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The Thinking Eye: From Semir Zeki to John Onians

Denitza Nedkova

Abstract • In 1994 Semir Zeki's neuro-aesthetics formalizes the interdisciplinary approach to aesthetic facts, linking scientifically the brain to creativity. Consequently, the history of art becomes a neuroarthistory of the human mind, defined as such in 2005 by the historian John Onians. Finding a universal code, based on the nervous system and able to decipher each visual preference and every stylistic shift is the aim of this new analytic attitude. The identification of both the contextual element on which the gaze is intensively and frequently set, bringing to perceptual choices' neural changes, and the particular mind plasticity modulation, as the genetic basis of any local *forma mentis*, clarifies how the brain conditions form the artistic manner. For this type of exam, the historian needs to observe in the creator's and consumer's brain the workings of the major cortical resources, such as neural plasticity, the rewarding system, the sectoring of the visual system, the intrinsic functional connectivity and mirror neurons. The discovery of this variability of "brain behavior" is the basis of the style shifts and the first step towards the neurohistory of art. Therefore, the named neuro-historical art analysis develops a narration of the somatosensory perceptions of the world, expressed through the language of forms. The latter infers, with the certainty of scientific data, the historical awareness and the aesthetic interpretation, opening up a new dimension of art criticism.

Keywords • Neuroarthistory; Artifact Analysis; Visual Experience; Neural Plasticity; Context

Ledizioni

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1. From the Engrams to the Neurography

At the beginning there was Aby Warburg and his term *pathosformel*. This concept of permanent archetypal images constantly returning throughout art history, from the Upper Paleolithic on, launches at the beginning of the twentieth century scientific researches on creativity through the rigorous psychology of perception. While Rudolf Arnheim captured the idea of the selective eye intelligence, Ernst H. Gombrich explicitly correlates aesthetic manners and genetics, aided by Michael Baxandall and his theory of the Period Eye (Baxandall 29). According to this thesis, each individual's mind differently processes visual information by activating innate neural connections and those built and molded by the socio-cultural context, resulting in unique aesthetic preferences defined by personal space-time experience. In this genuine trend that from Warburg leads to Gombrich stands out the prestigious scholar, John Onians, a professor emeritus at the University of East Anglia, Norwich. His neurological reconsideration of the entire history of art leads to the concept of *neurography*, i.e. the unconscious neural gesture of handwriting (Onians 36), proposing an analysis of the artistic fact both with historical and scientific instruments.

Specifically, Onians bases his research on neuroaesthetics, namely the grafting of art and brain established in 1994 by the neurobiologist Semir Zeki. The milestones of the bridge connecting minds and creativity consist of a series of brain functions hereby illustrated in general and defined by the latest scientific research as basics in the process of perception, cognition and creation of art (Ishizu 777). Let's take, for example, the truism "If you do not use your brain, you lose it." Its veracity is easily established in relation to one of the main characteristics of the human nervous system, neural plasticity.

It consists of the lifetime brain ability to change according to personal experience and biological evolution, which strengthens or weakens innate and neo-built neuronal resources, depending on their intensity and use frequency (Tonghui Xu *et al.* 915).

However, the constant neurogenesis of the human brain is already traced by the scientific research of the '60s, laying the basis of the definition of the creative mind not as a static fact but as an adaptive and changeable mechanism. Nowadays, the visualization of this cerebral activity is possible thanks to neuroimaging technologies, as demonstrated by the experiment conducted by Onians in collaboration with neuroscientists (Solso 31). This study aims to observe the cortical behavior of an artist and a non-artist performing a graphic task, precisely drawing a human face. The specific results of the experiment reveal that the artist takes less time, less brain concentration, and less physical fatigue than the non-artist. Evidently, while the visual cortex of the latter is "striving" to find background knowledge on which to base the drawing, the one of the artist can immediately process the perceived information passing it to brain areas previously involved in similar tasks and molded by the ability to run them.

These outcomes fall within the Baxandallian conception of the Period Eye and extend it to a cognitive conscious and unconscious phenomenon. While the artist chooses to develop his motor skills to draw, the plasticity of his brain allows the preservation and the modeling of this faculty, depending on the artist's experiential path. However, due to its

important contextual assessment, this approach raises distinct doubts (see Rampley) in the artistic historiography about a Materialistic Reductionism of Onians's thesis. Perplexities of this kind are faced with a specific accent on brain phenomena more consistent with the new method of neuro-historical art analysis.

The first element of this operation is the scientific confirmation that neural plasticity depends not only on the intensity and frequency of the actions and of external exposure, but also on conscious and unconscious attention placed there, which determines the understanding and acquisition or not of certain knowledge or abilities (Woolett and Maguire 2109).

As the original function of the brain is to ensure the individual's survival, it rewards him when he's able to act and consolidate his abilities in a natural neural act. The conscious and unconscious attention placed there. Its neural support is the Positive Network Tasks (TPNs) feeling of gratification in knowledge acquisition—highlighted as the second element of strength of Onians's thesis—, which is due to the to the functioning of another cortical circuit, the rewarding system (Chatterjee 71). Moreover, this feeling of wellness due to the dopamine neurotransmitter release is superior in contact with artworks (Shimamura, *Experiencing Art*). That's why their creator and consumer share the mechanism, conscious or not, of revoking in the aesthetic act forms embedded in the mind (engrams) through strong neural connections as to provoke the gratification of successful memory match. More clearly, the image that activates a mnemonic brain correspondence gives rise to a satisfying sensation caused by the success of the image recognition and the comprehension of the task. Thus, figurative art that proves easier to decipher is considered more beautiful by the majority of people than the abstract one. How the latter, however, recalls aesthetic gratification is the topic of the following pages.

2. Neural Instruments for a Historical Analysis

The third argument of the neuro-historical theme which contrasts the considerations of the contextual factors exclusivity is the central role of the Default Mode Network (DMN) in the processing of artistic data. This innate synaptic pathway, active during man's inactivity (relax), is complementary to TPN, redirecting the attention from non-attractive or incomprehensible external stimuli to the reflective activity of the episodic and autobiographical memory.

In fact, these states of mind wandering are called *creative solutions incubators*, as they refer to a predetermined brain mode which treats everything in the world as it does with the human being (Qin *et al.* 693). Therefore, the DMN is not only based on the ancient understandings of the world, such as anthropomorphism (Schilbach *et al.* 457), but also on the general tendency to approach both natural and artificial phenomena as if they shared certain properties with man. In this process of attribution emerges the important role of the fourth element of neuro-artistic argument, the visual system, namely the main sensorial channel in the construction and change of the neural connections involved in the understanding of the world. The clarity of its functioning emerges in 1991, when the already mentioned Semir Zeki operates a five area sectorisation of the visual cortex, one striated (V1) and four extra striated (from V2 to V5) to which recently the Italian neurological research (Galletti *et al.* 7962) added a sixth one, i.e. V6. Each visual sector elaborates a specific part of the visual information (color, movement, orientation, shape, depth), processed hierarchically but in parallel by the system. In fact, the input and output streams trigger not only the area pertinent to its sensory arousal, but also a wide range of brain circuits constantly interchanging and influencing each other.

How does this activation happen? The information transmitted by the eye is distributed in the neural system through two main paths: the *what* way that codifies information about the stimulus characteristics (form, color, material) and the object identity (Konen and Kastner 224), and the *where* way of the objects' location in space and their related actions (motion, depth, topography). The first one is near to the auditory areas in the temporal lobes and simplifies the integration of the information perceived by the ear and the eye and vice versa, while the second one facilitates the interplay with the somatosensory and motor areas in the parietal lobes.

Therefore, this complex highway is shaped from birth in distinct areas appointed to the visual recognition of objects, the representation of their characteristics and the unconscious sensory memory recall for the successful identification of such objects (Hasson *et al.* 304). The segmentation of visual data processing is, in this regard, a further confirmation that not all cognitive categories are socially formed, but some are biologically constituted. These ones, in an unconscious match process, drive the "warehouses" of sensory memories, the same used from the artist to draw the face in Onians's experiment.

Although the mnemonic stores are preexisting and genetically inherited, they are expanded and updated by further specialization of the two data transmission channels, determined by the conscious and unconscious relationship with the external context. This is the reason why the intense and long-lasting sensory exposure to certain contextual phenomena enhances the neural pathways that translate them, while long-inactive brain pathways tend to atrophy. The strengthened paths provide the mnemonic stores with a wide range of long-term mnestic trails, whose building and recall establish not only the learning but the individual preferences of any kind. At this point it's necessary to clarify the construction and recall mechanism initiated by a certain type of nerve cell, present in many areas of the brain, which Giacomo Rizzolatti's neurological research group defined in 1995 as *mirror neurons*. Thus, the fifth element in support of the neuro-artistic postulate is the activation of the mirror system both in carrying out and observing an action. It determines the unconscious learning by observation and imitation, namely the increase of the mnemonic "warehouse" and the operational capabilities. The mirroring corpus, moreover, not only copies and learns automatically the surrounding world, but permits to empathize with it (Freedberg and Gallese 411), that is to attribute mental states to oneself and others and to model, on this base, the own and other behavior.

Thanks to this cerebral property, here also merge spontaneous behaviors, strongly conditioned by internal and external factors, which influence aesthetic choices. For example (Kemp *et al.* 8), the mere words of other people are able to determine aesthetic preference, being a sensory (auditory) and conceptual input (linked to a cognitive code). This is due to the perception alteration obtained by reflecting and acquiring an external stimulus considered interesting. Clearly, the opinion of an art critic, considered valuable by the observer, can change the aesthetic preference of the latter towards a given artifact.

In the words of Peter Brook (see Rizzolatti and Sinigaglia), this richness of elements coherent with the neuro-artistic-historical method puts in a "cerebral stage" emotions and actions (*theatron* means just this: the place of the gaze), through the mirror system, which makes obvious the neural roots of the imagination. In fact, thanks to this resonance mechanism, one can imagine others' intentions, expectations and motivations without recurring to any kind of reasoning but basing solely on his own motor skills. This imaginary capacity, the sixth head of the neuro-artistic argument, closes the complex but rapid path of the cognitive highway, directly activating the visual cortex and the other areas associated with it and connected to the engrams' creation and re-enactment (Bartolomeo 107).

Finally, this scientific data excursus constructs the strong argumentation that the artistic creation and fruition are modeled, consciously and unconsciously, both by external sensory stimuli and by internal conceptual stimuli. The art history is woven by this flexible mechanism, which determines periods of purely material aesthetics (Clarke *et al.* 187), based on the predominant influence of the phenomenal world, intertwined by those of greater ideal artistry, built on images without any real referent, e.g. the concepts of Paradise and Hell (Onians 54, 137). The predominance of one art preference rather than another depends, as noted by John Onians, on where, when and how the consumer and the creator of art live. Therefore, Abstract art belongs both to the 20th century and to the Mesolithic as the Baroque to the 18th century and to these days (phenomena such as kitsch and Surrealism Pop are considered).

In order to understand what neural resources guide the artist's hand and the performer's eye in certain historical periods, we need to investigate the contextual constants and the sensory and emotional peaks that affect the perception, that is, the plasticity and the mirroring of the brain. Therefore, the definition of art as a social phenomenon or as a biological phenomenon is transformed by the new hybrid approach, which is applied here in some well-known cases of stylistic shifting.

3. Blurred Vision Creativity?

The current examination concerns European art as the best known and accessible to the majority of users. Names like Leonardo, Rubens, Raffaello are universally known and often resemble others less known, such as Bruegel or Giulio Romano, whose changeable and non-orthodox creative conduct allows to stress the encounter and contrast points with predominant style and to analyze the neuro-art historical causes of this phenomenon.

The art work of the Roman painter Giulio Pippi de' Jannuzzi, Giulio Romano, contains spectacular elements useful not only to highlight the detachment from the harmonious and serene art of Sanzio, but also to remain imprinted in the viewer's mind for its special effects. Palazzo Te, the Mantuan dwelling of Federico II Gonzaga, built and frescoed by Romano in the second decade of the sixteenth century, is the prime example that reveals a stylistic figure of exasperated alteration of the Raphaelesque models. Each art historian would define this as the Mannerist "crooked rib" emerging from the Italian Renaissance "classic torso" and revealing the intention of certain artists to counteract the official style due to certain political and social changes (from the Savonarola execution, in 1492, to the Sack of Rome, in 1527), strongly influencing the cultural life.

Thus this historical definition of Mannerism highlights one of the many causal gaps in artistic historiography, offering only contextual and experiential elements and omitting the differences of individual style expressions. Hence the neuro-art historian looks elsewhere. Firstly he dives in the dense and constant mists of Mantua and feels, just as Pippi did, with his whole body the air humidity (Onians 231). Then, having examined art works before and after Giulio Romano, he detects an omnipresent component in the art of Gonzaga's capital, namely the clouds. This contextual element, of less historiographical concern, becomes determinative for neurological analysis, as an obstacle to the correct eye perception and therefore decisive for all Mantuan creative behavior (Harley e*t al.* 197).

A clear example of the influence of this environmental factor is the art of Andrea Mantegna, the Gonzaga court painter in 1460. He arrives in the Mantuan looking for a new replay for his visual habits, accustomed to perceiving the white stone and the polished classical forms of the native Padua. And he finds his pareidolia in the clouds (Melcher and Bacci 347).

In the Gonzaga period, in the works of Mantegna, the clouds lose the typical for the artist's "stony" appearance. They become light and vaporous but carved as Roman statues, thanks, on the one hand, to the process of intrinsic functional connectivity that rectifies the incongruous to the personal mnestic model contextual input (fog), and on the other hand to the automatic and unconscious mirroring process that allows the rediscovering of the stony material in the cloud and the activating of the reward system. This same way of associating the characteristics of a certain material (the stone of Padua), processed and stored thanks to its long visual exposure, to another which is visually very similar (clouds) and abundant in the current context returns (Cox *et al.* 116), five centuries later, as the main stylistic aspect of the Metaphysics (Martinez-Conde *et al.* 10).

A very similar process affects the neural connections of Raffaello's student Giulio Romano. The mind of the artist reacted plastically on the new low-visibility environment, reconfiguring Pippi's visual preferences. The artist begins to perceive the fog as a heavy element, which absorbs and deforms the material reality, making it partially perceptible. Looking at Romano's works, from the overwhelming cloudy architecture frescoed in the Giants' Hall at Palazzo Te to the roughness of the architectural surfaces of the same building, there is a "corrosion" of the elements so far away from the smooth, Raphaelesque forms.

However, the humid and foggy climate is not present only in Mantua, and this consideration leads to examine the aesthetic expression in other areas with similar climatic characteristics as to confirm the neuro-artistic method. At the end of 18th century in such a misty and humid environment like the Essex countryside of England, was born one of the most celebrated cloud portrayers, the romantic painter John Constable. His neural connections are "infected" throughout the period of growth by the constant exposure to vaporous formations that, therefore, give him a purely unconscious preference for this type of phenomena and determine his entire creative process culminating in the famous series of cloud studies (Wood D'Arcy 30).

Nevertheless the glowing and unobtrusive atmosphere, seen as a natural phenomenon in Mantua and Essex, is also the main feature of many modern metropolises. The great industrial revolution that invades London in the 1800s offers a dense "steamy" environment not so far away from the Gonzaga's mists. And as far as so many artists of that period involved in technological art, no one like London-based William Turner creates works where smoke and steam determine every element of the depiction. The constant and enduring artist's exposure to the smoky context is the unconscious factor that determines his visual preference, strengthened by Turner's overwhelming interest in New Brittany.

Despite the overlapping of multiple environmental traits, artistic results are, however, noticeably different: the Italian case is stylistically defined *Mannerism*, while the English one is defined *Romanticism*. This evidence explicitly states that the context factor is not enough for the neurological examination and, therefore, not all Londoners are William Turner. John Onians points out that the artist's Period eye undoubtedly influences his stylistic choice, but before the conscious influence of the context, the artist's *forma mentis* arises from the unconscious brain "storing" of specific and personal data configuration, which "mental stage" leads to a hybrid and personal script that differentiates the artist from any other citizen of the same metropolis (Onians 298).

4. The Origin of Art, or About an Artistic Calculus of the World

The validity of a neurological approach to the history of art can be confirmed solely by its global applicability. Therefore, the great brain plasticity of the Renaissance man could

seem to be too easy an example to confirm the new interdisciplinary method. A stimuli saturated social scenario like the sixteenth-century in Italy or the nineteenth-century in England, that interprets a biologically evolved mind can only confirm but not demonstrate the veracity of neurological art analysis. It affirms its real efficiency by comparing the first question of the history of art (Lewis-Williams): Why and how does art arise, seemingly useless for the survival of the human being? The neuro-art historical response proves that the indispensability of the creative act lies precisely in the cognitive and inclusive function of the world, without which self-preservation is not possible.

The current analysis focuses on where history has always sought artistic roots, namely the first expressions of creativity: the cave handwriting of the Chauvet Cave in south-eastern France, dated about 30,000 years ago and characterized by a surprising naturalism and executive mastery (Colttes). This prehistoric context includes an unstable and primitive nomadic society, a human brain that has not yet completed its evolutionary path towards the *sapiens* and a Period eye solicited only by natural phenomena, but produces designs that are easily comparable to the graphic studies of any Art Academy student (Morriss-Key 160). This fact can be paradoxical for art history, but the interdisciplinary approach finds in it the best example of the brain bases of the aesthetic act. Onians performs a diligent neuro-artistic examination of Chauvet's drawings defining them *neurographics* (30). These are the results of unconscious brain activity that, thanks to the brain plasticity, allows the imitation and the learning through the mirroring system and leads to the gratification feeling in recognizing the reality in the artifact. The neurologist Zeki strengthens this position, claiming that these brain mechanisms are not only unconscious, but mostly mathematical. Mathematics, which has always been considered a logical deductive exercise of human reasonably thinking, is revealed by recent neural studies as an unconscious process necessary to understanding the world (Zeki *et al.* 10).

The French rock graffiti analysis clearly illustrates this position: the long and intense observation of a phenomenon important for survival, such as the herds of animals in the Paleolithic, leaves a long-term mnemonic trace that emerges, thanks to neural plasticity, in elements and forms that recall it.

That's why a rocky boulder similar to the bear's back assumes the appearance of the animal when the human hand imitates—through the mirror neuron circuit—the paw that grabs or stains the stony surface creating the first artistic image (Onians 37). This activates, then and now, the rewarding system in A1 area of the orbital frontal cortex and allows the experience of beauty. According to Zeki, the brain mechanisms that permit to feel beauty are the same as in the perception of colors, shapes, and the entire phenomenal world. These are subjective cognitive mechanisms stimulated by both sensory inputs (colors, lines, volumes, etc.) and conceptual ones (symmetry, contrast, etc.) that activate, regardless of the source of the aesthetic pleasure, the same A1 area. This means that the abstract quality of aesthetic experience is not related to the sensorial or conceptual source of beauty itself.

However, red is red for everyone and round is round for everyone, although cognition is always subjective. Despite the perception of every man being privatized and influenced by inherited or constructed neural connections, these always follow a physiological order of mathematical nature (Conway). When the hand of the Paleolithic man scratches the rock like the bear's paw, this pioneer artist already obeys to natural calculations and adjustments assumed by his mind to understand reality. On this mathematical order, humans base their own vital pace, from breathing and walking up to endocrine emission and mnemonic storage. Mathematics, therefore, is not a conscious cultural construction, but an innate biological mechanism. One natural omnipresent structure in particular highlights this postulate.

It's the biological equation called the golden ratio and is expressed in the relationship, theorized by Euclid in 323 BC, between two unequal lengths (Di Dio *et al.* 8). This correlation is measured by a non-regular number (the section never realizes two halves perfectly equal, but follows a displacement of about 0,1 from the half) and subject not to artificial calculations, but to natural phenomena that constantly confirm it in the material elements, from the plant and the drop of water to the human body. The golden ratio is, therefore, recorded by the human brain as a combination of proportions that characterizes pleasant and/or useful things, especially if we consider Onians's thesis that building and strengthening neural connections that determine visual preferences depends on a long and persistent perception of certain phenomenal data of strong appeal (hedonic or practical). This compliance, unlike many other contextual elements, is not subject to decay due to the change of the environmental conditions, as it is omnipresent and not related to a particular context, but rather to a natural schema emerging in infinite scripts.

The realistic bear image designed by the Paleolithic is pleasant both to him and to the contemporary consumer because it is matched to the mathematics of the natural forms. In addition, recent neurological research strengthens the biological mathematics' thesis through the discovery of a neural group (in the occipital lateral cortex), physiologically inherited and present in the brain from birth, appointed exclusively to the golden ratio acknowledgment.

The formation of neural connections, that do not atrophy but are transmitted genetically as necessary for the understanding of the life mechanism, and always present in a strong (Greek art) or weak (abstract art) mode, active firstly the learning and secondly the reproduction of the proportions that make up the feeling of satisfaction, as visual memory presents a "fidelity" for the golden stimulus, ensuring the rewarding system activation. Therefore, the neuro-art hypothesis on the formation and the stabilization of brain connections processing timeless formal combinations that characterize the "good things" (beautiful ones) presents a strong coherence with both historical and neural trends of aesthetic behavior. When the human being acquires semantic coding tools (such as language or geometry) to measure and abstract these combinations, he begins to apply them intentionally in his aesthetic production and defines them as volumes' symmetry or harmony (Binder and Desai 530).

It is assumed therefore that the link between the measures and the eurhythmy follows a golden mechanism that in itself leads to irregularities. Clearly, the slight golden shift from the artificial mathematical medium to anything considered pleasant is "encoded" in the structure of the universe which is never identical to itself. Thanks to this neural computational mechanism, the human cognition of the world is always more or less veritable and beauty, determined by the same mechanism, leads not only to the selection of the most suitable partner, as evolutionist theories claim, or to the most pleasing image, as the classical art historiography states, but to the total understanding of oneself and of the world.

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