Working Title

Neuroesthetics & Neuroenology: How the Brain Constructs Beauty, the Aesthetics and Flavor of Wine, and Why it Matters.

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"Wine is one of the most civilized things in the world and one of the most natural things of the world that has been brought to the greatest perfection, and it offers a greater range of enjoyment and appreciation than, possibly, any other purely sensory thing."-Ernest Hemingway

"Love of beauty is taste. The creation of beauty is art." - Ralph Waldo Emerson

Abstract

Professors David Freeberg (Department of Art History and Archeology, Columbia University, New York, United States) and Vittorio Gallese (Department of Neurosciences, University of Parma, Parma, Italy) have collaborated to further develop the emerging concept of neuroesthetics in their article titled, *Motion, Emotion, and Empathy in Aesthetic Experience*, which appeared in the journal: Trends in Cognitive Sciences in 2007. Essentially, Freeberg and Gallese posit the notion that beauty is not in the object but in the brain of the beholder. Neuroesthetics, as an evolving science, bridges philosophy, art theory and history, fine arts, psychology, and neuroscience under an interdisciplinary umbrella (Chatterjee, 2014). Professor of Neuroscience at Yale School of Medicine, Gordon Shepherd, takes this new discipline one step further by applying its principles to the study of cuisine, wine, and pleasure; flatly stating that like beauty, flavor is not in the food or wine object, but it is created by the brain based on various sensory inputs. However, Shepherd acknowledges that the brain takes its cues from the chemical and textural makeup of the food and wine object. It is my assertion, based on the principals of neuroaesthetics, neuroenology, and psychology, that the senses of taste and smell are important for acquiring sensory data, which than become the foundation for some of our aesthetic judgments and for engaging in aesthetic experience. This will be illustrated by engaging with the wine object. In addition, the sense of smell, in particular, is critical in cognitive function, brain health, and emotional well-being. These concepts will be explored in this paper.

Key Words

Hierarchy of the senses, neurogastronomy, neuroenology, neuroesthetics, volatile molecules, retronasal olfaction, Wine, wine tasting.[1],[2],[3]

[11]Aesthetics:The branch of philosophy dealing with such notions as the beautiful, ugly, the sublime, the comic, etc., as applic able to the fine arts,with a view to establishing the meaning and validity of criticaljudgments concerning works of art, and the principles underlying or justifying such judgments.
The study of the mind and emotions in relation to the sense of beauty.

Beauty is in the brain of the beholder:

"Beauty is certainly a soft, smooth, slippery thing, and therefore of a nature which easily slips in and permeates our souls." - Plato, Lysis

Neuroesthetics is a relatively new scientific approach to a philosophical concept that fuses theoretical aesthetics with neuroscience in an attempt to uncover the neural mechanisms involved in recognizing and processing beauty and art. "This basic level of reaction to pleasing images and art objects is essential to understanding the effectiveness both of mundane images and of works of art (Freeberg & Gallese, 2007)." Art historians, cultural theorists, philosophers, artists, and scientists do agree that there isn't yet a clear definition of art. However, with recent influences from neuroscience, many hope that we are nearing a consensus on that definition. In the millennia old debate about beauty, there has been a long held notion that beauty and aesthetic are a cultural construct varying from era to era and location to location. Nevertheless, traditional beauty[4] is definable, as it generally adheres to mathematical and scientific norms and averages related to the *Golden Ratio / Proportion*[i] formally presented several millennia ago by Greek mathematician and philosopher, Euclid (Euclid, 300 B.C.E.) and further explored in the book *De Divina Proportioni* by Luca Pacioli and Leonardo Da Vinci in 1509.[ii] In this sense, the philosophical concepts of beauty and aesthetics have a long tradition of being linked to and explored by scientists and mathematicians, alongside philosophers and artists.

What are the neural mechanisms involved in the aesthetic experience?

"The best and most beautiful things in the world cannot be seen or even touched – they must be felt with the heart." - Helen Keller

In a definition set forth by Anjan Chatterjee, "neuroaesthetics is both descriptive and experimental, with qualitative observations and quantitative tests of hypotheses, aimed at advancing our understanding of how humans process beauty and art (Chatterjee, 2014)." Not

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[2] Empathy: The capacity to understand what another being is experiencing-Being aware of, being sensitive to, and vicariously experiencing the feelings of other beings. Feeling and experiencing from another's point of reference. Imaginative projection of a subjective state into an object so that the object seems infused with it.

[3] Aesthetic experience: a special state of mind that is qualitatively different from the everyday experience.

[4] "Though Plato and Aristotle disagree on what beauty is, they both regard it as objective in the sense that it is not localized in the response of the beholder. The classical conception treats beauty as a matter of instantiating definite proportions or relations among parts, sometimes expressed in mathematical ratios, for example the 'golden section.' The sculpture known as 'The Canon,' by Polykleitos (fifth/fourth century BCE), was held up as a model of harmonious proportion to be emulated by students and masters alike: beauty could be reliably achieved by reproducing its objective proportions." (Sartwell, 2016).

only are neuroscientists conducting MRI neural mapping on the brains of artists during the creation of artworks, but also on the brains of viewers and participants that are consuming various works of art, foods, and beverages, in order to better understand the brain systems and mechanisms responsible for recognizing and categorizing beauty, aesthetics, and aesthetic experience. Neuroscientists are quickly realizing that specific regions of the brain, primarily but not exclusively situated in the pre-frontal cortex, are responsible for the recognition and categorization of the art object, and are also responsible for the processes of aesthetically experiencing and valuing the art object.

> Early neuroaesthetic writings in the late 1990s by neuroscientists Semir Zeki and Vilayanur Ramachandran identified parallels between an artist's approach to (her) visual world and (her) the brain's processing of visual information. Light entering our eyes is segregated into a number of elemental properties, such as luminance, color, and motion, that are processed in different visual centers in our brains. At the turn of the 20th century, artists played with these elements in their artwork. For example, the French artists Henri Matisse and André Derain highlighted color to express various emotions. (Chatterjee, 2014).

According to Caltech researcher, Marcus Woo, the author of *Beauty is in the Eye of the Beholder, and—as Researchers Have Now Shown—in the Brain as Well*, neuroscience research scientists at Caltech have concluded that it is possible to mechanically stimulate regions of the brain (with electrical currents) responsible for pleasure seeking activity, dopamine production, and for recognizing and evaluating beauty. In human trials, these scientists have been able to identify and stimulate various pleasure centers in the brain.[5] These studies are particularly interesting as they identify several regions of the brain that categorize and process art objects and performance art. Music, fine art, performance arts, and other arts are "processed by different brain centers such as the dorsolateral and ventromedial prefrontal cortex region" and may be "linked through neural connectivity to a deep region in the ventral midbrain thought to be responsible for dopamine production and secretion…" (Woo, 2013, Chatterjee, 2014). Dopamine is commonly known as the pleasure chemical: created by the

[5] The researchers, led by scientists at the California Institute of Technology (Caltech), have used a well-known, noninvasive technique to electrically stimulate a specific region deep inside the brain previously thought to be inaccessible. The stimulation, the scientists say, caused volunteers to judge faces as more attractive than before their brains were stimulated. The researchers hypothesized that they could exploit known neural connections and use tDCS to stimulate deeper regions of the brain. In particular, they wanted to access the ventral midbrain—the center of the brain's reward-processing network, and about as deep as you can go. It is thought to be the source of dopamine, a chemical whose deficiency has been linked to many neuropsychiatric disorders. The ventral midbrain is part of a neural circuit that includes the dorsolateral prefrontal cortex (DLPFC), which is located just above the temples, and the ventromedial prefrontal cortex (VMPFC), which is behind the forehead. Decreasing activity in the DLPFC boosts activity in the VMPFC, which in turn bumps up activity in the ventral midbrain. To manipulate the ventral midbrain, therefore, the researchers decided to try using tDCS to deactivate the DLPFC and activate the VMPFC. (Woo, 2013)

brain and responsible for blissful and elated feelings when stimulated in activities such as aesthetic experience, creating art, playing and performing music, sex, wine drinking, eating, exercise, and other pleasurable activities. This chemical is often out of balance in human brains and is "linked to many neuropsychiatric disorders (Woo, 2013)." While their (the neuroscientist researchers) purpose for researching electrical stimulation of these neural centers is for the development of potential, non-invasive, non-chemical, therapeutic benefits for depression, dementia, and Alzheimer's patients, (Woo, 2013) these revelations support the claims made by Freeberg and Gallese in their aforementioned 2007 work *Motion, Emotion, and Empathy in Aesthetic Experience*. These studies indicate a kind of universality of the criteria for beauty and the basis for aesthetic value and experience; which may be applied to fine arts as well as cuisine.

Hierarchy of the Senses

"Our hearts are drunk with a beauty our eyes could never see." - George W. Russell

The role of human sensory function is to give humans a methodology to analyze, categorize, and otherwise make sense of the outside world. Aristotle laid forth his *Hierarchy of the Senses* as a framework for analyzing and discussing sensory and aesthetic experiences.[iii] In the Aristotelean methodology, the visual and audio senses occurred at a distance outside of the body and were considered cognitive and conceptual. This is one reason that these senses have been privileged as higher or more sophisticated senses. Taste, smell, and touch, were merely sensual experiences situated in the body, inspiring pleasure, and unworthy of intellectual, philosophical commentary. Because of their link to passion and sexuality, Aristotle and other important philosophers and theologians have demoted the immoral lower senses to an unimportant position. To uncover the biases in the hierarchy of the senses, one analyzes the Aristotelian culture and origins of the conceptual framework still shading our modern view. In antiquity, limited scientific knowledge about the body led to poor understanding of the senses. Ancient and modern cultures feared the body's natural urges, hedonism, passion, and sexuality, which were invoked by the 'lower' senses.

As a Ph.D. candidate, wine aficionado and psychologist Dr. Frédéric Brochet worked with the concepts of the *hierarchy of the senses* by exploring neurological processes involved in producing taste and aroma by conducting quantitative and qualitative research on wine and systematic wine tasting for his dissertation. Brochet explains that there is a scientific and

physiological basis for this age old hierarchical sensory order. His subsequent work will be discussed later in this paper.

> Scientists know that the brain processes olfactory (taste and smell) cues approximately ten times slower than sight -- 400 milliseconds versus 40 milliseconds. It's likely that in the interest of evolutionary fitness, i.e. spotting a predator, the brain gradually developed to fast track visual information. Brochet's research further demonstrated that, in the hierarchy of perception, vision clearly takes precedence.[iv]

However, taste, smell, and touch, are our oldest senses stemming from the limbic system (or primitive reptilian brain). Psychologists claim that they are collectively related to memory and mating (Kenneally, 2013). Without taste and smell, humans would not fall in love or experience various the world and culture fully (Kenneally, 2013). For example, experiencing native gastronomy: cuisine and beverages, are modes for understanding and deciphering a given culture. These activities can be as telling and fulfilling as viewing a painting, reading a sonnet, touching a monument, or listening to a concerto.

Neuroenology and Neurogastronomy: A New Way to look at Cuisine

"The ideal wine … satisfies perfectly all five senses: vision by its color; smell by its bouquet; touch by its freshness; taste by its flavor; and hearing by its "glou-glou."" -Chef Paul Bocuse

In his books Neurogastronomy and Neuroenology, Dr. Gordon Shepherd determines that "the brain creates flavor (taste + aroma) essentially the same way that it creates color. The brain engages more functions than it uses for any other human behavior to create the flavor of wine, in particular (Shepherd, 2017)." Shepherd illustrates that "specific sensory pathways in the prefrontal and cerebral cortex create memory of wine" and govern how language (metaphor / simile) is used to identify and imprint wine characteristics onto the brain (Shepherd, 2017). The crux of Shepherd's argument in Neuroenology lies in the complex systems and processes of fluid dynamics, biomechanics, in conjunction with neurological and neuroaesthetic activities that are engaged to create taste and aroma of wine (and food). "In tasting and categorizing the flavors present in wine (food and other beverages), the brain must engage the tongue, nose, and biomechanics of swishing, chewing, and swallowing. This multi-motor mechanic action uses more systems than any other bodily function. These multifarious actions makes taste (creating flavor) an active sense rather than a passive one (Shepherd,2017)."

The brain depends on individual and group sensory stimulation and analysis in order to formulate a specific sense of order or signature derived from the sensory stimuli in the form

of volatile molecules (Chartier and Reiss, 2012). Once the brain designs this signature, the sensation is deposited into a preassigned category (example: cherry) which has a specific vocabulary association based upon previous exposure to the category / object. (Shepherd, 2017) Once the taster has experienced cherry, for example, their brain can almost instantly recategorize similar/same volatile molecules and code them as cherry. Slight variations may still be categorized as cherry, for example: black cherry, Morello cherry, Luxardo maraschino cherry, cherry flavoring (chemicalized), cherry cough syrup, and even cherry cola. (Spinner, 2014) Wine terminology bases itself on the use of metaphor to explain these volatile molecules and their categorical assignments. (Chartier & Reiss, 2012 /Charters & Pettigrew, 2006) These categories hold ideas of objects and are simply representations or forms (Plato: Meno, c. 380-360 B.C.E., pg. 71-81)[v] of an ideal object as a reference point. (Shepherd, 2017).

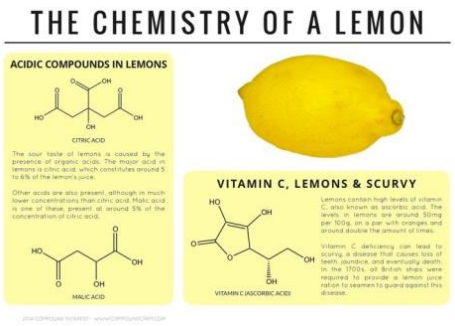
Is that a Lychee in Your Glass?

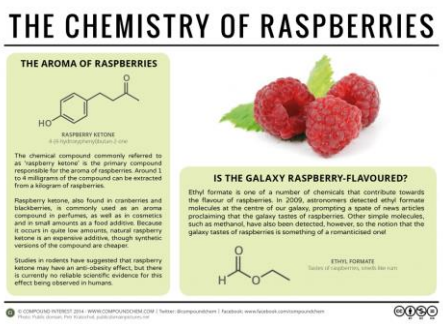
"What's in a name? That which we call a rose, By any other word would smell as sweet;" Shakespeare

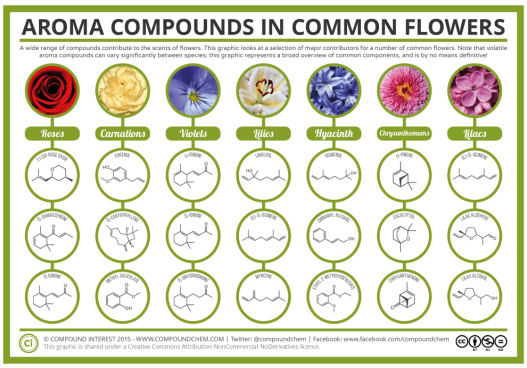
Human beings in optimal condition "have 350 Olfactory Receptors and can smell 10,000 different volatile aroma molecules."[vi] Health, environment and climate affect the mobility of these molecules (Chartier and Reiss, 2012). Human brains categorize these odors based on previous experiences (volatile molecules with previous reference points) and must work with established vocabulary to categorize these sensations. New aromas require new vocabulary associations in order to create a new categorical reference point for future access. (Spinner, 2014). Without these vocabulary associations, these new sensations are ignored by the brain. If a wine tasting note lists, for example, lemon chiffon, white flowers, ripe white peach, and lychee, and the taster has never experienced lychee fruit, then that note is useless to them. "White flowers" is a frequently used wine tasting note that is general and easily misinterpreted: gardenias, freesia, carnations, roses, magnolia, and orchids all come in hues of white and all smell vastly different from one another (see figure 3 below). Molecularly, these tasting notes are abstractions of the actual volatile molecules attached to them. Organic chemist, Andrew Brunning of the University of Cambridge is developing infographics featuring molecular maps of various aromas ranging from the aromas in food and wine to the aromas of the sea, rain, flowers, herbs, Christmas trees, and even humans. The infographics presented here (figures 1-5 below) illustrate the molecular maps of raspberries, lemon, and

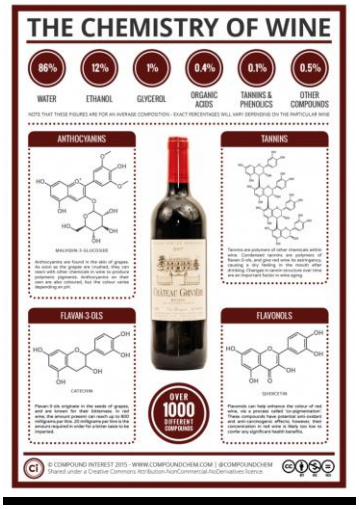
various flowers, all of which are common wine aroma notes. Also included are representations of red wine and champagne to illustrate the increasing complexity of their volatile molecular structure known as phenolics.

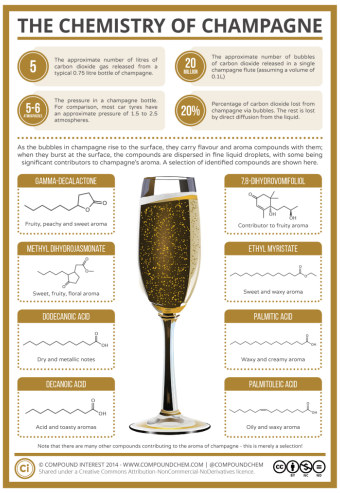
Figures 1-5











vii

According to UC Davis Enology Program: wine science expert, Dr. Susan Eberler, the basic components in grape juice consists of 79% water and 20% carbohydrates, 1% organic acids and trace amounts of glycerol, tannins, phenolics, vitamins, minerals and nitrogenous compounds. The sugars, organic acids and phenolics give the juice its flavor, while the

vitamins, minerals and nitrogenous compounds are, in many cases, essential to yeast growth and fermentation. Wine has a similar composition, but has much lower levels of sugar (none in dry wines), 8 - 17% alcohol and a greater range of minor components created as a by-product of the fermentation process. (Eberler: 2017) Although phenolics make up less than one percent of a wine's composition, wine can have as many as 300-500 different phenolics (volatile aroma molecules), making it one of the most complex food objects: in contrast, bananas have four volatile aroma molecules. Aesthetically superior wine is a result of balanced components per varietal standards. (Spinner: 2016). Wine experts train with a codified language of vocabulary associations that are largely based on metaphor and simile: for example, (this) wine tastes like cherries, plums, vanilla, spice, and smoke. Dr. Frédéric Brochet and the late enology professor, Dr. Denis Dubordieu collaborated multiple times in efforts to explore and refine wine language and the cognitive sensory processes involved in identifying and categorizing various aromas and tastes in wine. In their article *Wine Descriptive Language Supports Cognitive Specificity of Chemical Sense* Brochet and Dubordieu illustrate how wine is analyzed.

> Wine is one of the more often described foods, and wine literature is widespread with numerous journals, books, and reviews being presented to the public and experts or professionals. People who fail in describing wine flavors, i.e., who cannot speak about its taste in a professional manner, usually consider themselves as ''not knowing anything about wine.'' A question can then be posed as to whether this means that knowledge requires language. Winemakers, professional critics, enologists, and amateurs have built a wine language or vocabulary that they use to describe sensory properties of wine. They use it to exchange sensory data among themselves and to analyze their information for other uses, for example, to determine the way that wine should be managed in the future to acquire a specific taste…Although many efforts have been made to characterize the quality and flavor of the compounds in wine by gas chromatography and other chemical techniques, tasting remains the single universal test used to assess properly wine sensory properties. This is because the taste of a molecule, or of a blend of molecules, is constructed within the brain of a taster. It is a complex recognition of different properties which integrates many aspects of the sensory faculties of an individual. Such information is not contained entirely in the physicochemical structure of the complex molecular structure of a wine taste. For example, it is known that the perceived flavor of a blend of two molecules is rarely the combination of the two flavors but usually a third flavor which is not predictable from the two initial ones. (Frédéric Brochet and Denis Dubordieu)[viii]

Through their work, Brochet and Dubordieu establish the importance of taste and smell in cognitive function, while maintaining that they are not the prominent senses, they are critical to cognitive and aesthetic experiences, nonetheless.

Why Smell & Taste Matter

"Taste and smell qualify as cognitive senses of aesthetic significance."-

As discussed earlier, thanks to Plato, Aristotle and the Church, the sense of smell was long considered an unimportant, dangerous, lusty, and hedonistic sensory activity for gathering and processing information about the world that would inevitably lead to moral decline and inappropriate sensual engagement (Spinner, 2016). Actually, the sense of smell may be the most important sense of all. We know that the olfactory system is directly linked to the prefrontal cortex via nerve endings that reach through the microscopic perforations in the cribriform plate separating the brain from the olfactory bulb. These nerve pathways reach into the limbic center of the brain, a center thought to be responsible for human emotions, a sense of well-being, and even happiness (Drummond, 2015).

Loss of the sense of smell[6] is called Anosmia and is directly linked to cognitive decline, dementia, Alzheimer's, PTSD, TBI, and depression. Anosmia can be the cause of these cognitive issues or the result of traumatic brain injury, illness, and stroke. 70-85% of all concussions have some degree of anosmia, often undetected, resulting in depression, general confusion, memory issues, and other health dangers like food poisoning (Drummond, Melanie, et al: Nov. 2015). Partial and total loss of the sense of smell, and in effect, the sense of taste, can lead to a significant degradation of quality of life in anosmia patients, resulting in lingering depression and isolationist tendencies (Kenneally, 2013). Anosmiacs are unable to enjoy the aroma cuisine, a steaming cup of coffee, a glass of wine, Christmas trees, flowers, or smell fresh cut grass in a summer day. They are unable to experience complex flavors and aromas of food and wine because their olfactory receptors fail to recognize the volatile molecular stimuli responsible for triggering their neural pathways to code and categorize flavor identifiers as vocabulary associated references, resulting in a reduced ability to engage in the aesthetic valuation and aesthetic experience of tasting and enjoying a glass of beautifully balanced wine.

[6] "The association of fragrance and emotion is not an invention of poets or perfume-makers. Our olfactory receptors are directly connected to the limbic system, the most ancient and primitive part of the brain, which is thought to be the seat of emotion. Smell sensations are relayed to the cortex, where 'cognitive' recognition occurs, only after the deepest parts of our brains have been stimulated. Thus, by the time we correctly name a particular scent as, for example, vanilla, the scent has already activated the limbic system, triggering more deep-seated emotional responses." [6]iii

"Studies show that 75% of emotions are triggered by smell which is linked to pleasure, well-being, emotion and memory."[6]iv

Appendix

Definitions:

Neuroesthetics (not to be confused with the concept of **Neuroaesthetics**) is a relatively recent sub-discipline of empirical aesthetics. Empirical aesthetics takes a scientific approach to the study of aesthetic perceptions of art, music, or any object that can give rise to aesthetic judgments. Neuroesthetics received its formal definition in 2002 as the scientific study of the neural bases for the contemplation and creation of a work of art.

Neuroaesthetics, by contrast is "a concept that encompasses new possibilities of aesthetic experience and the capacity of works of art to effect and sculpt the materialized brain" (Mathieu Copeland) and was conceived by Warren Neidich in 1995 while lecturing at the School of Visual Arts in New York City. Neidich published artbrain.org, in 1997, which includes '*The Journal of Neuro-Aesthetic Theory*'. Neuroesthetics uses neuroscience to explain and understand the aesthetic experiences at the neurological level. The topic attracts scholars from many disciplines including neuroscientists, art historians, artists, psychologists, and philosophers.

> Since its dawn in the early 2000s, neuroaesthetics has been flowering as an independent research field (Nadal and Skov, 2013). Its emergence has mostly been driven by researchers who specialize in the study of visual perception and cognition, and who show interest in visual arts. This strong link between neuroaesthetics and vision science is reflected not only by the fact that the term "neuroaesthetics" was coined by the renowned vision researcher Semir Zeki (Zeki and Nash, 1999), but also by recent reviews on neuroaesthetics focusing primarily on aesthetic experiences induced by paintings, abstract patterns, landscapes, faces, architecture, fashion and design objects (Cinzia and Vittorio, 2009; Cela-Conde et al., 2011; Chatterjee, 2011, 2014; Nadal, 2013; Chatterjee and Vartanian, 2014). Current models of aesthetic experiences and their brain correlates revolve around the visual modality and include moderators of aesthetic experiences (social, cultural and situational context, personality, expertise etc.) (Ramachandran and Hirstein, 1999; Chatterjee, 2004; Tinio, 2013; Leder and Nadal, 2014; Redies, 2015). These models are not exclusively concerned with the study of beauty or preference, although these concepts are of historical importance, but include a wide range of aesthetic emotions, judgements, and behaviors.[ix]

> Neuroaesthetics received its formal definition in 2002 as the scientific study of the neural bases for the contemplation and creation of a work of art. The neuroscientist Jean-Pierre Changeux has been engaged in this area of study since l988, notably in his book *Raison et Plaisir* of 1994. Currently, this field at large is in search of a neuronal interpretation of creativity. To this end, Changeux's neuronal workspace model (1998), as presented again in his 2002 book *The Physiology of Truth*, offers a comprehensive scheme for understanding the epigenetic dynamism of the artistic process and its network architecture. From her perspective in the humanities, the literary scholar Suzanne Nalbantian conjoins a few selected literary and artistic works of the twentieth-century to illustrate in concrete terms aspects of Changeux's workspace model. This interdisciplinary collaboration helps to focus on the memory component in the creative process of higher-level synthetic brain functioning.[x]

> 5 Statements on Neuroaesthetics:
> Neuroaesthetics has generated new tools with which to understand and elucidate the history and the production of art. Through its' window works of art have been re-sampled to create a productive phylogeny of aesthetic forms, which beyond their primary meaning as art works functioning in the aesthetic field, can also explain questions that formerly were the jurisdiction of Neuroscience, The Philosophy of Consciousness and Evolutionary Psychology just to name a few.

> Neuroaesthetics is a dynamic process in flux through which aesthetic ideas and methods pertaining to perception, concept, the phenomenal, illusions, just to name a few, which have always formed

the latent content of aesthetic practice are fore-grounded. As such, it clears another path to be added to the already existing histories of art in which artistic practice can also help to play a role in the investigation of the brain. As an art historical tool it follows in the path of Rudolph Arnheim, E.H. Gombrich and recently Francesco Varella except that in its contemporary form it attempts to move the discussion away from primary structures towards a theory of the production of the mutating subject in an evolving cultural field.

Neuroaesthetics imports, displaces, appropriates, deterritorializes and reterritorializes the ideas of neuroscience into artistic practice and thereby commits it to a very different history, context and set of genealogic conditions.

Neuroaesthetics realizes that optical phenomena embedded in the structure of an artwork can play a significant role in how that artwork is perceived and cogitated. It is not, however, the whole artwork rather it is enmeshed in a network of cultural and historical conditions that give it meaning.

These conditions cannot be stripped from it without altering and changing it into something else. These same cultural conditions also re-make the subject as an observer in two important ways. First by affecting how, by what means, and what he or she pays attention to and secondly by changing the matter of the brain itself. Recent theories called Neural Darwinism and Neural Constructivism have given us the tools with which to understand the conditions under which this might occur and the mechanisms by which it might happen. It is by effecting the spatial and temporal distribution of connections of neurons, synapses and neural networks, that the brain uses to code the world that it acts and participates in, that new forms of thoughts become possible.

Neuroaesthetics embraces the single occurrence as a fact and as a real thing. One artist and one artists' work can change the course of art history and cause seismic shifts that ripple throughout the strings of networks that make up the cultural system

Finally, Neuroaesthetics adds a Bergsonian evolutionary model to that of a Darwinian one. Ideas that form the building blocks of the imagination are never subtracted and deleted but rather simply change their energy states from high to low or low to high. Variability and difference are not pruned but rather promoted. Ideas and artworks never die but rather resonate and vibrate at different intensities awaiting the proper set of cultural conditions in which to become re-activated.xi

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