Conrad, Noel Michael, and OpenAI. *Nuliometry: Shapes of the Unknowable*. Raven Valley / Opus II / Visual Holography, white paper version 1.0, 9 Sept. 2026.

Conrad, Noel Michael, and OpenAI. *Visual Holography: Prompt / Image / Drawing Lineage*. Raven Valley, white paper version 1.0, 11 Aug. 2026.

Conrad, Noel Michael, and OpenAI. *Visual Equations*. White paper, 4 May 2026.

Conrad, Noel Michael, and OpenAI. *Five Up Five Down*. Raven Valley, white paper version 1.0, 2026.

APPENDIX G — SOURCE AND VERACITY AUDIT

The checked citation opens, not closes, inquiry.
A verified title does not prove its thesis.
Read what was measured and where it failed;
the Raven does not borrow certainty.

Verification basis: Each external reference above was checked against a reputable publisher bibliographic page, a PubMed record, institutional catalog, or original journal archive. DOIs were copied from those records and not generated from assumed patterns. Verification validates identity and bibliographic details, not replication of every paper's empirical findings. This manuscript is intended as a review and a research proposal; it has not itself undergone external peer review.

Examples of confirmed source identity: Masland, 2012, *Neuron* 76(2):266–280, DOI 10.1016/j.neuron.2012.10.002; Nilsson and Pelger, 1994, *Proceedings B* 256(1345):53–58, DOI 10.1098/rspb.1994.0048; Cumming and DeAngelis, 2001, *Annual Review of Neuroscience* 24:203–238, DOI 10.1146/annurev.neuro.24.1.203; Keltner and Haidt, 2003, *Cognition and Emotion* 17(2):297–314, DOI 10.1080/02699930302297; Palmer, Schloss, and Sammartino, 2013, *Annual Review of Psychology* 64:77–107, DOI 10.1146/annurev-psych-120710-100504.

Correction retained: Brielmann and Pelli's *Beauty Requires Thought* article was published in 2017, not 2019, and has a published erratum. Their distinct *Intense Beauty Requires Intense Pleasure* appeared in 2019. Turing's morphological paper first appeared in 1952 (the 1990 reprint is not used as the original source). The 1999 fractal attribution claim is paired with the 2006 critical reply rather than uncritically repeated.

Limits: This audit did not involve reanalysis of original subject-level datasets, formal systematic-review screening of every publication on aesthetics, or prospective experimental validation. Claims about cross-species subjective worlds, necessary neural conditions for beauty, universally preferred fractal dimensions, and project-specific equations are explicitly bounded. For journal submission, a domain expert should conduct line-by-line source review and update any later corrigenda, contested findings, or methodological standards.

FINAL RAVEN NOTE

Light enters in the present. Meaning gathers across a lifetime. The world can exceed the eye without escaping inquiry. Beauty remains an experience; wonder remains an honest invitation to discover.