Review Article

Neuroesthetics and its Excitatory Sensitization of the Cerebral Cortex

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Abstract

The human mind receives, perceives, and processes visual and auditory input daily from the everyday world of art and culture as an esthetic neural experience involving several regions of the cerebrum. It is important to comprehend how this process of neuroesthetics works and how it affects each individual's emotions and behavior. This article will incorporate various clinical scanning techniques and methods to examine the anatomical cerebral structures where the effects of external neuroesthetic stimuli can be correlated with its resultant neural cognitive response. The effects of neuroesthetic stimuli on the clinical improvement in patients experiencing depression, cognitive decline, and other forms of behavioral manifestations will be reviewed. The results of these studies (including international examples, along with various comparative analyses) demonstrate the beneficial effects of art on the pleasure centers of the brain and its consequent positive effects on patients' behavior and emotions, thus exemplifying the short- and long-term importance of incorporation of neuroesthetics in not only the clinical setting but also in our global society.

Keywords: *Cerebral cortex, cognitive neuroscience, functional magnetic resonance imaging, neuroesthetics*

Neuroesthetics, What Happens in Your Brain When You See/Experience Art?

Neuroaesthetic is a subfield of cognitive neuroscience concerned with the neural basis of esthetics, particularly in the field of visual arts. The term neuroesthetics appeared in the last decade of the 20th century. Esthetic encounters are widespread in our daily lives, and delving into their biological underpinnings can help us better understand human behavior in key areas such as mate selection, consumer behavior, communication, and art. Neuroscientific studies in this area have used imaging and neurophysiological techniques such as functional magnetic resonance imaging (fMRI), electroencephalography, and magnetoencephalography.

"An aesthetic experience is one that allows the beholder to 'to perceive-feel-sense' an artwork (from the Greek aisth-ese-aisthanomai), which in turn implies the activation of sensorimotor, emotional and cognitive mechanisms."[2]

Esthetic experiences can be found in a variety of settings (e.g., museums, galleries, and churches). Esthetic experience was viewed as a rewarding process by some psychological viewpoints, and a link between esthetic experience and pleasure was proposed.[3] Esthetic experiences include the feelings, judgments, and behaviors that these items inspire as well as the methods used in their creation and interpretation. Researchers are interested in how the brain initiates esthetic experiences and how our understanding of brain mechanisms contributes to our comprehension of these experiences. This area combines cognitive and emotional neuroscience with empirical esthetics. A descriptive or experimental approach to neuroesthetics is possible to form. Observations are used in descriptive neuroaesthetics which helps brain facts to be connected aesthetic impressions. The claims are qualitative in persona. Experimental studies for neuroaesthetics generates quantitative and statistically validated data. The technique puts hypotheses to the test, predicts outcomes, and welcomes feedback. It is either a replication or a falsification.[2]

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These sensory systems are activated by esthetic interactions in that as we view a work of art, it produces a subjective impression of movement and reactively activates the visual motion regions. Portraits stimulate the fusiform gyrus's face area, whereas landscape paintings activate the parahippocampal gyrus's place area. Astonishingly, in addition to classifying visual elements, these sensory areas may also be involved in evaluating them. Beautiful faces stimulate the fusiform face (and adjacent) areas (the FFA), located in the inferior temporal cortex (IT) within the fusiform gyrus (Brodmann area 37). The pleasure people get from gazing at beautiful images activates our reward circuitry automatically. Attractive faces stimulate the FFA and ventral striatum areas, even when people are not thinking about how gorgeous they are. Beautiful visual images generate reactions in the orbito- and medial-frontal cortex, ventral striatum, anterior cingulate, and insula, whereas music and architectural spaces evoke responses in the medial orbitofrontal cortex and adjacent cingulate cortex.[1] Some studies demonstrate that the beauty of art imagery boosts brain activity in visual areas, much as it does with faces.

Esthetic pleasure may be the result of interactions between brain structures that support the perception of particular images (e.g., parahippocampus for sceneries and neurotransmitter distribution in the cerebral cortex). When we observe images of actions, it has been observed that certain regions of the motor cortex in the brain are activated. This suggests that there is a connection between visual perception of actions and the motor system. There is a network of neurons called mirror neurons, which are part of the extended mirror neuron system, that play a role in this process. Mirror neurons were found in monkeys and birds and are known to respond to both action execution and perception. Interestingly, humans also possess a similar system of mirror neurons. Humans have a similar system.

Furthermore, the activation of reward networks and the default mode network during the creation and perception of art is another topic of investigation for neuroesthetic researchers. Dopamine, serotonin, and oxytocin are the "feel-good" neurochemicals produced by the reward system and are responsible for pleasure and happy feelings. When we engage in esthetic experiences or create and behold the arts, we activate the brain's pleasure centers and can observe that these areas become illuminated upon imaging.[3]

Several studies have found that art museums can be beneficial as therapeutic settings. These advantages include improved memory, reduced stress, and increased social inclusion. People with enduring mental health problems, such as dementia, and the socially isolated have all been studied. Furthermore, both traditional and modern galleries increased positive social effect and cognitive well-being in a research study of patients with dementia and their caretakers.[4] Furthermore, an emotional state is important in the improvement of our body and brain. Exempli gratia, "Joy or sorrow can emerge only after the brain registers physical changes in the body," says Antonio Damasio, a well-known neuroscientist who conducts research on the brain networks underlying emotion, decision-making, memory, language, and consciousness at the Brain and Creativity Institute of the University of Southern California. According to Damasio in an interview with Scientific American Mind, the brain continually receives information from the body and registers what is happening within each of us. After the impulses have been processed, brain maps are assembled in structures known as somatosensory centers. It is evident from reading the maps that sentiments and emotional shifts have been noted.[3]

Art is a challenging experience. It is the outcome of multiple cognitive and emotional processes interacting with one another. Neuropsychology and neuroimaging studies have shown the enormous network of brain areas on which it is built. This network has three functional components:

i. The prefrontal, parietal, and temporal cortical regions support evaluating judgment, attentional processing, and memory retrieval
ii. The reward circuit, which encompasses the cortical and subcortical areas as well as some of its regulators, is involved in the formation of pleasurable experiences and emotions, as well as the appraisal and anticipation of reward
iii. Modulating activity in low-, mid-, and high-level cortical sensory areas enhances perceptual processing of certain characteristics, relations, places, or objects.[5]

Art expression has been proven to be a powerful instrument for well-being. Advanced fMRI investigations are revealing the structure of the brain. Neuroplasticity influences the brain's evolution, structure, and capacity to repair or re-route circuits. Both hemispheres of the brain are activated and stimulated by art, with the motor cortex being stimulated even when there is no movement involved. This is a significant step forward in the treatment of neurological conditions such as stroke and traumatic brain injury. Researchers analyzed post-retirement effects on people using fMRI and half of them showed "art intervention" for 10 weeks. Those who received the visual art intervention demonstrated improved functional connectivity in the frontal and parietal cerebral cortices. This was linked to a higher level of psychological/stress resilience. In the control group, no such effects were seen. The research was noteworthy since it was the "first to show the neural of visual art output on psychological resilience in adulthood."[6]

Another fMRI research based on the neuroesthetics of Noh masks (a Japanese theatrical mask) postulated that the amygdala would respond when a negative emotion, such as grief, was represented by a theatrical mask. Masks are utilized by actors in traditional Japanese Noh drama to reflect several of the characters' mental states. A fMRI

research in which participants' brains were examined while watching Noh masks with beautifully mournful features was presented. Viewing sad masks stimulated the right amygdala, according to the results of an area of interest study. We hypothesize that such tiny sorrowful masks might stimulate the amygdala, presumably because they are similar to emotions such as fear and disgust.[7]

In addition,[8] they aimed to identify the neural correlates of both the visual esthetic experience (VAE) general aspect and those that were more intimately connected to the content of the artworks. Forty-seven fMRI tests from 14 published publications were subjected to a general activation likelihood estimation (ALE) meta-analysis. In addition, they conducted four separate ALE analyses to identify the neural substrates of reactions to specific categories of artworks, namely portraits, representation of real-world visual scenes, abstract paintings, and body sculptures. The general ALE revealed that the VAE relies on a bilateral network of areas, and the individual ALE analyses revealed that maximal activation for the categories of the artworks differed depending on their content. Many content-dependent sections of the ventral visual stream, as well as a few other brain locations, are involved in VAE. Art-related neural responses, as a result, activate widely distributed networks in both hemispheres, including content-dependent ventral visual stream brain areas. Esthetic emotions involve sensory, perceptual, and cognitive processes, according to the findings.

How could we comprehend the human brain's unique and wonderful talents to produce and enjoy art in biological terms? In the last decade, neuroscience has made significant progress in terms of establishing experimental methodologies and theoretical frameworks for understanding emergent features arising from vast neural networks' activity. The 37 articles that make up this special Frontiers Research Topic combine theoretical and experimental research, connecting cutting-edge understanding of the brain with the phenomena of art.[9] It includes contributions from eminent authorities on vision, audition, somatosensation, movement, and film, and it covers a wide range of issues.

The purpose of art is perception. It may be assumed that artists, whether intentionally or unintentionally, find proof of the brain bases of esthetic perception. Because art serves as a visual representation of reality, it drives artists to explore new methods to enhance the representation, usually using perceptual shortcuts that our brains cannot discern apart from reality. Visual information is processed in the primary visual cortex, which is the first section of the brain to process it. Neurons in this region of the brain detect lines and corners. After detecting lines and corners in the visual field, information is then sent to the brain's ventral and dorsal visual processing centers via two independent, yet related, routes. The ventral stream, sometimes recognized unofficially as the "what" pathway of perception, is responsible for processing information on shape, color, and object recognition in general. From the main visual cortex to the IT lobe, this neuronal route runs. The dorsal stream (unofficially recognized as the "where" pathway of perception) projects to the posterior parietal cortex and is important for spatial information.

Manipulation of the reward center has also been demonstrated to boost esthetic appreciation. A 2014 research investigated whether esthetic perception may be enhanced by utilization of transcranial direct current stimulation (tDCS) to the left dorsolateral prefrontal cortex (lDLPFC), which is projected from the ventral tegmental area. They were effective in establishing a connection between lDLPFC activity and appreciation of esthetic beauty. Affinity for artistic images was higher in those who got tDCS to the lDLPFC than in those who did not. Although the lDLPFC has been connected to esthetic pleasure in the past, this study is the first to demonstrate a causal connection. Studies using fMRI have revealed a strong correlation between reward circuit activation and looking at artistic imagery. These studies demonstrate that reward processing is essential for enjoying visual art.[10]

In conclusion, the research suggests that emotions are at the heart of the esthetic experience. The associated emotional reaction appears to be the ultimate reward, whether it is seeking out the best works of art or simply enjoying the view. The neural activity of areas involved in both positive and negative emotional processing, such as the nucleus accumbens, the prefrontal cortex, and the amygdala, among others, transcends artistic mediums. By increasing the number of art forms studied through neuroscience, the functions that these regions exhibit may become even more solidified. Esthetic experiences have been shown to alter cognitive and emotional states as well as improve physical and psychological well-being. Perhaps, the future of neuroesthetics will reveal more about the origins and evolution of art than our neurological reactions to it.

Patient informed consent

There is no need for patient informed consent.

Ethics committee approval

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Conflict of Interest

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Author Contributions subject and rate

Esra Torlak (100%): Manuscript preparation, reviewing results.

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