The Shifting Boundaries of Art, Ruins and NeuroArtifacts (draft)

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Premise

Art implicates an act of art, because it needs a high level of consciousness and symbolic thinking. In prehistoric archaeology there is a long-standing debate about the first art object: for example, are the Blombos cave bone tools (70,000 years old) the oldest ones? The presence of eagle talons, probably as necklace pendants, in Neanderthal's tombs, introduces a new view over their capacity of symbolic thinking. If there is a ritual action, it is symbolic, if it is symbolic, it is art. In this case symbolic thinking and self-consciousness (artifact as project) embody the artifact as pre-existing planned project. Art has the unique capacity to communicate ideas, emotions, and experiences through symbols—whether through visual representation, metaphor, or abstract forms. Symbolic thinking allows artists to express concepts that go beyond literal representation, providing layers of meaning that can be interpreted in multiple ways. This symbolism can take many forms, from the use of color to convey emotion, to the depiction of mythological or religious scenes that resonate with deeper societal values. All these processes should take in account the role played by affordances in the interchange between artwork, use and consumption. Affordances refer to the potential actions or interpretations that an artwork makes possible. This concept, borrowed from ecological psychology, suggests that art provides various affordances that depend on both the artist's intent and the viewer's interaction with the work. The materials used in an artwork, for example, afford certain kinds of expression—whether it's the malleability of clay, the permanence of bronze, or the fluidity of paint. The medium itself can afford different forms of engagement and expression, influencing the outcome of the work. Similarly, for the viewer, an artwork offers affordances based on its form, style, and content. A painting might afford a reflective, introspective experience, while a sculpture might invite physical interaction or movement around it. Affordances highlight the interactive nature of art, where meaning is co-constructed through both the artist's creation and the audience's interpretation.

Art, in its essence, is more than just a product; it is a process and a dynamic interaction between the artist, the medium, and the audience. By exploring the key concepts of transition, self-consciousness, symbolic thinking, and affordances, we gain a richer understanding of art's multi-faceted nature. These concepts demonstrate that art is not just an object of beauty or expression but a complex interplay of thought, symbol, and action that reflects both the individual and collective human experience.

Through this lens, art continues to be an evolving, transitional force that shapes and is shaped by its cultural and historical context, offering new possibilities for meaning and interaction with every act of creation.

In the neuroaesthetic framework, art is more than just a visual object—it is a dynamic experience involving intricate neurological processes that govern perception, emotion, empathy, and cognition. The brain interprets and responds to art through various neural pathways that process visual information, evoke emotional responses, and engage with cognitive reflection. Art's beauty and meaning are not just subjective experiences but are deeply rooted in our neurological wiring, shaped by evolution and culture. The term "art object" is defined in a complex and multifaceted manner within the field of material culture. An art object is any artifact that elicits an aesthetic response in the observer, whether it be a functional object, paint, or sculpture. This response activates brain regions that are involved in reward processing, such as the orbitofrontal cortex and nucleus accumbens, as well as those that are involved in affective processing and self-referential thought. Nevertheless, historical and cultural factors have an impact on the definition of an

art object. In certain cultural contexts, artifacts may serve as tools, while in others, their principal function may be symbolic or decorative. The cultural milieu in which an artifact is produced and utilized may influence the extent to which individuals regard and appreciate it as an artistic work.

The subjective evaluation of an art object's aesthetic attributes, such as beauty, originality, or technical proficiency, may be a factor in its cognitive characterization. The evaluation is contingent upon the observer's prior knowledge and experiences, as well as their personal preferences and biases. Potential cognitive processes that contribute to the evaluation of an artwork include the assessment of technical quality, the interpretation of its symbolic or metaphorical significance, and the comparison of the object to prior experiences or expectations.

During my stay at the Academy, I will be focused mainly on the study of cognitive perception of ancient ruins and archaeological artifacts.

Ruinscapes and NeuroArtifacts

Nolli, Piranesi, Canina, and other artists of the 18th and 19th centuries were fascinated by the representation of ruins as symbolic images of ancient cities, for example Rome and its landscape. The romantic view of these ancient scenarios populated books prints and maps of the period. The transformative process as cities crumble to ruinsand become "lost cities" creates new hybrid ontologies; the ruins, which stimulate different imaginative worlds, embody transformed spaces. *"These speaking ruins have filled my spirit with images that accurate drawings…could never have succeeded in conveying,"* Piranesi wrote in 1743. This quotation synthetizes the feeling and perceptive impact of ruins and their iconic power that inspired generations of artists, travelers, archaeologists and philosophers. A good example is the Grand Tour, the 18th to early 19th-century custom of a traditional trip through Europe, with Italy as a key destination. The tour was also a way to discover or re-discover ancient ruins and "exotic" artifacts to buy and save in private collections.

The idea of a "ruin cult" centers on the assumption that a multisensorial interaction with ruins creates an aesthetic experience. This happens in the contemplation of ruins as iconic vestiges of the past and recognition of their enduring symbolic value. Based on the continued popularity of sites such as Pompeii, Rome, and the Acropolis, it appears that this aesthetic experience continues as an active phenomenon today, when we have the capacity to represent and experience ruins not only in print but also in a variety of new media, including virtual reality.

This study focuses on the analysis of the cognitive impact in the observation and contemplation of ruins and artifacts by combining methods of empirical observation, AI and digital processing. The main goal is to connect cognitive activities in the processing of visual content to identify how previous knowledge and skills can amplify the perception of the visual stimulus. This kind of research is important for the humanities, for science, and for the study of aesthetics because it investigates the complexity of the human experience in a domain ("lost cities") that has never been studied before with a synthesis of these disparate perspectives.

The main case study of ancient ruins is the Etruscan and Roman city of Vulci. Its archaeological landscape, monumental tombs, temples, sanctuaries, and buildings of different periods have been represented by maps, drawings, digital models, 3D reconstructions and prints from the 19th century to the present. Moreover, the archaeological site has been investigated by Duke University (PI Maurizio Forte) since 2016 and new "ruins" and archaeological intact layers are digitally documented by maps and 3D

photogrammetry. In this case it is possible to setup eye-tracking experiments in virtual reality (VR immersive headsets) and by mobile eye tracking that is powered by a novel end-to-end gaze estimation pipeline. All the results of neuroscientific tests (based on the above-mentioned digital products) are used for analyzing different visual simulations and related digital design.
Finally, algorithms of artificial intelligence are used for the visual and textual description of archaeological ruins and artifacts in order to test final renderings and simulations.

Artifacts and ruins

What does it mean to look at a ruin or an ancient artifact? The answers suggested by aesthetics and cognitive science have diverged. For many years aesthetics and cognitive science shared a similar attitude towards vision when accounting for the perceptual representation of the world and the ensuing aesthetic experience. Both approaches endorsed a sort of 'visual imperialism', conceiving vision as the mere outcome of the so-called 'visual brain', while neglecting the multimodal nature of vision. Observing the world is more complex than the mere activation of the visual brain. Vision is multimodal: it encompasses the activation of motor, somatosensory, and emotion-related brain networks. Hence, vision and visualization are always active constructs of multiple sensory, motor and associational networks in the brain.
Ruins are microcosms that reflect the structure of societies over time. The many layers of the past are part of our experience either as residents relying on our city's historical/cultural identity or as tourists wanting to have a glimpse of other cultures and ways of life. Archaeologists, architects, urbanists and historians are faced with the enormous task of understanding ruins in all their aspects in time and space, including its diachronic character. Contributing to the complexity of our research topic is the transformative nature of ruinscapes and artifacts as a living organisms interconnected with the environment (humans, animals and vegetation) and intangible factors such as social, cultural and political dynamics.
This knowledge is created by our spatial embodiment. In fact, the perception of space is a biocultural domain since the human mind is genetically designed by motor skills for exploring the environment (its size, scale, and dimensions) with the inherent cognitive capacity to generate spatial maps for the acquisition and storage of newly situated knowledge, while the definition/description of space also depends on cultural and chronological contexts. Therefore, ruins and artifacts are experienceable as mediated realities in relation with present, past and future. This embodied experience forms at the intersection of empirical observation, multisensory narrative, episodic-social memories, and multivocal imagination.

Nevertheless, expert archeologists, anthropologists, curators, and historians, as well as novices and the public at-large may still generate aesthetic experiences through the means of spatial embodiment when visiting ruins or the cultural artifacts excavated and curated from such sites. But how does this work on us today? How does this aesthetic experience operate cognitively and emotionally? Are there distinct neurocognitive signatures of spatial embodiment that situate the aesthetic experience of ruinscapes and artifacts?
The visual inspection of a limited area, such as an altar, a temple, or a simple wall, also entails the activation of a performative level of experience of the same images, which is enabled by the embodied simulation such images are capable of triggering in the brains and bodies of beholders. The 3D objects we look at are classified by the motor brain as potential targets of the interactions we might entertain with them. Premotor and parietal 'canonical neurons' control the grasping and manipulation of objects and also respond to their mere observation. Now we understand that our body's motor capabilities cognitively manifest the space

around us. Embodied simulationis also triggered during the experience of spatiality around our body and during the contemplation of objects such as architectural elements at any stage of conservation.
The functional architecture of embodied simulation seems to constitute a basic characteristic of our brain, making possible our rich and diversified experiences of space, objects and other individuals, being at the basis of our capacity to empathize with them. Empathy, recently explored by cognitive neuroscience, can reframe the problem of how art works, ruins and architectural spaces are experienced, revitalizing and empirically validating old intuitions on the relationship between body, empathy and aesthetic experience.

This allows a direct apprehension of the relational quality linking space, objects and others' actions to our body. Thus, the analysis of archeological records, particularly when acquired in 3D and enabling a true immersive interaction, naturally lends itself to a 'performative' study of the acquired evidence, enabled by the possibility to empirically document the relationship between a given object, be it a wall, a depiction, a room and the body activity, practices, and habits it evokes by means of the embodied simulation triggered by its visualization or haptic exploration. Ruins of cities, for example, evoke perception and imagination of city-plans, people, streets, human and non-human activities, empty spaces, built and natural landscapes; in short, we are embodied in this space. This embodiment is constituted by performing activities, intimately related to the ruins as "performing" space.

A NeuroArtifact study: the Sarcophagus of the Spouses

The case study concerns an iconic and important masterpiece of Etruscan funerary art (about 530-510 BCE): the Sarcophagus of the Spouses, currently on display at the National Etruscan Museum of Villa Giulia in Rome. The artifact is displayed in a separate section of the museum to give the visitors enough space for a full visual experience from any spatial perspective.

The artifact is reconstructed from approximately 400 fragments, and it was an urn designed to contain the physical remains of the deceased. It depicts a couple in the traditional banquet position, with their busts raised in front of them while reclining on a bed (*kline*). The man envelops the woman's shoulders with his right arm, bringing their faces in proximity while they maintain their characteristic "archaic smile." The configuration of the woman's fingers and hands implies the potential existence of now-lost objects, such as a miniature vase utilized to pour precious perfume or a cup for sipping wine. This iconography is recurring in Etruscan funerary art, and it recalls a traditional banquet where the couple showed their symbolic aristocratic power that should be perpetuated in life and death. Because of that, the scene symbolizes the transitional period in between life and after-life that creates a very specific visual consumption of the artifact (fig.1).

Fig.1 The sarcophagus of the Spouses at the National Etruscan Museum of Villa Giulia in Rome

It is particularly important to emphasize that the comprehension of the sarcophagus depends mainly on its affordances that describe multiple relationships with its original context and its ritual boundaries.

I use the concept of “affordance” as developed by the psychologist James J. Gibson[i] as actionable possibilities that an object or environment offers to an organism, specifically those that are directly perceived. According to Gibson, affordances are properties of the environment that are objectively measurable but are also relative to the abilities of the individual. For example, a glass might suggest the action of drinking or a digital mouse a computer interaction.

Gibson's concept of affordance emphasizes direct perception — meaning that humans perceive affordances without the need for complex cognitive processing. The interpretation of an artifact “by affordances” is implicitly connected to its performing power or embodied action. Whereas affordances address "what is about," taxonomy addresses "what is it." This is a significant distinction because it emphasizes interpretation over the embodied contact between an object and its viewer/user and may reveal the thought process that went into creating a particular piece of art.

The main issue with a traditional museum’s display is the descriptive-taxonomic approach: a long list of details and features that don’t show the power of the artifact in its original context or symbolic value.

The discovery of mirror neurons, in the early 1990s observed that specific neurons in a monkey's brain activated both when the monkey performed an action and when it watched another monkey or human perform the same action. This discovery suggested that these neurons play a crucial role in understanding others' actions, empathy, and learning through imitation. This recalls the role of affordances as well. The observation of an object’s affordance might activate neurons correlated with a specific object’ affordance or with multiple affordances according to the use and the context. For example, a toy can be used differently in relation to specific narratives or different games. In short, space, time and context can determine the

result of the affordance and the meaning of an object. In these terms we can see the performing power of an artifact as “transitional” object: from the creation to the consumption.

The museum's isolation of the sarcophagus can enable a more precise analysis of its features from various perspectives and prolonged visual observation. However, is this sufficient for a correct interpretation? What are we overlooking in this unguided process?

As mentioned, the sarcophagus is a performing object showing the aristocratic power of a couple in a transitional space, in between life and death. Second, the social context, the banquet/fest, makes these human actors the core of a hypothetical scene where we should imagine music, sounds, food, beverages, dances and much more, as documented in several Etruscan painted tombs. The functionality of the sarcophagus as “urn” is hidden by the symbolic iconography that embodies the couple in a spatial projection of gestures and actions. The attitude of the statues to observe and being observed interacts with an imaginary audience standing in front of them. The quality and complexity of this artwork required visual interaction with the public at the time of the funeral but also during periodic visits to the tomb. In this way there the artifact becomes subject and object of observation: the “spouses” watch a scene, and they are watched as well. In fact, the gazes of the male and female figures are different, and they interact differently with the surrounding space. The calculation of the eyes’ gaze of the male and female figures 3D gaze directions for each eye, considering a slight forward direction on the Z-axis, is the following (fig.2):

Female figure:

Left eye: Approximately [0.828,−0.552,0.100][0.828, -0.552, 0.100][0.828,−0.552,0.100], indicating a gaze direction slightly to the right, downwards, and slightly forward.

Fig.2 Gaze direction of the male (pink) figure and female (blue) by Open AI via Python coding

Right eye: Approximately [0.976,−0.195,0.100][0.976, -0.195, 0.100][0.976,−0.195,0.100], indicating a gaze more to the right, slightly downwards, and slightly forward.

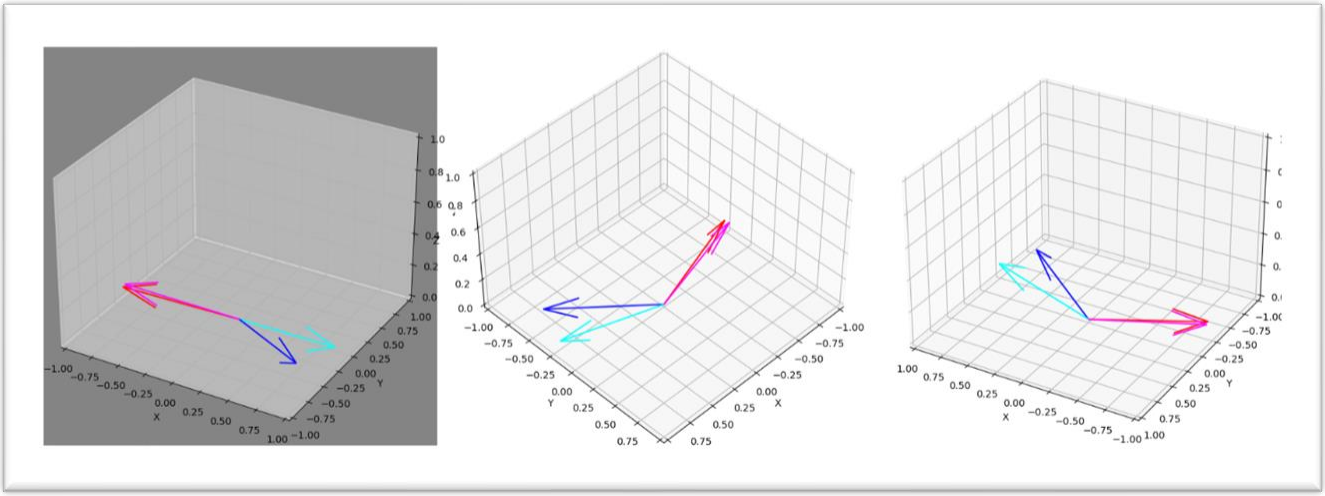
Male figure:

Left eye: Approximately [−0.965,−0.241,0.100][-0.965, -0.241, 0.100][−0.965,−0.241,0.100], indicating a gaze direction slightly to the left, downwards, and slightly forward.

Right eye: Approximately [−0.976,−0.195,0.100][-0.976, -0.195, 0.100][−0.976,−0.195,0.100], indicating a gaze more to the left, slightly downwards, and slightly forward.

The male figure's gaze is slightly upwards and to the left, suggesting some type of engagement. It may imply a dynamic interaction with his surroundings or a person nearby. The female figure's gaze is slightly upwards and to the right, which could suggest attentiveness, curiosity, or contemplation.

These vectors provide an approximation of the gaze directions in three dimensions based on the estimated pupil positions and a forward tilt in the Z-axis. The different gaze directions create visual balance and harmony in the composition, guiding the viewer’s eyes across the sculpture. This makes the artwork aesthetically pleasing and reinforces the interaction between the figures. By presenting figures with varied



gazes and expressions, the artist adds depth to the narrative, allowing multiple interpretations and engaging the viewer's imagination.

The ritual boundaries designed the performing space surrounding the sarcophagus, where we can identify the main visual region of interest and the space for its affordances. Fig.3 simulates the hypothetical boundaries around the sarcophagus (oval in the central part) where different colors differentiate the main visual entanglement based on the intensity of the visual interaction. This suggests that viewers' gaze is most concentrated on the sarcophagus itself, with attention gradually diminishing as it moves away from the central object.

The glowing aura consists of concentric ellipses with gradually shifting colors that pulse over time, symbolizing the spiritual energy surrounding the sarcophagus. Patterned boundaries are formed by ellipses rotated at various angles and in different colors, slowly rotating and changing opacity to represent the ritual boundaries and the passage of time. The dots, distributed both within and outside the ovals, likely represent individual fixation points or areas where viewers' eyes paused. The concentration of dots is higher near the center, aligning with the idea that the sarcophagus itself attracts the most attention.

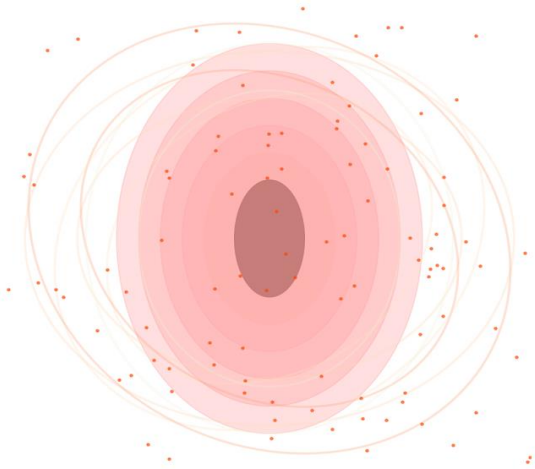


Fig.3 The “aura” of the sarcophagus (ritual space) with different levels of visual attention. The dots represent individual fixation points or areas where viewers' eyes paused

Below a list of the main sarcophagus’ affordances (fig.4):

- The act of hugging. This shows the feelings and proximity of the couple. It also unifies the two bodies into one single entity.
- Facial expressions. The two faces (male and female) characterize sex and eye gazes of the main actor of this scene. They apparently look for eye-contact.
- Eyes. Man and woman’s eyes look at different directions with the intent to engage a visual connection with different audiences as discussed above.
- The empty hands. The hands are empty, but they were originally holding cups or other ritual objects. This gesture projects the harms into an imaginary space.
- The two bodies merge in a single shape which affects the perception of the scene where the observers are forced to imagine one single body.
- Feet are different: bare feet for the man, shoes for the woman
- Clothing.

Next step of the affordances’ analysis was to try a graphic Python simulation through Open AI-ChatGBT4o starting from the original image of the sarcophagus. The results are shown in Fig.4

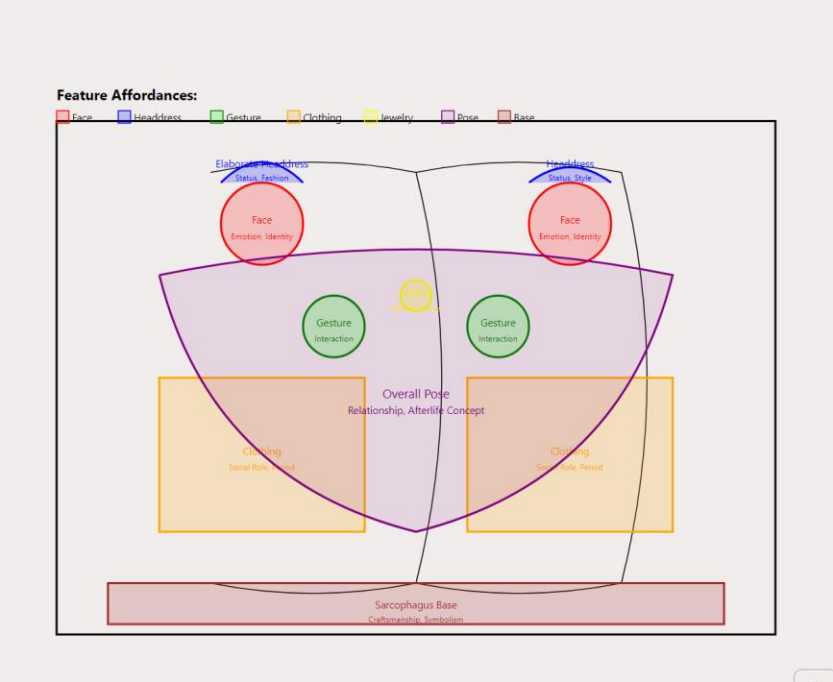


Fig.4 Graphic reconstruction of the features affordances (Open AI-ChatGBTo Python-Colab)

The chart emphasizes both individual features (faces, headdresses) and shared elements (pose, jewelry), reflecting the dual nature of the sarcophagus as representing both individuals and a pair.

Hierarchy of Detail: The size and placement of affordance areas suggest a hierarchy of importance, with faces and overall pose being primary focus points.

Gender Distinctions: Differences in headdresses and potentially clothing highlight gender-specific aspects of Etruscan culture.

Symbolic and Practical Elements: The chart balances elements with symbolic significance (gestures, pose) and those with more practical cultural information (clothing, jewelry).

Craftsmanship Focus: Attention to details like jewelry and the sarcophagus base emphasizes the importance of Etruscan artisanship in understanding the artifact.

Holistic Cultural View: When considered together, these features provide a comprehensive view of Etruscan elite culture, beliefs about death, artistic conventions, and social structure

The different affordances of the sarcophagus represent various aspects of cultural, social, and symbolic significance. The sarcophagus defies straightforward classification, and upon closer inspection, one feels observed. As an essential element of the initial communicative principle, the gaze of the statues intersects with the symbolic-funeral function of the artistic endeavor. Sarcophagus is a "medium" whose malleability with respect to semantics must be investigated.

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Glossary

- ✓ Neuroaesthetics
  The interdisciplinary field that investigates how brain processes influence the perception and appreciation of beauty, art, and design.

- ✓ Visual Cortex
  The part of the brain responsible for processing visual information, essential in interpreting and responding to visual art.

- ✓ Amygdala
  A brain structure involved in emotional processing. It plays a role in the emotional response to art, influencing how we feel about certain aesthetic experiences.

- ✓ Prefrontal Cortex
  The area of the brain involved in complex cognitive processes like decision-making and symbolic interpretation. It's key for understanding and interpreting abstract or complex artworks.

- ✓ Mirror Neurons
  Neurons that fire both when an individual performs an action and when they observe the same action performed by others. These are thought to play a role in how we relate to and empathize with art, particularly performance or figurative art.

- ✓ Theta Waves
  Brain waves associated with deep thinking, creativity, and symbolic interpretation. They are often involved in activities like ritual creation or contemplation of art.

- ✓ EEG (Electroencephalogram)
  A method used to record electrical activity in the brain, often used in neuroaesthetic studies to measure brain responses to different forms of art.

- ✓ Limbic System
  A complex system of structures involved in emotions and memory. It's critical for emotional responses to aesthetic experiences.

- ✓ Symmetry
  A key concept in aesthetics and neuroaesthetics, symmetry often appeals to the brain's desire for balance and order, activating neural circuits associated with pleasure and satisfaction.

- ✓ VTS, Visual Thinking Strategies
  A teaching method that encourages individuals to engage with visual art by observing, describing, and discussing what they see, promoting critical thinking and collaborative interpretation. It relies on open-ended questions and group dialogue to help participants construct meaning from visual stimuli, improving observational skills and fostering deeper understanding.