

The Neuroscience of Art Appreciation: A Multimodal Investigation of Perceptual Dynamics across Visual Communications

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Abstract

This paper examines how the brain supports the perception and appreciation of visual art. It argues that visual aesthetic experience emerges from the interaction of basic visual processing, attentional selection, reward and affective systems, and individual differences shaped by expertise, age, and culture. The discussion begins with the neural pathways that transform light into meaningful visual structure, then considers how bottom-up, top-down, and intermediate forms of attention shape what viewers notice in artworks. It then compares the neural mechanisms engaged by different visual content types, including artworks, brands, and human faces, and extends this comparison by examining research on ambiguous social cues such as surprised faces, which show how context and prior expectations can resolve uncertain visual information differently. The paper also considers how certain visual properties may evoke broadly shared positive responses, including joy-related responses to color, curvature, symmetry, abundance, and elevation, while still being modulated by cultural learning and personal history. Finally, it reviews behavioral and technological methods for studying art viewing and proposes future directions for individualized models of aesthetic attention and emotional prediction. Together, these perspectives suggest that art appreciation is best understood as a dynamic, context-sensitive process rather than as the output of any single neural system.

Keywords

Visual Attention, Neuroscience, Art, Visual Aesthetic Experience, Eye Tracking, Individual Differences, Reward, Emotion

1. Introduction

Humans devote enormous time and resources to creating and experiencing art, yet the neural processes that allow people to perceive and appreciate it remain only partially understood. National time-use data indicate that Americans who attend art museums spend substantial time doing so, and those who participate in arts and crafts often devote hours per day to those activities [1]. These patterns raise a central neuroscientific question: why does visual art feel meaningful, emotionally evocative, and rewarding to the brain?

When people look at art, the same visual and attentional systems that support everyday seeing are shaped by goals, prior knowledge, and cultural background. Together with reward and affective systems, these processes contribute to what is often called visual aesthetic experience [2] [3]. Across cultures, art helps build identity, transmit values, and create shared emotional experiences [4]. Public art, murals, installations, and collaborative visual projects rely on images to guide attention, evoke feeling, and create meaning among viewers [5]. At the same time, art appreciation is not governed solely by learned interpretation. Some visual properties may evoke relatively widespread positive responses across viewers, even as culture and experience still shape the final meaning of what is seen. Recent discussions of joy in design and perception suggest that bright color, roundness, symmetry, multiplicity, and a sense of elevation or buoyancy may function as visual cues that reliably invite positive affect in many observers, offering a useful complement to research emphasizing cultural difference [6]-[9]. This tension between shared perceptual tendencies and individual variability is central to understanding why some artworks feel immediately inviting while others require more learned forms of engagement. This paper argues that visual aesthetic experience emerges from the dynamic interaction of basic visual encoding, attentional selection, affective and reward systems, and individual differences shaped by expertise, age, and culture. To develop this claim, the paper proceeds in several steps. First, it outlines how the visual system transforms light into structured representations and how different forms of attention select among those inputs. Next, it compares artworks with brands and faces because these are visual stimuli that share form, attention, learned value, and affective relevance while differing in their communicative purpose; surprised expressions serve as a focused case of affective ambiguity, making them especially useful for showing how context and prior expectations shape interpretation. It then examines how expertise, age, and culture tune these perceptual and affective responses. After that, it reviews key behavioral and technological methods for studying visual aesthetic experience. Finally, it considers future directions for individualized prediction models that better capture how personal and cultural context shape art appreciation.

2. Cultural Importance of Art and the Question of Joy

Art is a foundational element of society, transcending linguistic and geographic boundaries to shape both collective identities and individual experiences [4]. In

many societies, artistic expression preserves tradition, transmits values across generations, and facilitates intercultural exchange [10]. These functions matter for neuroscience because they show that aesthetic experience is not a trivial byproduct of perception but a meaningful mode of human engagement that links visual form to emotion, memory, and social life. Aesthetic value is central to this role. Encounters with beauty, emotional resonance, or formal complexity can provoke reflection, inspiration, and heightened awareness. Peer-reviewed evidence also supports more carefully bounded claims about art and well-being: an integrative review found that participatory arts can support social cohesion and well-being by fostering connection, collective participation, and shared meaning, while systematic reviews of creative-arts interventions report that many studies observe reductions in stress or anxiety. These findings do not establish that every encounter with art is therapeutic, but they support viewing artistic engagement as a potential resource for social connection and emotion regulation [5] [11]. At the same time, cultural framing does not exclude the possibility that some visual properties are associated with broadly positive evaluations. Empirical aesthetics provides qualified support for several features commonly linked to joy: a meta-analysis of 61 studies found a reliable, moderate preference for visual curvature, although the effect varied with task, stimulus type, expertise, and presentation duration; experimental work also finds that curved contours can be rated as more beautiful, likable, and less stressful than angular contours in some contexts [6] [7]. Symmetry often contributes to aesthetic preference, but its effects depend on the image category, task, and viewer; a critical review cautions against treating symmetry as a universal or sufficient cause of beauty [8]. Color similarly influences affective evaluation, yet color preferences are shaped by contextual, learned, and cultural associations [9]. Evidence for abundance and elevation as distinct joy cues is less direct; they should therefore be treated as hypotheses about compositional qualities rather than as established universal mechanisms. This distinction matters for the paper's broader argument. If some aspects of visual response are widely shared while others are strongly shaped by history, expertise, or identity, then visual aesthetic experience must be understood as the interaction of universal perceptual tendencies with culturally and personally specific meaning-making. Art becomes especially powerful because it can work at both levels at once, attracting attention through form while deepening significance through interpretation.

3. Neural Processing of Visual Information

Visual aesthetic experience begins with basic visual perception, so any account of art appreciation must first explain how the brain converts light into meaningful structure. When light reflected from an artwork enters the eye, photoreceptors in the retina convert it into electrical signals that travel along the optic nerve [12] [13]. These signals partially cross at the optic chiasm and are relayed through the thalamus to the primary visual cortex, or V1, in the occipital lobe [14]. Early visual areas such as V1 and V2 encode relatively simple features, including edges, orien-

tation, contrast, and spatial frequency [15] [16]. As processing continues, visual information is organized into two broad pathways. The ventral “what” pathway projects into temporal regions and supports the recognition of objects, faces, and complex patterns, whereas the dorsal “where” or “how” pathway projects into parietal regions and supports spatial localization and visually guided action [17] [18]. When a viewer encounters a painting, these systems work together to identify what is depicted, locate salient elements within the composition, and lay the perceptual foundation for later emotional and evaluative responses [3]. In this way, even the earliest stages of seeing contribute to visual aesthetic experience by determining what information is available for attention and interpretation.

4. Early Visual Coding and Saliency

The link between low-level vision and aesthetic response becomes clearer when considering classic work on receptive fields. Hubel and Wiesel showed that neurons in the primary visual cortex are tuned not only to points of light but also to oriented edges arranged in specific spatial patterns within a receptive field [15]. They distinguished simple cells, whose responses could be predicted from specific excitatory and inhibitory zones, from complex cells, which responded to preferred orientations across broader regions and were often sensitive to motion [15]. This hierarchy demonstrated how visual systems build increasingly complex representations from simpler inputs. That logic remains influential in modern computational approaches to attention. Convolutional neural networks trained to predict gaze patterns often learn low-level filters resembling simple cells in early layers and more integrated, position-tolerant representations in deeper layers [19]. When such models are applied to artworks, they can generate saliency maps that estimate which regions are likely to attract initial gaze based on contrast, contour, color, and figure-ground structure [20]. These models do not explain aesthetic experience on their own, but they clarify how the visual system creates the perceptual scaffolding on which attention, feeling, and evaluation later depend.

5. Types of Visual Attention

Because visual aesthetic experience depends not only on what is present in an image but also on what is selected for deeper processing, attention is central to art appreciation. Visual attention can be broadly divided into bottom-up and top-down processes [21] [22]. Bottom-up attention is driven by the stimulus’s properties: sudden movement, strong contrast, high saturation, or unusual shape can automatically attract attention. In a painting, a vivid red region or a sharply bounded contour may draw the eye because it stands out from the surrounding field. Top-down attention, by contrast, is guided by the viewer’s goals, expectations, and prior knowledge [21] [22]. A person who has read a wall label, studied the artist’s historical context, or learned to notice compositional balance may search a painting differently than someone viewing it casually. Experts may attend deliberately to brushwork, structure, or symbolism, whereas novices may focus

more on recognizable objects or emotionally expressive content. These differences matter because they help explain why the same visual stimulus can support different aesthetic experiences across viewers.

Many real-world viewing situations involve a mix of these influences. An intermediate form of attention can be understood as visually salient information whose impact is amplified or suppressed by higher-level beliefs, expectations, and emotional orientation. Politically charged or morally complex artworks may contain features that naturally attract the gaze, yet prior beliefs can shape how long viewers look, what they interpret as central, and whether the work feels compelling, unsettling, or beautiful. Visual aesthetic experience therefore depends not only on what is visible but also on how perceptual salience and interpretive goals interact over time (see **Figure 1**).

Bottom-up, top-down, and intermediate visual attention

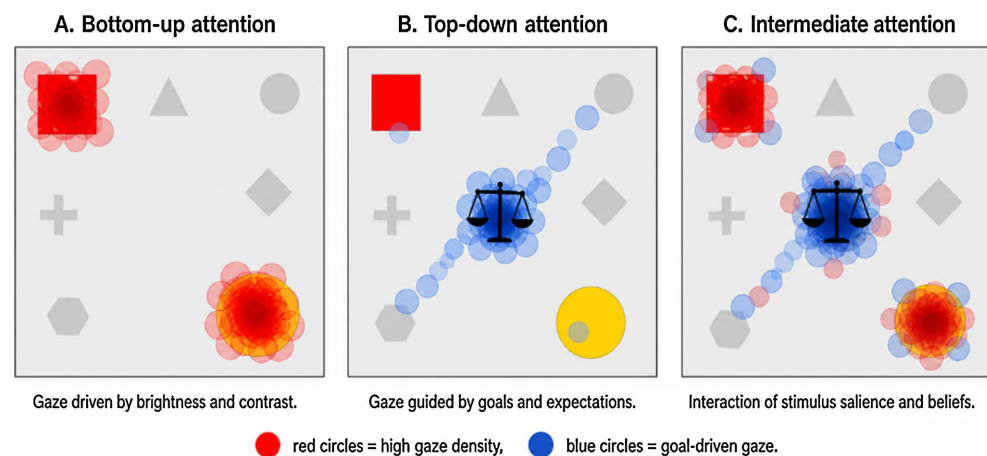


Figure 1. This figure illustrates the concept of intermediate visual attentional processing, which is a hybrid of both top-down allocentric and egocentric driven cues, that blend preconceived, or learned, constructs shaping what is visually salient with respect to bottom-up visual attention.

6. Neural Processes across Content Types

The neural basis of art appreciation becomes clearer when artworks are compared with other forms of visual content. These comparisons show that visual aesthetic experience is not isolated from ordinary perception but instead emerges from the brain's existing systems for processing form, value, social relevance, and ambiguity. At the same time, artworks often combine these functions in unusually layered ways, making them particularly useful for studying how perception and interpretation interact.

7. Art Perception and Distributed Aesthetic Networks

Functional neuroimaging studies suggest that viewing artworks engages not only the visual cortex but also networks implicated in valuation, emotion, and self-referential processing. Quantitative meta-analyses of painting and visual-art studies report a distributed pattern spanning occipital and temporal visual regions, in-

cluding category-sensitive ventral-stream areas, together with regions associated with affective and internally oriented processing; these findings argue against a single specialized “art center” [23] [24]. Individual studies linking aesthetic judgments to orbitofrontal and striatal activity remain informative, but they should be interpreted within this distributed-network account rather than as evidence for one-to-one mappings between a region and beauty. Meta-analytic evidence reinforces this view by indicating that visual aesthetic experience depends on a distributed bilateral network rather than a single specialized “art center” [23] [24]. Across portraits, scenes, abstract paintings, and sculptures, aesthetic responses recruit both shared valuation-related processes and content-sensitive mechanisms in the ventral visual stream. This pattern suggests that aesthetic response is built on perceptual and cognitive systems used to identify, interpret, remember, and value visual information in ordinary life, rather than operating separately from them.

8. Art Genres and Content Sensitivity

Genre differences further illustrate how visual aesthetic experience depends on the interplay between general valuation systems and content-specific perceptual mechanisms. Portraits may engage face-processing and social-cognitive systems, landscapes may recruit scene-sensitive mechanisms, and abstract works may rely more heavily on pattern analysis, tolerance of ambiguity, and higher-order inference. Genre is therefore not merely a descriptive label used by art history; it shapes the perceptual and interpretive demands placed on the viewer. This point helps maintain the paper’s throughline. If different genres recruit distinct constellations of perceptual and conceptual resources, there is no single neural route to art appreciation. Instead, artworks produce aesthetic experience by combining shared processes of value and affect with genre-specific demands on attention, recognition, and meaning construction. This is one reason some viewers may find figurative art immediately engaging, while others derive a stronger aesthetic response from abstraction or formal pattern.

9. Brand Imagery

Brand logos and advertisements provide a useful point of comparison because they also combine visual salience with learned value. Like artworks, branded images rely on color, shape, and composition to attract attention, but they are more tightly linked to expectations, memory, and consumer reward [25]. Familiar logos can activate associations tied to prior experience, and preferred brands may evoke stronger responses in valuation-related systems than unfamiliar ones. These findings show that visual pleasure and meaning are often inseparable from memory and learned context. The comparison matters because it highlights a broader principle: visual form does not influence viewers only through passive sensory appeal. Instead, perceptual features guide attention, while memory and valuation systems determine what those features mean to the observer. Artworks differ from brands

in their openness to interpretation, but both illustrate how visual aesthetic experience depends on the interaction of perceptual structure and affective learning.

10. Human Faces, Bodies, and the Social Brain

Human faces and bodies are especially powerful visual stimuli because they recruit specialized systems for social perception. The fusiform gyrus, particularly the fusiform face area, plays a central role in face recognition, while other regions support processing of expressions, biological motion, and inferences about mental states [3]. Emotional expressions and bodily posture can also engage networks involved in fear, empathy, attachment, and person knowledge. When artworks depict people, they therefore draw on both general visual mechanisms and highly specialized social-cognitive systems. This social dimension is crucial for understanding why figurative art can feel especially immediate. A portrait is not merely a set of lines, colors, and proportions; it is also a cue to identity, emotion, agency, and relationship. As a result, artworks depicting human figures may engage viewers through systems tuned to socially relevant information long before explicit interpretation begins. In such cases, visual aesthetic experience emerges from the rapid coupling of perceptual analysis with social and emotional appraisal.

11. Ambiguity, Surprised Faces, and Emotional Inference

Ambiguity provides one of the clearest demonstrations that visual aesthetic experience depends on both interpretation and perception. Some visual stimuli do not specify a single emotional meaning and must be resolved by the viewer in context. Research on surprised faces is especially relevant here because surprise has uncertain valence: the same expression can signal delight, alarm, amazement, or threat, depending on surrounding cues and prior expectations. This makes surprised faces a powerful model for understanding how the brain interprets emotionally ambiguous visual information. Work by Kim and colleagues [26] shows that surprised faces often elicit an initial negativity bias unless contextual information or regulatory processes shift interpretation toward a more positive reading. In other words, the visual system does not simply register the face and stop there; higher-order systems help determine whether ambiguity is resolved as danger, uncertainty, or positive arousal. This line of work is useful for art because many artworks deliberately preserve ambiguity rather than eliminating it. A face in a painting, like a surprised expression in an experiment, may invite viewers to project expectations, mood, and prior knowledge into what they see. The relevance to the paper's central argument is direct. Art appreciation often depends on how uncertain social or emotional cues are interpreted, and those interpretations can differ widely across viewers. A face that seems hopeful to one person may seem ominous to another, not because the image itself changes, but because perceptual input is filtered through affective expectation, context, and learned meaning. Surprised-face research therefore offers a strong empirical analogue for how visual artworks can hold viewers in a state of interpretive suspense and draw aesthetic power from

that uncertainty.

12. Bodily Responses, Joy, and Negative Aesthetic Experience

Aesthetic experience depends not only on perception and interpretation but also on bodily and affective states. The James-Lange tradition holds that conscious emotional feeling is informed, in part, by the perception of bodily changes, whereas somatic-marker accounts hold that physiological signals can guide evaluation and decision-making [27] [28]. In art viewing, changes in arousal, tension, or bodily readiness may therefore contribute to the felt qualities of awe, serenity, unease, or delight. This bodily dimension helps explain why visual features associated with positive evaluation matter. Curvature has the strongest empirical support among the features discussed here, while symmetry and color can also influence preference under particular task and stimulus conditions [6]-[9]. These associations should not be read as universal “joy triggers”: their magnitude and meaning vary with image content, cultural learning, viewing goals, and individual experience. Thus, an artwork may feel buoyant, playful, or welcoming partly because of its formal properties, but viewers’ interpretations remain essential to the resulting emotion. Negative aesthetic experience is not simply the absence of pleasure. A recent meta-analysis of negative aesthetic evaluations in visual art found consistent activation in a right fusiform/anterior-cerebellar cluster and emphasized that aesthetic context can alter how domain-general affective systems are engaged [29]. Disliking an artwork can therefore be an organized response shaped by perceptual tension, affective appraisal, and interpretive conflict.

13. Individual Differences in Perception

If visual aesthetic experience emerges from the interaction of perception, attention, and affect, then individual differences are not peripheral complications but central explanatory variables. Art appreciation is not uniform across viewers, and variation in expertise, age, and culture helps explain why the same artwork can feel profoundly meaningful to one observer yet relatively flat to another. These differences do not replace the mechanisms described earlier; they modulate how those mechanisms operate in specific viewers. Expertise is one important source of variation. Trained artists, curators, and art historians often display different eye-movement patterns than novices, spending more time on structural features such as composition and technique and less time on obvious focal points. They may also draw more on semantic and conceptual knowledge, allowing them to derive meaning from stylistic choices that less experienced viewers overlook. Expertise therefore changes visual aesthetic experience not by bypassing perception but by altering how attention and interpretation are organized.

Age introduces another layer of variation. Older adults often experience reduced visual acuity and altered color perception, including lens yellowing that can change the appearance of hue, brightness, and contrast. Emotional processing

may also shift with age. Research summarized in the draft indicates that older adults can rate emotional pictures as more positive and arousing than younger adults yet show fewer measurable skin-conductance responses; when physiological responses occur, their magnitude may resemble that of younger adults. In younger adults, subjective ratings often correlate with physiology. In older adults, however, self-reported emotion may be partly decoupled from autonomic responding. In the context of art, this pattern cautions against inferring emotional meaning from physiology alone. Cultural background also shapes visual processing. Research on scene perception suggests that people from some East Asian cultural contexts tend to attend more holistically to relationships between objects and backgrounds, whereas Western viewers more often prioritize focal objects [30]-[33]. Cross-cultural research also shows differences in change blindness and in sensitivity to incongruities between foreground and background objects [34] [35]. These patterns matter for art because they influence what viewers notice first, what they treat as meaningful, and how they connect parts of an image into a coherent interpretation. Visual aesthetic experience is therefore shaped by culturally learned habits of attention as well as by perceptual structure itself.

14. Methods for Studying Art Interpretation

Because the aesthetic experience of visual stimuli is distributed across perception, attention, affect, and interpretation, it cannot be captured by a single method. Researchers therefore rely on multiple approaches that illuminate different layers of the viewing process [2]. The value of these methods lies not only in what each reveals independently but also in how they can be combined to trace the progression from visual input to aesthetic response.

15. Self-Report

Self-report measures ask participants to describe their experiences through ratings, verbal descriptions, or open-ended interpretations [2] [36]. Viewers may report how much they like a painting, how moving or beautiful it feels, or the memories and emotions it evokes. This method is valuable because it provides direct access to conscious judgment and perceived meaning. At the same time, self-report is limited by memory, language, introspective access, and social desirability, so it cannot fully capture the unconscious or rapidly unfolding processes that contribute to art appreciation [37].

16. Eye Tracking

Eye tracking records where viewers look, the sequence of fixations, and how long they look. Measures such as fixation duration, fixation count, time to first fixation, and scanpath order allow researchers to study how attention is allocated across an artwork. Reviews of eye tracking in the visual arts emphasize its value for linking viewing dynamics to image structure, task demands, and visitor or viewer expertise, while experimental studies show that both task instructions and art expertise

can alter scanpaths and saccade patterns [38] [39]. Eye tracking is therefore useful for testing cultural differences and the balance between bottom-up salience and top-down goals, although gaze alone does not reveal the emotional or conceptual significance of what is seen.

17. Vision Prediction Models and Emerging Tools

Visual salience prediction software uses computational models to estimate which regions of an image are likely to attract attention. Some models rely primarily on low-level features such as contrast, color, and orientation, whereas others incorporate human gaze data and higher-level semantic information. In art research, these tools can help distinguish generic image salience from viewer-specific visual strategies. They cannot, however, substitute for evidence about meaning, emotion, or expertise, because an algorithmic salience estimate is not a direct measure of aesthetic experience. Yet current models often underrepresent the viewer. They are better at predicting generic salience than at explaining how expertise, cultural background, political attitudes, or emotional expectations alter attention and interpretation [25]. Emerging approaches discussed in the meeting transcript, such as non-contact technologies for magnifying subtle bodily movements and physiological changes, suggest future opportunities for integrating visual attention with measures of affective response. These tools remain beyond the scope of the present paper's main argument, but they underscore the broader point that aesthetic experience is a multi-level process requiring methods that can bridge visual selection, bodily response, and subjective meaning.

18. Conclusion and Future Directions

Limitations. Much of the evidence reviewed here derives from controlled laboratory tasks, static face paradigms, neuroimaging studies, or scene-perception experiments rather than sustained, real-world encounters with original artworks in museums, galleries, or everyday settings. These methods are valuable for isolating perceptual and affective mechanisms, but they may not capture social context, movement through space, material qualities, curatorial framing, or the longer time scales of natural art viewing. The conclusions should therefore be understood as a mechanistic framework for visual aesthetic experience, not as a complete account of art engagement in the wild. Art appreciation emerges from the interaction of multiple neural and psychological processes rather than from a single specialized mechanism. Basic visual pathways transform light into structured representations; attentional systems select which elements receive deeper processing; reward, affective, and self-referential systems contribute to the felt significance of artworks; and individual differences in expertise, age, and culture shape how those processes unfold in particular viewers [2] [12] [30]. Visual aesthetic experience is therefore best understood as a dynamic encounter between the image and the perceiver.

This framework helps explain why art can feel both widely resonant and deeply personal. Formal properties such as curvature, symmetry, and color can bias aes-

thetic evaluation, but their effects are conditional rather than universal [6] [9]. Research on surprised faces offers a complementary lesson: even tightly controlled visual input can retain uncertain emotional meaning until a viewer interprets it in context [26] [40]. Artworks can exploit the same interplay between perceptual invitation and interpretive uncertainty. A promising future direction is developing individualized prediction models that treat viewer characteristics as core explanatory variables rather than as noise. Such a model could use inputs including prior art expertise, cultural background, age-related sensory factors, viewing goals, affective traits, prior familiarity with an artwork or artist, and a viewer's earlier gaze and rating patterns; its outputs could predict attention allocation (for example, fixation locations and dwell time) and subjective outcomes such as liking, interest, perceived meaning, or emotional valence for a new artwork. This approach could improve museum interpretation, art education, and inclusive design while raising ethical questions about personalization and affective prediction.

Author Contributions

Conceptualization, Clark and Cao; methodology, Clark and Cao; software, Clark and Cao; investigation, Clark; resources, Clark; writing—original draft preparation, Clark and Cao; writing—review and editing, Clark and Cao; visualization, Clark; supervision, Clark; project administration, Clark. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] National Endowment for the Arts (2024) How Much Time Do Americans Spend on Arts Activities? (Arts Participation Indicator B.4). National Arts Statistics and Evidence-Based Reporting Center.
- [2] Leder, H., Belke, B., Oeberst, A. and Augustin, D. (2004) A Model of Aesthetic Appreciation and Aesthetic Judgments. *British Journal of Psychology*, **95**, 489-508. <https://doi.org/10.1348/0007126042369811>
- [3] Chatterjee, A. (2014) *The Aesthetic Brain: How We Evolved to Desire Beauty and Enjoy Art*. Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199811809.001.0001>
- [4] Kassem, F. (2024) The Significance of Art in Revealing a Culture's Identity. *Open Journal of Social Sciences*, **12**, 1-15.
- [5] Sonke, J., Pesata, V., Colverson, A., Morgan-Daniel, J., Rodriguez, A.K., Carroll, G.D., et al. (2025) Relationships between Arts Participation, Social Cohesion, and Well-Being: An Integrative Review of Evidence. *Frontiers in Public Health*, **13**, Article ID: 1510487. <https://doi.org/10.3389/fpubh.2025.1589693>
- [6] Chuquichambi, E.G., Vartanian, O., Skov, M., Corradi, G.B., Nadal, M., Silvia, P.J., et al. (2022) How Universal Is Preference for Visual Curvature? A Systematic Review and Meta-Analysis. *Annals of the New York Academy of Sciences*, **1518**, 151-165. <https://doi.org/10.1111/nyas.14919>

- [7] Tawil, N., Grzybowski, A. and Bertamini, M. (2022) The Contour Effect: Differences in the Aesthetic Preference and Stress Responses to Curved Versus Angular Contours. *Frontiers in Psychology*, **13**, Article ID: 933344. <https://doi.org/10.3389/fpsyg.2022.933344>
- [8] Bertamini, M. and Rampone, G. (2020) The Study of Symmetry in Empirical Aesthetics. In: Nadal, M. and Vartanian, O., Eds., *The Oxford Handbook of Empirical Aesthetics*, Oxford University Press, 488-509. <https://doi.org/10.1093/oxfordhb/9780198824350.013.23>
- [9] Palmer, S.E., Schloss, K.B. and Sammartino, J. (2013) Visual Aesthetics and Human Preference. *Annual Review of Psychology*, **64**, 77-107. <https://doi.org/10.1146/annurev-psych-120710-100504>
- [10] Eclectic Gallery (2018) Cultural Influences in Art: Tracing the Roots of Creativity. <https://eclecticgallery.co.uk/news/209-cultural-influences-in-art-tracing-the-roots-of-bridging-worlds-exploring-the-cultural-tapestry-of-artistic/>
- [11] Arnaud, C. and Koch, S.C. (2022) The Art of Managing Stress: Effectiveness of Creative Arts Interventions for Stress Reduction and Stress Management: A Systematic Review. *GMS Journal of Arts Therapies*, **4**, Doc10.
- [12] Bear, M.F., Connors, B.W. and Paradiso, M.A. (2020) Neuroscience: Exploring the Brain. 4th Edition, Wolters Kluwer.
- [13] Kandel, E.R., Schwartz, J.H., Jessell, T.M., Siegelbaum, S.A. and Hudspeth, A.J. (Eds.) (2013) Principles of Neural Science. 5th Edition, McGraw-Hill.
- [14] Wandell, B.A. (1995) Foundations of Vision. Sinauer.
- [15] Hubel, D.H. and Wiesel, T.N. (1962) Receptive Fields, Binocular Interaction and Functional Architecture in the Cat's Visual Cortex. *The Journal of Physiology*, **160**, 106-154. <https://doi.org/10.1113/jphysiol.1962.sp006837>
- [16] Livingstone, M. and Hubel, D. (1988) Segregation of Form, Color, Movement, and Depth: Anatomy, Physiology, and Perception. *Science*, **240**, 740-749. <https://doi.org/10.1126/science.3283936>
- [17] Goodale, M.A. and Milner, A.D. (1992) Separate Visual Pathways for Perception and Action. *Trends in Neurosciences*, **15**, 20-25. [https://doi.org/10.1016/0166-2236\(92\)90344-8](https://doi.org/10.1016/0166-2236(92)90344-8)
- [18] Ungerleider, L.G. and Mishkin, M. (1982) Two Cortical Visual Systems. In: Ingle, D.J., Goodale, M.A. and Mansfield, R.J.W., Eds., *Analysis of Visual Behavior*, MIT Press, 549-586.
- [19] Chen, S., Jiang, M. and Zhao, Q. (2023) What Do Deep Saliency Models Learn about Visual Attention? In: *Advances in Neural Information Processing Systems*, Vol. 36, Curran Associates, Inc., 9543-9555. https://papers.neurips.cc/paper_files/paper/2023/file/1e680f115a22d60cbc228a0c6dae5936-Paper-Conference.pdf
- [20] Novin, S., Fallah, A., Rashidi, S. and Daliri, M.R. (2023) An Improved Saliency Model of Visual Attention Dependent on Image Content. *Frontiers in Human Neuroscience*, **16**, Article 862588. <https://doi.org/10.3389/fnhum.2022.862588>
- [21] Carrasco, M. (2011) Visual Attention: The Past 25 Years. *Vision Research*, **51**, 1484-1525. <https://doi.org/10.1016/j.visres.2011.04.012>
- [22] Posner, M.I. and Petersen, S.E. (1990) The Attention System of the Human Brain. *Annual Review of Neuroscience*, **13**, 25-42. <https://doi.org/10.1146/annurev.ne.13.030190.000325>
- [23] Boccia, M., Barbetti, S., Piccardi, L., Guariglia, C., Ferlazzo, F., Giannini, A.M., *et al.*

- (2016) Where Does Brain Neural Activation in Aesthetic Responses to Visual Art Occur? Meta-Analytic Evidence from Neuroimaging Studies. *Neuroscience & Biobehavioral Reviews*, **60**, 65-71. <https://doi.org/10.1016/j.neubiorev.2015.09.009>
- [24] Vartanian, O. and Skov, M. (2014) Neural Correlates of Viewing Paintings: Evidence from a Quantitative Meta-Analysis of Functional Magnetic Resonance Imaging Data. *Brain and Cognition*, **87**, 52-56. <https://doi.org/10.1016/j.bandc.2014.03.004>
- [25] Bazley, W.J., Cronqvist, H. and Mormann, M.M. (2021) Visual Finance: The Pervasive Effects of Red on Investor Behavior. *Management Science*, **67**, 5616-5641. <https://doi.org/10.1287/mnsc.2020.3747>
- [26] Kim, M.J., Mattek, A.M., Bennett, R.H., Solomon, K.M., Shin, J. and Whalen, P.J. (2017) Human Amygdala Tracks a Feature-Based Valence Signal Embedded within the Facial Expression of Surprise. *The Journal of Neuroscience*, **37**, 9510-9518. <https://doi.org/10.1523/jneurosci.1375-17.2017>
- [27] James, W. (1884) II.—What Is an Emotion? *Mind*, **9**, 188-205. <https://doi.org/10.1093/mind/os-ix.34.188>
- [28] Damasio, A.R. (1996) The Somatic Marker Hypothesis and the Possible Functions of the Prefrontal Cortex. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, **351**, 1413-1420. <https://doi.org/10.1098/rstb.1996.0125>
- [29] Slaby, R.J., Arioli, M., Tettamanti, M. and Cattaneo, Z. (2025) Neural Correlates of Negative Aesthetic Evaluations in Visual Art: A Neuroimaging Meta-Analysis. *Cerebral Cortex*, **35**, bhaf156. <https://doi.org/10.1093/cercor/bhaf156>
- [30] Boduroglu, A., Shah, P. and Nisbett, R.E. (2009) Cultural Differences in Allocation of Attention in Visual Information Processing. *Journal of Cross-Cultural Psychology*, **40**, 349-360. <https://doi.org/10.1177/0022022108331005>
- [31] Chua, H.F., Boland, J.E. and Nisbett, R.E. (2005) Cultural Variation in Eye Movements during Scene Perception. *Proceedings of the National Academy of Sciences*, **102**, 12629-12633. <https://doi.org/10.1073/pnas.0506162102>
- [32] Masuda, T. and Nisbett, R.E. (2001) Attending Holistically versus Analytically: Comparing the Context Sensitivity of Japanese and Americans. *Journal of Personality and Social Psychology*, **81**, 922-934. <https://doi.org/10.1037/0022-3514.81.5.922>
- [33] Nisbett, R.E. and Miyamoto, Y. (2005) The Influence of Culture: Holistic versus Analytic Perception. *Trends in Cognitive Sciences*, **9**, 467-473. <https://doi.org/10.1016/j.tics.2005.08.004>
- [34] Masuda, T. and Nisbett, R.E. (2006) Culture and Change Blindness. *Cognitive Science*, **30**, 381-399. https://doi.org/10.1207/s15516709cog0000_63
- [35] Goto, S.G., Ando, Y., Huang, C., Yee, A. and Lewis, R.S. (2010) Cultural Differences in the Visual Processing of Meaning: Detecting Incongruities between Background and Foreground Objects Using the N400. *Social Cognitive and Affective Neuroscience*, **5**, 242-253. <https://doi.org/10.1093/scan/nsp038>
- [36] Silvia, P.J. (2005) Emotional Responses to Art: From Collation and Arousal to Cognition and Emotion. *Review of General Psychology*, **9**, 342-357. <https://doi.org/10.1037/1089-2680.9.4.342>
- [37] Paulhus, D.L. and Vazire, S. (2007) The Self-Report Method. In: Robins, R.W., Fraley, R.C. and Krueger, R.F., Eds., *Handbook of Research Methods in Personality Psychology*, Guilford Press, 224-239.
- [38] Rosenberg, R. and Groner, R. (2022) Eye Tracking and Visual Arts. Introduction to the Special Thematic Issue. *Journal of Eye Movement Research*, **13**, Article No. 1. <https://doi.org/10.16910/jemr.13.2.1>

- [39] Sharvashidze, N. and Schütz, A.C. (2020) Task-Dependent Eye-Movement Patterns in Viewing Art. *Journal of Eye Movement Research*, **13**, Article No. 12. <https://doi.org/10.16910/jemr.13.2.12>
- [40] Wieser, M.J. and Brosch, T. (2012) Faces in Context: A Review and Systematization of Contextual Influences on Affective Face Processing. *Frontiers in Psychology*, **3**, Article No. 471. <https://doi.org/10.3389/fpsyg.2012.00471>