The neuro-philosophy of archetype in visual aesthetics: from Plato to Zeki and beyond

Dyutiman Mukhopadhyay
Indian Institute of Technology

Abstract
The definition of 'Archetype' typically refers to an original which has been imitated. The origin of the concept of Archetype in the traditional sense of the term refers to the primitive, universal perceptual imprint – a theory that dates back to Plato. The idea of the archetypal image is conceptually integrated with the aesthetics of visual arts and discussed under the guise of widely researched equivalent terms. The philosophical and scientific propositions on the concept of Archetype with reference to visual arts tended to have a neurological constitution even from ancient times. Starting from the 1990s, a radical outlook emerged in the field of cognitive aesthetics in the form of 'neuroaesthetics' which shows a significant potential in dealing with the problem of construction of the symbolic system in visual arts. Does the represented image of an aesthetically appealing artwork have structured within it the roots of an archetype? Is it innately constructed? And finally, is there at all any difference between pattern recognition among humans and other animals and the philosophical descriptions of Ideal, Form and Archetype? The review tries to interpret the development

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I. Introduction

'...forms do not have an existence without a brain.' (Zeki 1998)

'...it is possible that some types of art...are activating brain mechanisms in such a way as to tap into...certain innate form primitives which we do not yet fully understand.' (Ramachandran and Hirstein 1999)

'There is nothing mystical about the collective unconscious' (Jung 1970)

The definition of 'Archetype' typically refers to 'an original which has been imitated' or according to Jungian Psychoanalytic theory: 'a primitive mental image inherited from the earliest human ancestors, and supposed to be present in the collective unconscious' (Oxford Dictionaries 2013). Even if the two definitions are deeply interconnected, Jungian concepts of Archetype are now largely overlooked by current cognitive neuroscientists. However, the origin of the concept of Archetype in the traditional sense of the term refers to the primitive, universal perceptual imprint – a concept that dates back to Plato. Since then, the theme of archetype is, along with psychology, mythology and literary criticisms, conceptually integrated with the aesthetics of visual arts. Fathoming the universal essence behind the creation and appreciation of visual arts is the central quest of art theory throughout the ages. The concept of the archetypal image is thus discussed under the guise of certain widely researched equivalent terms like 'Ideal' [Plato (Plato 2003, pp. 316,317,322 and Zeki 1997)], 'Form' [Aristotle (Fine 2004)], 'universal' [St. Thomas Aquinas (Aquinas 1947, p. 587)] 'intellectus archetypus' (Kant 2007, p. 236) and currently 'form primitives' (Ramachandran and Hirstein 1999). The psycho-physiological approach began primarily with 18th century empirical aesthetics. Much later, the psycho-physical experimental works of Fechner, Helmholtz and Wundt started the true scientific quest to unravel the secret behind aesthetic experience and it reached a certain height with the works of Daniel Berlyne, Rudolf Arnheim and E.H. Gombrich.

Starting from the 1990s, a radical outlook emerged in the field of cognitive aesthetics due to the significant advancement of cognitive neuroscience especially in brain-imaging technology which led to a hitherto unimagined level of cross-linking between the arts and the sciences. This neurobiological foundation had been chiefly visualised first by the pioneering works of Jean Pierre Changeux, Semir Zeki and V.S.Ramachandran. Prof. Semir Zeki was instrumental in coining the term 'neuroaesthetics' (Zeki 1999) and proposed: 'the future field of what I call 'neuroaesthetics' will, I hope study the neural basis of artistic creativity and achievement, starting with the elementary perceptual process' (Zeki 2001). The most notable similarity between these three ground-breaking neuroscientists was that all of them specifically dealt with the problem of neurobiological construction of the symbolic system in visual arts. Although none of them literally coined the term 'Archetype' [may be intentionally, to avoid the Jungian flavour], the search for the Ideal had been scientifically investigated by each of them. Jean Pierre Changeux (in CASBS lecture, 2012) explained the 'unforeseen syntheses' of the symbolic systems 'within the global neuronal workspace', Semir Zeki discussed it as 'The neurology of the Platonic ideal' (Zeki, 1997) and V.S.Ramachandran (1999) referred to it as the 'innate form primitives' explaining it through the works of Nikolaas Tinbergen and his (and Hirstein's) laws of aesthetic universals.

The questions of primary relevance are: Does the represented image of an aesthetically appealing artwork have structured within it the roots of an archetype which may act as a sign stimulus both to the artist and to the observer? What is the neurological basis of the formation of this stimulus? And finally, Is there at all any difference between pattern recognition among humans and other animals and the philosophical descriptions of Ideal, Form and Archetype?

II. The Foundations

The concept of the Ideal was discussed in Book 10 of Plato's *The Republic* (around 380 BC) in which by giving an example of a couch he said that the painting of a couch is an imitation of a couch made by a carpenter which is also an imitation of a singular Ideal couch made by God (Plato 2003, pp. 316,317,322). This Idea of the essential 'couch-ness' is the model or archetype of all particular couches. Mimetic art is thus according to Plato thrice removed from reality. Plato's explanation of the universal essence behind things brings in the concept of the Ideal Image which is thus a unique singular image and an imitator can capture only a little part of the image. Plato thus indicated the concept of the perceptual Ideal that drives the creation of non-mimetic art. However, the fact remains that even the greatest of non-mimetic arts is still an imitation of the Ideal and thus the emphasis on imitation often misrepresents the concept of the Platonic Ideal. The issue is not the process of imitation but how close the imitation is towards the archetypal image built within the mind of the artist and whether he can successfully convey the essence of an Ideal image [not necessarily his Ideal image] to the observer.

According to Plato's disciple Aristotle (384-322 BC), the Ideal is an inseparable component of the represented image and not something which is imperceptible through senses. The representation itself contains the inherent species defining property and that constitutes the Form. In his *Metaphysics* he mentioned that 'it would seem impossible that the substance and the thing of which it is the substance exist in separation; hence how can the Ideas, if they are the substances of things, exist in separation from them?' (Aristotle 2014, *Metaphysics*, section 1.991b [online]). The debate between the Platonic and Aristotelian viewpoints is of significant relevance even in the 2000s. Now cognitive neuroscientists try to construct the 'form primitive' by attempting to synthesise the contribution of memory and experience of represented object on one hand and the innate predispositions independent of the represented object on the other.

St. Thomas Aquinas (1225–1274) was instrumental in providing a compelling and comprehensive formulation of Aristotle's theory of Forms through his own ideas on cognition. Aquinas followed the Aristotelian concept when he said 'a subject composed of matter and form ceases to be actually when the form is separated from the matter' (Aquinas 1947, p. 349). He said

that the way to acquire knowledge about this world is through the senses and intellect and the act of processing this knowledge is cognition. Aquinas commented: 'the principle of singularity in material things is individual matter, whereas our intellect...understands by abstracting the intelligible species from such matter. Now what is abstracted from individual matter is the universal. Hence our intellect knows directly the universal only' (Aquinas 1947, p. 587). Regarding the role of intellectual cognition, Aquinas thus believed that the intellect abstracts the 'universal' Form from the sensory matters of the image which is the material condition of sense and imagination. So, if sensory cognition is about this object X, then intellectual cognition is about conceptualising the X-ness of the object X. Intellectual cognition forms a perceptual imprint of the X-ness which is not any particular X but allows the observer to identify the particular X aided by sensory cognition. Though current cognitive neuroscientists do not believe that the cognitive Form is created somewhere outside the realm of the brain, they agree with the fact that there is indeed a huge difference between sensory processing of an image and the actual conscious perception of the image. It is also undoubtedly correct that cognition refers to the formation of an internal representation of an external particular object and that internal representation is guided by a generalised Form of the particular object. Without the theory of cognition the concept of the Archetype or the Ideal would have remained a mystical term. For the first time we could think of actually deciphering the process of construction of this universal Form.

German philosopher Immanuel Kant (1724–1804) argued that the very existence of objects outside us is at the mercy of our cognition. In his '*Critique of Judgment'* Kant distinguished between 'intellectus ectypus', which is our discursive understanding that has need of images with 'intellectus archetypus' which is the quality of our reflective judgment of the original (Kant 2007, p. 236).

III. The seeds of Neuroaesthetics: from Fechner to Gombrich

The rise of empiricism along with transcendental aesthetics from the 18th century brought our awareness to the role of the human senses, physiology and psychology in the cognition, conscious perception and appreciation of arts. However, it was only from the later part of the 19th century onwards that the attention was seriously given to the quantification of aesthetic appreciation through neuropsychophysical experiments. As noted by one of the leading founders of this field of experimental aesthetics, Gustav Fechner, without this quantifiable empirical foundation 'all of our systems of philosophical aesthetics seem to me like mighty giants with feet of clay' (Fechner 1998, p. 634).

Gustav Fechner (1801-1887), the German philosopher and experimental psychologist can be regarded as one of the chief creators of the field of

experimental aesthetics. Through his experiments on psychophysics he tried to understand, for the first time, the quantifiable relation between a stimulus and its sensation. Fechner investigated the golden section hypothesis through experiments on the pleasantness of quadrangles and established that a mathematical function clearly corresponded to appeal, thus providing a psychophysical link between stimulus and sensation (Fechner 1997, p. 123). The neural process underlying the link between stimulus and sensation was still unknown but the search had begun.

One of Fechner's contemporaries was the German physician, physicist and psychologist, Hermann Helmholtz (1821–1894), whose expertise both in fields of science and arts begun to unite these diverging fields. He is known worldwide for his principles of conservation of energy as well as for his theories on the optics of visual perception. His not so well known views on aesthetics combined these theories of physics and psychology. In one of the very few researches done on the Helmholtzian synthesis of physics, physiology, psychology and aesthetics, M. Norton Wise (2008), sketches how Helmholtz integrated the concept of his 'curve of energy' and the curve 'displaying directly the Form of the muscle contraction' with the dynamics of universal Form of visual arts in general. As Wise analyses, Helmholtz was concerned with 'the crucial role of 'Anschauung' in the immediate perception of ideal Forms, without conscious reflection' (Wise 2008). Helmholtz believed that technical training is significantly important in recognising the Ideal Form to differentiate essential from non-essential features. However, he believed that the artistic 'genius' is independent of technique. This screening of the essence has a similarity with the physiological process of 'optical deception' that our optical devices have to carry out to attain 'sensual intelligibility' and 'spiritual victory over the ever-changing manifoldness of...earthly object' (Wise 2008). Thus Helmholtz for the first time sowed the seeds of the pivotal neuroaesthetic concept that the aesthetic processes are an extension of brain processes - an idea which was extensively elaborated much later by Prof. Semir Zeki (Zeki 1997; 1998; 2001; 2004; 2012).

Helmholtz's most famous disciple was Wilhelm Wundt (1832-1920) who, along with Fechner and Helmholtz, is also regarded as the founder of experimental psychology. Wundt's structuralist, introspective, experimental psychology tried to assess the subjective experience of consciousness. Although introspective psychology is controversial, Wundt's pioneering work with the complexity of the stimulus and the corresponding pleasantness or unpleasantness is of significant relevance till today. In 1874 Wundt first visualised the inverted-U curve relating stimulus intensity with its degree of appraisal. The curve showed that:

'as the arousal potential rises above the absolute threshold, the stimulus becomes more and more pleasant and rewarding with positive hedonic value reaching a peak when arousal potential is at a moderately high point. Further

increase causes a decline in the positive hedonic value towards indifference and then the stimulus becomes increasingly unpleasant and punishing with a gradual levelling off' (Berlyne 1971, p.39).

Psychologist Daniel Berlyne (1924-1976), almost hundred years later, modified Wundt's curve to integrate it with experimental aesthetics. According to Berlyne (1970; 1971; 1974) there is a phase in the curve where the increasing complexity of the Form results in a conflict between appraisal and aversion. This is where new information accumulation can result in a reduction of uncertainty which results in renewed interest in the Form until a phase comes when aversion overrides.

The investigations on the perceptual psychology of art reached a certain height with the works of German psychologist and art theorist Rudolf Arnheim (1904 –2007) who is often regarded as twentieth centuries' most influential art-psychologist. Arnheim's work was highly influenced by the Gestalt school of psychology created chiefly by the pioneering works of Max Wertheimer, Wolfgang Kohler, and Kurt Koffka. As explained by Arnheim himself:

'The gestalt theory is...a new style of science. It came about, negatively, as a protest against what is now called the atomistic approach: the method of explaining things by adding up local effects, qualities, and functions of isolated elements' (Arnheim 1943, p.71).

The Gestalt school believed that the perceiver doesn't merely receive information passively but it is also an active organizer and the human experience is a dynamic interactive process between the parts and the whole field. Arnheim used this concept for interpretation of visual arts and argued through his theory of isomorphism that 'identity of form between psychological and physical processes' leads to the expressiveness of visual art evident by the organization of a form in relationship to its content (Arnheim 1943, p.75). In 'Art and visual perception: a psychology of the creative eye' [in 1954], regarded as Arnheim's most notable book, he tried to explain the psychology of the perceptive process in visual arts much more scientifically than those of his predecessors. Arnheim synthesised concepts from Gestalt psychology and Archetypal psychology to demonstrate the basis of the generation of this significant form. In 'Art and visual perception', Arnheim stated:

'Vision is not a mechanical recording of elements but rather the apprehension of significant structural patterns' (Arnheim 2004, p.6).

He emphasised that 'the percept is a continuous field of forces' resulting from 'an interplay of directed tensions' and that:

'Every aspect of a visual experience has its physiological counterpart in the nervous system' (Arnheim 2004, p. 17).

These nervous processes operate through Gestalt interactions between the parts and the whole. Howard McConeghey (1994) brought into notice the parallelism between Archetypal psychology and Arnheim's theories on the cognition of the visual image. Although Arnheim, he said, ignores the role of psyche in visual perception, both Jung and he believed that the 'pattern' behind the image 'needs no interpretation; it portrays, its own meaning.' The pattern is generated through the Gestalt process by an 'elementary relationship between perception and balance'. The dynamic tension between elements of the image induces a 'balance based on activity' striving for the most stable configuration just like physical forces which follow this 'universal tendency in nature' (Arnheim 1943, p.74). [Later in section 5.1 we shall discuss how the concept of top-down processing in cognitive psychology integrates the neuro-philosophy of Ideal with Jung's Archetype and Gestalt theory.]

Austrian-born British art-historian Sir E.H. Gombrich, in his two famous books 'Art and illusion' (1960 [1977]) and 'The sense of order' (1979), borrowed concepts from Popperian philosophy of 'conjecture and refutation' (Popper 2002) and from information theory to substantiate his theory of schema and correction which explained how the mental cognitive imprint [schema] interacts with the process of direct observation and image construction through a feedback loop. According to Gombrich, the artwork is produced first by classifying the subject into a familiar schema. Then by the process of 'making and matching' (Gombrich 1977, p. 160) the artist constructs the image. It is worth noting that in current neuroaesthetics there has been a considerable amount of research regarding the top-down control of possible artistic representations in the artist's brain which we shall discuss in the following section.

IV. Neuroaesthetics: *art and the brain*

The significant improvement in the neuroimaging techniques in the 1990s channelized experimental empirical aesthetics into a new dimension as the development of the concepts of brain-computer-interfaces began to flourish. For the first time, particular areas of the brain that are functionally activated due to a perceptive phenomenon could be localized by non-invasive mechanisms in live condition. The immediate outcome of this sensational methodology was a disastrous one with a section of scientists and media claiming to have discovered the objective truth behind subjectivity, which is obviously far from the truth. However, the implications of these neuroimaging techniques were far-reaching in localising functional areas of the brain. Coupled with this, extensive researches in cognitive neuroscience, neuropathology, clinical neuropsychiatry, neurogenetics and evolutionary

biology paved the path for the development of a new interdisciplinary branch of science. This neuroscientific approach drew much attention from the field of arts and subsequently the science of arts reached a new level. Scientists, artists and art-historians, albeit with different degrees of reservations, all came to comprehend that for the first time a neural correlate of aesthetic response could be objectively analysed in a hitherto impossible manner.

In the 1990s, three seminal articles, written by three pioneers of cognitive neuroscience, brought into notice the potential of development of a neuroscientific approach towards aesthetics. The first article, '*Art and neuroscience'*, was published in 1994 by Jean Pierre Changeux, neurobiologist of Pasteur Institute, Paris (Changeux 1994). In 1995, Semir Zeki of University College London, delivered the '*Woodhull lecture on visual art and the visual brain'* which was later published in '*The Proceedings of the Royal Institution of Great Britain'* in 1997 (Zeki 1997). In 1999, V.S. Ramachandran of Center for Brain and Cognition, University of California, San Diego, along with William Hirstein wrote: 'The science of art: a neurological theory of aesthetic experience' (Ramachandran and Hirstein 1999). These three articles precisely gave birth to the subject of 'neuroaesthetics', a term coined by Zeki himself (Zeki 1999). As per the Copenhagen neuroaesthetics conference, 2009, Marcos Nadal and Marcus Pearce proposed the new definition of neuroaesthetics in 2011 as follows:

'Neuroaesthetics encompass the study of the neural and evolutionary basis of the cognitive and affective processes engaged when an individual takes an aesthetic or artistic approach towards a (western or non-western) work of art (used in the broad sense to include music, film, theatre, poetry, literature, architecture and so on), a non-artistic object or a natural phenomenon' (Nadal and Pearce 2011).

It is to be noted that although Changeux, Zeki and Ramachandran made crucial contributions in the development of neuroaesthetics, significant parallel contributions from other scientists should also not be overlooked. Marcos Nadal, Ellen Dissanayake, Anjan Chatterjee, Martin Skov, Patrick Cavanagh, Camilo J. Cela-Conde, Cinzia Di Dio, Mengfei Huang, Alumit Ishai, Thomas Jacobsen, Hideaki Kawabata, Oshin Vartanian and Dahlia W. Zaidel are some of the major contributors in this field. The questions on aesthetic variability among individuals, difference between aesthetic and real-life representations, the neuroscience of empathy in art appreciation and the evolution of the aesthetic mind are major areas of investigations in current neuroaesthetic research. However, the complete evaluation of all these facets of research is not the purpose of this review. As discussed up to this point, we shall be focussing only on those works that deal explicitly with the problem of the aesthetic Ideal or the Archetype though I admit that the issues are related and can't be rigorously separated from one another. The unique similarity in the

works of Changeux, Zeki and Ramachandran is that all three of them specifically wanted to solve the problem of the aesthetic Ideal which haunted philosophers and scientists alike, since Plato. For the first time the neurology of the brain was investigated to answer the fundamental questions:

How the Archetypal image hidden behind the constructed image of an artwork is itself created in the mind [brain] of the artist as well as the spectator and is there at all any difference between pattern recognition among humans and other animals and the philosophical descriptions of Ideal, Form and Archetype?

Jean Pierre Changeux: neural Darwinism and Global Neuronal Workspace

French neuroscientist Jean Pierre Changeux's unique speciality is that he has explored in depth the areas of cognitive neuroscience starting from the molecular to the cellular, from the cerebral to the extra-cerebral levels. It was from around 1990s that Changeux's attention was devoted to the modelling of cognitive functions – a project which he pursued with long time collaborator Stanislas Dehaene (Dehaene et al. 1998; 2003). The collaboration culminated in the development of a model for consciousness based on the dynamic interactions of long-range axonal connections in the brain referred to as the Global Neuronal Workspace [GNW].

The extreme diversity in the research arena of Changeux is united by a single concept: 'selection'. Changeux is one of the leading neuroscientists who brought in the idea of mental or neural Darwinism (Changeux 1994). He believed that the theory of natural selection of Darwin can be applied to cognition and consciousness as well. It is from this perspective that his neuroscientific investigations of art should be analysed. While writing his seminal paper 'Art and neuroscience' in 1994, he analysed how 'selections from several representations of neuronal connections' develops the 'style' of the artist (Changeux 1994). Changeux's view of artistic Ideal suggests that:

'forms and figures from paintings stimulate selective recall of stored long-term autobiographic memories of acquired symbolic systems, socio-cultural representations in their historical context and with strong emotional value' (Changeux, in the CASBS lecture, 2012).

According to Changeux, the genetic and epigenetic predispositions along with the interaction of short-term and long-term memories [LTMs and STMs] play a crucial role in the generation and selection of the image representations while creating or appreciating a work of art. Synaptic efficacy plays a role in ontogenic development which takes days and years. It also shapes the dynamics of thought in spontaneous activities which takes 10 to 100 milliseconds. Finally it also shapes social and cultural evolution by constructing extra-cerebral memories of art pieces, literature etc which may

range from 100 milliseconds to thousands of years (Changeux, in the *CASBS lecture*, 2012).

The Global Neuronal Workspace, as suggested by him, is an interconnection between Pre Frontal Cortex, Parieto-Temporal cortex, and Cingulate cortex of the brain by long range axons which broadcasts signals to multiple brain areas binding subjective experience. During artistic activity:

'There is an unforeseen synthesis within the Global Neuronal Workspace of actual perceptions of external representations and of internally stored, emotionally labelled memories' (Changeux, in the CASBS lecture, 2012).

Semir Zeki: neurology of the Platonic Ideal

Neuroscientist, Professor Semir Zeki, having coined the term 'neuroaesthetics' (Zeki, 1999) has been focussing on the 'neural basis of artistic creativity and achievement, starting with the elementary perceptual process' (Zeki, 2001). His key proposal is that visual art is an extension of the functions of the visual brain and that function is the acquisition of knowledge (Zeki 1997). According to him, visual art follows two principal laws of the visual brain namely: the law of constancy and the law of abstraction (Zeki 2001). Since our visual environment is in a continuous state of flux, the brain, he says, has to extract the constant essentials from the ever-changing information reaching it by the process of discarding non-essential information, by selecting only those necessary for acquiring knowledge and comparing and categorising the selected information with brain's stored record (Zeki 1997). The limitations of human memory impose the brain to generalise or abstract information from the array of particulars for efficient acquisition of knowledge. Drawing an extremely interesting analogy, Zeki points out that this is exactly what visual art construction also involves. He says: 'a great work of art tries to distil on canvas essential qualities' and abstraction is also a fundamental characteristic of art 'through which it externalizes the inner workings of the brain' (Zeki 2001).

While explaining art as an extension or manifestation of the function of the brain in the quest for constancies and essentials, Zeki explains the concept of Platonic Ideal through neurological inputs. Explaining the discussions on the 'Ideal couch' as mentioned in Plato's Republic, Zeki elucidates the same by referring to the brain. He says:

'In neurological terms, therefore, the Platonic Ideal is nothing more than the brain's stored representation of the essential features of all the couches that it has seen and from which, in its search for constancies, it has already selected those features that are common to all couches' (Zeki 1997).

However, according to Zeki, Plato's concept of the Ideal as an abstract form must have bases in perception. Zeki explains with examples how the databases

of observations within the 'critical period' stored in memory interacts with daily experiences as well as with innately acquired abstractive processes of the brain to form the Ideal or the Concept or the Archetype. How the brain forms abstraction, he says, is a central problem in cognitive neurobiology. He refers to certain limited number of cells [less than 1%] in the Inferior Temporal Cortex of the brain, which seem to be able to recognize objects in a view invariant manner after brief exposure to several distinct views, which they obviously synthesise (Zeki 1997). That the formation of Ideal is not merely a learning based construct is however admitted by him in a later article when he says:

'But I believe that there is a formal contribution that is made repetitively by the brain, in every area of the cerebral cortex - and that contribution – abstraction - is not acquired through experience but is innate' (Zeki 2002).

Zeki extends the concept of Ideal formation of external objects to the abstraction and idealisation of emotional values like love. According to Zeki, the abstract Ideal synthesised by the brain from many particulars leaves an indelible imprint in the mind of the artist though the daily experience is that of particulars. This leads to a deep dissatisfaction since the universality of the Ideal seems to be missing in the real tangible object. To resolve this conflict the artist takes refuge in art and adopts certain techniques to represent the Ideal as closely as possible. In an ambitious endeavour, Zeki transcends the object Ideal and discusses how the Ideal of romantic love that the artists Dante, Michelangelo and Wagner created in their brains, resulted in a conflict in their real lives (Zeki 2002). Each of these artists, he said, was impelled in a different way to express their Ideal through their works of art. Dante's unfulfilled and unsatisfied love for Beatrice is sublimated into his love for philosophy and wisdom expressed in his works through the '*Vita Nuova'*, the '*Convivio'* and the '*Paradiso'*. The non-finito or incompleteness in a majority of sculptures of Michelangelo [like the Rondanini Pietà] is, according to Zeki, a conscious attempt to express the universality of his Ideal human form. Wagner, similarly, understood the impossibility of reconciling with Ideal love in real life and instilled the dissonant, unresolved and unfinished quality into the progression of the Tristan chord in his masterpiece composition of '*Tristan* and Isolde'.

Zeki critically analysed the aesthetic theories of Plato, Kant, Hegel and Schopenhauer and arrived at the conclusion that the brain can go beyond the information provided by the physical environment and so does art. His laws of constancy and abstraction establish how acquisition of knowledge is possible by the visual brain and visual art. The inborn predispositions, he believes, needs to be nurtured within 'the critical period' of development to build up any ability to recognise forms and hence he made the striking [he himself regarded it as 'audacious'] remark that 'forms do not have an existence without a brain' (Zeki 1998).

V.S. Ramachandran: Tinbergen's Gull and the super-stimulus

The 1999 article of Ramachandran, '*The science of art - a neurological theory of aesthetic experience* (Ramachandran and Hirstein 1999)' had a background deeply rooted in Indian art. Ramachandran, while studying historical Indian sculptures, especially the Chola bronzes, realized that art has got nothing to do with replicating realism and one of its essential roles is to evoke emotional responses (Ramachandran, at Asian Art museum lecture, 2011). He was intrigued by the exaggeration of forms in Indian art. In several of his gripping lectures on the neurology of art he compares the deliberate unnaturalism of 12th century Indian bronze sculpture of a woman with 20th century work of Picasso (Ramachandran, at Asian Art museum lecture, 2011). Ramachandran dismissed the concept that Indian art at that time was not aware of the perfect form and showed with examples from Indus Valley sculptures how extraordinary sense of proportion and realism they had since antiquity (Ramachandran, at Asian Art museum lecture, 2011). He suggested that during an aesthetic experience:

'Each stage of visual processing is not isolated but linked in such a way that each step produces partial reward for discovery and creates a bias decision for the next step. The amygdala sends back processes to every stage of visual processing for the mini-reward' (Ramachandran, *CARTA lecture* at UC, San Diego, 2009).

In their 1999 paper, Ramachandran and Hirstein formulated the laws of artistic experience which according to them are the underlying universal rules of art. The key aspects of the laws are - peak-shift, grouping, contrast, isolation, perceptual problem solving, symmetry, generic viewpoint, balance, harmony and metaphor. They however categorically stated that the artistic individuality does not necessarily deny aesthetic universals. It was while explaining the principles of the peak-shift that Ramachandran stressed upon his concept of the primitive perceptual imprint (or Archetype) that he emphasised cuts across phylogeny. So for the first time a neuroscientist seriously looked into the roots of art deeper down into the animal kingdom. The explanation of the peak-shift principle by Ramachandran is a subject of huge controversy and hence I quote exactly what he himself meant by the term:

'Consider the peak shift effect — a well-known principle in animal discrimination learning. If a rat is taught to discriminate a square from a rectangle (of say, 3:2 aspect ratio) and rewarded for the rectangle, it will soon learn to respond more frequently to the rectangle. Paradoxically, however, the rat's response to a rectangle that is even longer and skinnier (say, of aspect ratio 4:1) is even greater than it was to the original prototype on which it was trained. This curious result implies that what the rat is learning is not a

prototype but a rule, i.e. rectangularity. We shall argue in this essay that this principle holds the key for understanding the evocativeness of much of visual art. We are not arguing that it's the only principle, but that it is likely to be one of a small subset of such principles underlying artistic experience' (Ramachandran and Hirstein 1999).

As stated by Ramachandran in his article and several subsequent lectures (Ramachandran and Hirstein 1999; Ramachandran, at Asian Art museum lecture, 2011) the essence of the peak-shift principle is best illustrated by the work of Nobel Prize winning ethologist Nikolaas Tinbergen on the stimuli that elicit pecking behaviour in young herring gull, *Larus argentatus* [Tinbergen's work is discussed later in this essay with reference to archetypes in section 6]. Young herring gull chicks, as a rule, peck at the red patch on the lower mandible of their parent's yellow beak (tenCate et al., 2009). To investigate the 'instinctive behaviour' of these chicks, Tinbergen examined whether the presence, colour and position of the patch affected the pecking of the chicks. The fundamental inference of his experiment was that irrespective of whether it was the original mother bird, or a model or simply a stick, the presence of the red dots significantly increased the pecking behaviour and surprisingly 'a very long, thin brown stick, with three red stripes at the end is even more effective in eliciting pecks than the original beak' (Ramachandran and Hirstein 1999; Ramachandran, at Asian Art museum lecture, 2011). The 'red dot' as Ramachandran said, 'is an example of a 'releasing stimulus' or 'trigger feature' since, as far as the chick's visual system is concerned this stimulus is as good as the entire mother bird' (Ramachandran and Hirstein 1999). Ramachandran drew the conclusion that Tinbergen had inadvertently produced a super-stimulus, or a caricature in 'beak space' and he extended this concept to visual art production and appreciation when he inferred:

'Likewise, it is possible that some types of art such as cubism are activating brain mechanisms in such a way as to tap into or even caricature certain innate form primitives which we do not yet fully understand.' (Ramachandran and Hirstein 1999).

A potential question can be raised from these discussions that if the perceptual imprint acts as super-stimulus then the members of the same species, just like the herring gulls, should be uniformly attracted or drawn towards the expressed form. It may work in case of gulls but this is simply not the case in art appreciation by humans. There is an enormous diversity in human preference towards a particular type of art. This problem is more-or-less similar to the problem of 'variability based upon a commonality' that Zeki discussed elsewhere (Zeki 2001). Ramachandran tried to deal with it while describing the neurology of the Cubist art-form. He explained in one of his lectures (Ramachandran, at the Millennium lecture at UC, San Diego, 2000) that the

human brain, in the Temporal lobe [an area known as Fusiform Face Area or FFA], contains face-recognising cells of different categories each of which recognize a face in a particular orientation. These face-recognising cells get activated after a facial-perspective is presented and transmits the input to a master-face cell which can combine the information of an integrated face [compare Zeki's view-invariant cells, (Zeki 1997)]. Cubist form has in its essence the conscious effort to eliminate perspectives and hence there are juxtapositions of multiple perspectives in the form. Thus, he postulates that when an observer views a Cubist facial composition, the master-face cell in his brain gets directly super-stimulated. Now, why is it then a section of people simply don't like cubist art? Ramachandran believes that even in these people the master-face cell gets super-stimulated but a process of 'engagement and denial' is also operating in the highly plastic human brain which is a result of development of his personal taste through learning. Thus the highly evolved human brain that can modify itself through independent decisions and judgments can modulate and even negate instinctive responses.

V. Neuroaesthetics: *criticisms, extensions and limitations*

Opinions against Ramachandran and Zeki

The new branch of science 'neuroaesthetics' has met with strong criticism from several quarters: from the scientific community as well as from art historians and philosophers. Lots of questions were put forward, some, to dismiss the subject altogether and some to point serious loopholes.

John Hyman, Professor of aesthetics, Queens College, Oxford, for example had stated to have discovered vital flaws in the concept of the peak-shift principle as put forward by Ramachandran. Hyman stated:

'Unfortunately, however, Ramachandran's theory has three fatal weaknesses. First, Ramachandran seems to have misunderstood the peak shift effect. Second, the theory is not really about art at all. It is really about why men are attracted to women with big breasts. And third, the theory is based on an extremely limited knowledge of art' (Hyman 2010).

The Hyman-Ramachandran conflict is a very interesting topic which may require another full article to discuss and I think the harshness with which Hyman dismissed Ramachandran was also not appropriate. The interpretation of Ramachandran's version of the peak shift principle by Hyman is misleading and I think that the peak shift towards 'very slightly wider hips and very slightly larger breasts than average (Hyman 2010)' represents exactly the exaggerated contours as represented in the Indian sculptures and as described by Ramachandran. If one reads Kalidasa and his description of the female form, one can get an idea of the 'average' Indian woman figure that was appreciated at that time. I also differ with him when Hyman says: 'there is no evidence that male spectators who find these sculptures beautiful have innate

or learned stereotypes that interact to produce a peak shift in their response to female body-shapes' (Hyman 2010). If we take into account the numerous scientific studies performed on the 'innateness' of preference, conducted especially during researches on 'infant semiosis' and 'fetal psychology' (Dissanayake 2009; Trevarthen 1994; 1997; Meltzoff & Moore 1977; Field et al. 1982; Jaffe et al. 2001) [the innate proto-aesthetic predispositions are discussed later in section 6.1], we can understand that innateness is regarded as one of the crucial interactive factors along with experience and learning to generate preferences. Hence, it is premature to dismiss a hypothesis regarding innateness of aesthetic preference. It is altogether a different issue whether we would indeed like to draw careful correlations between genetically predisposed pattern recognition and some of the basic attributes of archetypes or whether we would prefer not to de-mystify these philosophical terms such as Ideal, Form and Archetype and keep them isolated from scientific investigations [this is discussed later in sections 6.2 and 6.3].

Lastly, I differ from Hyman's interpretation of Ramachandran's 'caricature' and also his criticism of Zeki's concept of 'ambiguity' which he dismissed by saying 'Multiplicity is not always a good thing.' The true meaning of these terms can well be deciphered if one reads Changeux, Zeki and Ramachandran with an open mind and I think this review explains their fundamental ideas. Both 'caricature' and 'ambiguity' are used as means to represent the universality of the image and they do not merely involve the exaggeration of lines or adding multiple objects in the picture but can involve the countless number of facets including caricature and ambiguity of content, ideas and motifs which can be done in endless number of possible manipulations of Form. It is the higher levels of ambiguity that Zeki explains with reference to art that is important in our analyses (Zeki, 2004). Through Vermeer's paintings and Michelangelo's sculpture (Rondanini Pieta) Zeki asserts that a great work of art deliberately introduces element of ambiguity through form and content so that the capacity of multiple experiences are there even though we are conscious of only one at any given moment (Zeki, 2004). These multiple experiences, he says, can even be contradictory in nature which can enhance the interpretive perspective. At a higher level this ambiguity of art can activate several distinct areas of the brain including the frontal and pre-frontal cortices that are able to bring their influence certainly involving top-down effect (Zeki, 2004).

The concept of top-down processing in cognitive psychology is that it is the sensory processing which is influenced by expectations, stored knowledge, context and so on (Eysenck, 1998, p. 152). The brain, as we know, is not a mere passive recorder of external events but an active participant in constructing what we see to gain knowledge about the world (Zeki, 2004). Top-down control has a priming effect on our psychology of perception as well as interpretation. Thus through top-down control, what we experience is guided by what we expect to experience. Top-down processing is a knowledge-

driven processing involving the use of contextual information supplied from memory (Carlson et al., 2010, p. 202). It's crucial difference with bottom-up processing is that top-down processing does not rely solely on information directly drawn from a stimulus but uses innate as well as imprinted (the difference between the terms 'innate' and 'imprinted' were already explained before) information that already exists in the cognitive system. This concept of top-down processing integrates the neuro-philosophy of Ideal with Jung's Archetype and Gestalt theory.

E.H. Gombrich, whose ideas were discussed in this review itself, strongly criticised Ramachandran and Hirstein commenting that 'Even a fleeting visit to one of the great museums might serve to convince the authors that few of the exhibits conform to the laws of art they postulate' (Gombrich 2000).

The typical criticism of neuroaesthetics concerns the common theme that neuroaesthetics is shrinking the subjective aspect of aesthetic experience to a set of neurological laws. The interesting aspect to note is that none of the neuroaesthetes yet, had ever claimed that the aesthetic universals or the functional specializations of the brain in anyway deny artistic individuality. One only need to look at Zeki's articles where he repeatedly mentioned the fact that the areas V4, V5 etc are not the mediators of aesthetics of a particular art form but only that they are necessary to it. Zeki even confessed:

'I am tempted to generalize and say that there is a functional specialization in aesthetics, which does not exclude the fact that all of these separate aesthetic systems may both interact with one another and also lead to a higher aesthetic which neurology has not even begun to investigate' (Zeki 1997).

Extending the boundaries of neuroaesthetics:

A crucial area of concern about neuroaesthetics, however, comes from Anjan Chatterjee's views. Chatterjee, from the University of Pennsylvania, was instrumental in formulating the 'assessment of art attributes' to quantify judgments of descriptive attributes of visual art (Chatterjee et al. 2010). As summarised by Nadal and Pearce in their article on the Copenhagen neuroaesthetic conference, Chatterjee raises an important issue regarding the testing of hypotheses about the neural basis of artistic appreciation and production. He stated that although these tests

'makes the tacit assumption that complex artistic and aesthetic experiences result from the interaction of simpler processes whose contribution to aesthetic experience can be investigated separately,...this may not be the case: it may be impossible to isolate the component processes without losing the aesthetic experience itself' (Nadal and Pearce 2011).

Chatterjee argued that the restriction of laboratory conditions is 'a strongly limiting factor' in testing these hypotheses.

Similarly, Ellen Dissanayake (2009) believes that the boundaries of neuroaesthetics should be broadened to encapsulate the huge spectrum of arts. She proposed that artifaction is a 'universal adaptive behavioural predisposition' whose components are ancient and the root of its development and selection is the convergence of higher cognitive ability of human brains and the crisis of early gestation.

The primary drawback of current neuroscientific investigations on art is that it fails to trace the functional coherence of the entire process of generation of aesthetic delight. Brain imaging studies have localised certain areas which respond to specific art attributes (see Nadal & Pearce 2011) but have failed to offer a justifiable rationale how these regions work differently outside their normal context to generate the distinctive feeling of aesthetic delight. Based on this problem therefore, recent studies are trying to trace the temporal changes in the activity of the brain during aesthetic activity by measuring Event Related Potentials (ERP) (Augustin et al. 2011). The relevance of the Default Mode Network of the brain in relation to aesthetic delight was recently investigated in at least in two significant works by Cela Conde et al. (2013) and Vessel et al. (2012; 2013). To understand the functional coherence of the entire process of generation of aesthetic delight the temporal dynamics of the Default Mode Network needs to be understood (Mukhopadhyay 2014). The use of complex natural stimuli is now preferred in recent studies along with neuro-cinematic approaches (Hasson et al. 2008; Carvalho 2011; Kauppi 2010; Wang et al. 2012). The contribution of semantic context was also dealt with in recent investigations (Kirk et al. 2009).

VI. The relevance of Jung

The genetics of Archetypal inheritance:

In the introduction, I did mention the two definitions of the term Archetype and up till now have largely refrained from providing any explanations of the definition based on *Jungian Psychoanalytic theory*. The Swiss analytical psychologist and psychotherapist Carl Gustav Jung's (1875–1961) development of the concepts of 'collective unconscious' and Archetype with reference to depth psychology had its roots in Darwinian natural selection, in the fundamentals of evolutionary biology and in a profound research on ethnography. It had even been amalgamated later with the philosophy of quantum physics as seen in the Jung-Pauli Archetypal hypothesis (Morariu 1998). Still, there are two reasons why Jung's theory was marginalized and not acknowledged by a large section of the scientific community. The primary reason behind this is Jung himself, who, rather than following the conventional materialism of experimental science, integrated his non-testable hypotheses on psyche and spirituality with his theory on Archetype. The second reason is

fundamentally linked with the first one and that is the problem of acceptability in the scientific community. The way Jung is dismissed even today is very similar to the way the indeterminacy and unpredictability of quantum physics was dismissed even by Einstein and the way Chaos theory was ridiculed even a few decades ago. The problem is, despite having the mathematical and experimental proofs that we do not live in a determinate world, most of our scientists, not directly linked with the studies on the probabilistic universe, even now, are anchored to the clockwork concept. I do believe that Jung's views on consciousness which echoed fundamentals of Hindu and Buddhist philosophies will rekindle new scientific research in the future. It will be similar to the advancements of quantum physics which had discovered remarkable similarities with its principles of the observable universe and the essentials of Eastern monistic philosophy. The interesting aspect though is the fact that the basic theory of collective unconscious and Archetype can now be well explained by current evolutionary genetics and ethology without delving deep into the unexplainable. I shall review its relevance here.

Jung believed that beyond a 'personal unconscious' as described by Sigmund Freud, 'there exists a deeper layer of 'collective unconscious', which does not derive from personal experience and is not a personal acquisition but is inborn' (Jung 1969, *Collected Works,* Vol. 9, p. 3). He stated:

'This deeper layer I call the collective unconscious. I have chosen the term "collective" because this part of the unconscious is not individual but universal; in contrast to the personal psyche, it has contents and modes of behaviour that are more or less the same everywhere and in all individuals... The contents of the collective unconscious... are known as archetypes' (Jung 1969, *Collected Works*, Vol. 9, pp. 3-4).

According to Jung, it is through the analysis and interpretation of symbols that are evident in dreams, fantasies, visions, myths and art that Archetypes can be analysed. Jung associated his Archetypal image with the Platonic Ideal and called it an 'explanatory paraphrase' of the same (Jung 1969, *Collected Works*, Vol. 9, p. 4). The Archetypal image in art forms was explored since pre-historic times as is found in ancient artworks throughout the world starting from the cave paintings and is still prevalent among numerous tribes. Jung believed so deeply in the representation of Archetypal symbolism in visual art that he adopted art-therapy as part of his psychoanalysis stratagem and exploration of the collective unconscious (Jung 1969, *Collected Works*, Vol. 9). The essential biological attribute of Archetype acknowledged by Jung is as follows:

'This collective unconscious does not develop individually but is inherited. It consists of pre-existent forms, the archetypes, which can only become conscious secondarily' (Jung 1969, *Collected Works,* Vol. 9, p. 43).

Hence, the universal Archetypal imprint is, according to Jung, physically inherited from our ancestors and is a phylogenetically conditioned part of the human structure. If this collective unconscious is an accumulation of repeated experiences over many generations, the fundamental area of investigation is whether these patterns can be inherited within the span of human development. We have to revert back to Changeux who believes that there is indeed genetic evolution in the development of the human brain within the time period of Hominin evolution. Changeux refers to the brain development from Homo erectus (1.5 million years ago) to Homo sapiens (100,000 years ago) and showed how the concepts of 'symmetry', development of symbolism through funerary offerings and development of cave paintings successively originated in Homo erectus, Homo heidelbergensis and Homo sapiens respectively (Changeux 2009). He also cites example from the '1000 genomes project' and stated that although the gene sequence difference between chimps and humans is only 1.2%, there is a difference in the *Copy Number Variations* (CNVs) between humans and apes and some of these CNVs are associated with intellectual development (Changeux 2012).

To discuss Jung's Archetype, we should focus on the possibility of genetic inheritance of the Archetypal template. That the new-born child is born with some innate genetic predispositions was emphasised by Jung himself when he stated: 'It is in my view a great mistake to suppose that the psyche of a new-born child is a tabula rasa in the sense that there is absolutely nothing in it' (Jung 1969, *Collected Works*, Vol. 9, p. 66). In 2009, Ellen Dissanayake, while discussing the proto-aesthetic dispositions in infants to develop her Artifaction hypothesis, echoed almost the same view:

'...common pediatric wisdom held that apart from a few innate reflex behaviors—crying, suckling, clinging, startling—babies were pretty much wax tablets for their elders to inscribe as they (and their cultures) decreed. Today, however, it is well established that newborns come into the world with decided preferences and motivations, so that one can speak intelligently of "infant semiosis" and even "fetal psychology"' (Dissanayake 2009).

Dissanayake cited some remarkable examples to demonstrate that newborns are born with some genetically inherited proto-aesthetic predispositions. For example, she explains how the newborns prefer human faces to any other sight and human voices to any other sound. How they can imitate gestures and respond to emotional expressions of sadness, fear, and surprise and lastly how they have remarkable ability to anticipate temporal patterns (Dissanayake 2009).

One may argue that a few million years of development of human race is insufficient for expression of a trait through natural selection. Current evolutionary genetics have proved that this is not true. Huge genetic differences were shown to have been accumulated since the human and

chimpanzee species diverged from our common ancestor (Mikkelsen et al. 2005). Further, a recent study concluded in 2010, presenting a draft sequence of the Neandertal genome, also observed the following:

'Comparisons of the Neandertal genome to the genomes of five present-day humans from different parts of the world identify a number of genomic regions that may have been affected by positive selection in ancestral modern humans, including genes involved in metabolism and in cognitive and skeletal development' (Green et al. 2010).

The alteration of lactase persistence allele necessary for lactose absorption (Ingram 2009) or the variation in the FOXP2 gene (Enard 2002) necessary for modulating plasticity of neural circuits facilitating cognitive functions also occurred within these few million years and their changes got expressed within this time scale. The discovery of human accelerated regions (Pollard 2006) in the genome has delineated its potential to evolve distinct human traits. The discovery of human specific micro-RNA copies [for example the miR-941 in the human brain (Hu et al. 2012)], which can regulate the activity of large set of genes by controlling which messenger RNAs do translate proteins, can induce development of unique human characters even long after humans separated from the chimps. Thus we see that there can indeed be a genetic basis of inheritance of Archetypal predispositions too. If the cultural traits were not inherited genetically one cannot explain how the systematic evolution of concepts of symmetry-symbolism-art could occur from Homo erectus to Homo sapiens. Also, the selection pressure operating on the development of certain cultural or artistic traits may be functional not only within the time period of Hominin evolution but long before that. Who can tell whether or not the instinctive aesthetic preferences of some birds which assist them in mate selection, later evolved into human aesthetic preferences? [This is discussed in the next section 6.2]. Lastly, one more important concept that Jung emphasised was that the archetypes can only become conscious secondarily. Recent studies on the neuroscience of subliminal consciousness categorically prove that unconscious subliminal representations can influence conscious judgments (Breitmeyer, 1984; Dehaene et al. 2006). Thus the influence of the Archetypal symbol in aesthetic appreciation of visual art does have strong neuro-genetic background.

Pattern recognition and Archetype:

The fundamental question that the essay tries to address is whether there is at all any difference between pattern recognition among humans and other animals and the philosophical descriptions of Ideal, Form and Archetype. I have also stressed upon the fact that it is a matter of choice whether we would indeed like to draw careful correlations between genetically predisposed pattern recognition and some of the basic attributes of archetypes or whether

we would prefer not to de-mystify these philosophical terms such as Ideal, Form and Archetype and try to keep them isolated from scientific investigations. In our discussions on foetal psychology and infant semiosis I have highlighted the findings which imply that certain behavioral patterns can appear in fully functional form the first time it is performed without previous experience. These behaviors are not simply restricted to crying, suckling, clinging and startling (Dissanayake 2009) as thought previously but they extend to recognition of faces, voices, gestures and emotional responses. These pattern recognising behaviors can't be explained by mother-infant interaction unless they have a firm genetic constitution. This pattern recognition, as we discussed before, is not restricted to humans but runs deep down evolutionary history (as shown in Tinbergen's study on Herring gulls). Tinbergen and others categorized these instinctive responses as Fixed Action Pattern (FAP) and the key component of an object that activates an FAP is referred to as a sign stimulus or a releaser. The neural machinery responsible for triggering an FAP response is termed as innate releasing mechanism (Alcock 2001, p. 118). These innate responses are markedly different from the other category of animal behaviour known as imprinting behaviour which is solely dependent on cues from parents or care-givers and is modulated through experience. The question is whether this primitive innate pattern recognition ability can influence the cultural traits of modern human beings. As I had discussed before, extant scientific research traced the systematic inheritance and evolution of cultural traits during the course of human evolution through the recognition of symmetry, symbolism and finally art from Homo erectus to Homo sapiens. This recognition of cultural traits can comprise an inherent advanced form of FAP response. However, the highly interactive influence of the imprinted socio-cultural-autobiographical experiences can modify the highly flexible human brain which definitely assisted in this cultural evolution. Thus in the context of visual art, a sign stimulus or the releaser in the visual form may trigger an innate releasing response (which here may be an inherent attraction towards the image) which in turn may be moulded by imprinted experiential attributes resulting in the final liking or disliking of the art.

Next we come to the most important issue whether the sign stimulus or releaser which triggers an innate releasing mechanism can be equated with Jung's Archetype or Plato's Ideal. While Jung himself partly obscured the essence of his views on Archetype delving into the spirituality of the collective unconscious, he was also keen to formulate a scientific basis of his concept. This was evident when he commented that 'there is nothing mystical about the collective unconscious' (Jung 1970, p. 45) and when he said that the psychic processes in a certain sense are the result of the action of the organism's instincts (Jung 1969, *Collected Works*, Vol. 8, par. 375, p. 180). Further, most importantly, Jung drew parallels between archetypes and animal behaviour tracing the FAP behaviors of insects (the yucca moth; Jung 1969, *Collected Works*, Vol. 8, pp. 132 and 137; Samuels 2003, p. 30). However, it was

psychologist Michael Fordham who first introduced a biological-ethological theory in defining archetypes (Fordham 2013, Chapter 1, pp.1-34). In his book New developments in analytical psychology (first published in 1957) which was foreworded by Jung himself, he republished his 1949 paper titled Biological theory and the concept of archetypes. Fordham first emphasised the fact that archetypes are hereditary functions. He commented:

'it follows that when it is said that archetypes are hereditary functions what is meant is that they must be somehow represented in the germ cells and that therefore any archetypal image recorded by the conscious mind likewise contains within it the effect of genetic factors' (Fordham 2013, Chapter 1, p. 11).

Fordham followed this with his discussions on instincts and archetypes where he drew parallels between Tinbergen's demonstration of innate releasing mechanisms and the functioning of archetypes (Fordham 2013, Chapter 1, pp. 12-13). Relating instinctual activities with the endocrine system and the central nervous system, Fordham commented:

'Of all the organs of the body, the brain is the most psychic. As it is now established that in any instinctive behaviour the nervous system, its receptors, its central structure and function, and its effective motor units play the major part, it appears likely that the study of the brain, its structure and function, will assist most in bridging the gap between body and psyche' (Fordham 2013, Chapter 1, p. 14).

Anthony Storr and Anthony Stevens also echoed similar biological-ethological viewpoints while analysing Archetypes. Storr related the innate releasing mechanisms with the innate predispositions with which the infant is born and Stevens was more specific in labelling the DNA as 'the replicable archetype of the species' (Samuels 2003, pp. 30-31).

Advanced neurological viewpoints on archetype: Rossi, Henry and current neuroimaging:

The advanced neurological interpretations of Archetypes had been developed in Ernest Rossi's 1977 paper titled: *The cerebral hemispheres in analytical psychology* (Rossi, 1977) and J.P. Henry's subsequent comments on it (Henry, 1977). Rossi proposed that archetypal processes may have their source in the right hemisphere of the brain. In his paper he investigated first the experimental findings of split brain studies (lesion studies and cerebral commissurotomy studies) by Sperry, Gazzaniga and others and showed that the '...holistic and essentially synthetic approach of the right hemisphere is in sharp contrast to the analytic, linear and reductive aspect of left hemispheric functioning' (Rossi 1977, p. 39). He then discussed archetypes in the context of these different

patterns of hemispheric functioning and commented 'Jung's concepts of archetype, collective unconscious and symbol are more closely associated with the use of the imagery, gestalt and the visuo-spatial characteristics of right hemispheric functioning...Inner figures such as shadow, anima, and animus would be archetypal processes having sources in the right hemisphere and finding expression via the forms of left in terms of language, personal experience and learned cultural tradition' (Rossi 1977, pp. 42,43). The problem though is that, this concept of cerebral dichotomy and the localisation of archetypes cannot be integrated with the other aspect of pattern recognition which occurs through imprinting as well as through innate releasing mechanisms. The simple reason being this kind of cerebral lateralisation is not seen in other animals while imprinting and innate behaviour runs deep down evolutionary history. However, the development of advanced cultural traits in humans may indeed need this kind of cerebral lateralization and dichotomy in order to constantly engage in the ability to modulate the instinctive response through experiential conditioning aided by a highly plastic brain. J.P. Henry, while commenting on Rossi's paper began by saying that 'many of the activities in religion and art may depend on transcallosal interaction' (interaction between the hemispheres through the bridge or the corpus callosum) (Henry 1977, p. 52). He also commented on the evidences that 'fantasy and dreaming are times when the brain processes the interaction of innate behaviour with recently acquired condition' (Henry 1977, p. 52). However, Henry stresses the need to investigate subcortical structures when he emphasised that neocortical areas (the hemispheres) 'cannot account for the emotional responses accompanying inborn patterns of behaviour' (Henry 1977, p. 52). Henry commented on Jung's archetype by saying that 'his concept of the archetype was of a linking network whose symbols project up into the peculiarly human interhemispheric world of language, images and ideas, but which was rooted in the biological processes of the subcortical regions' (Henry 1977, p. 54).

The significant improvement in the neuroimaging techniques from the 1990s made possible for the first time to investigate particular areas of the brain through non-invasive mechanisms in live condition. Among the neuroimaging technologies available till date, two are most frequently used: functional Magnetic Resonance Imagery (fMRI) and Magnetoencephalography (MEG). In order to measure synchronous, spontaneous activity over a precise small unit of space, the fMRI offers a reliable measure of activity. The fast-paced temporal changes in neuronal activity are also another criterion to look into while observing how the activity changes over time in different parts of the brain. For that MEG is now successfully used. In order to solve the problem of individual deficiencies of either MEG (/EEG) or fMRI, approaches currently in use also combine the two neuroimaging techniques. Using Magnetoencephalography (MEG) Cela Conde et al., (2013) categorised two different phases of aesthetic appreciation: a fast aesthetic appreciative

perception formed within 250-750 ms time window and a delayed aesthetic appreciation performed within 1000-1500 ms time window. Subsequent fMRI studies by Vessel et al. (2013) and the 'dual phase oscillation' hypothesis proposed by Mukhopadhyay (2014) supports the occurrence of these two phases of art appreciation. What is worth investigating here in the context of Rossi and Henry's studies is that whether we can spatially and temporally locate the differential activation patterns of the cerebral hemispheres as well as the subcortical brain regions through fMRI and/or MEG while recording the neural signatures during art appreciation. It is worth noting whether the 'synthetic-gestalt' (Rossi, 1977, Table 1, p. 33) response of the right hemisphere shows a different temporal activation pattern in comparison with the 'logical-analytic' (Rossi, 1977, Table 1, p. 33) responses of the left hemisphere while analysing an art work. The fundamental patterns of the art form can influence the limbic system during the initial, fast aesthetic appreciative perception phase though the conscious representation of these emotional states may not have yet developed (Mukhopadhyay, 2014). It can be investigated through current neuroimaging whether this subcortical activation phase corresponds with the activation of the right hemisphere and whether this again corresponds with the 'synthetic-gestalt' response during art appreciation.

It is now possible through neuro-imaging to localize brain areas specifically responding to a super-stimulus like the master-face cell areas of Fusiform Face Area or the view-invariant cells in the Inferior Temporal Cortex of the brain. Hence specific neural signatures of individual responses to a super-stimulus can be codified.

As mentioned earlier, Jung associated his Archetypal image with the Platonic Ideal and called it an 'explanatory paraphrase' of the same (Jung 1969, Collected Works , Vol. 9, p. 4). The Platonic notion of the Ideal Form has got striking similarities with Jung's concept of Archetypes. Our discussion on Zeki's neurological explanation of the Platonic Ideal suggests that the concepts of Archetype and the Ideal can be integrated as both can be neuro-genetically explained through an inherent hereditary template. Hence, if we make careful correlations leaving out the mystical haloes from these terms, we can construct a scientific foundation based on the essences of Archetype and Ideal especially with reference to neuroaesthetics.

VII. Conclusions

Neurological constitution of art appreciation

My review concerns the philosophical and scientific propositions on the concept of Archetype with reference to visual arts, which I have shown that even from ancient times tended to have an inherent neurological constitution. Thus the development of neuroaesthetics, I believe, had its roots embedded deep into the past. The concepts of Ideal and Archetype refers to a wider

perspective dealing with the interaction of the observer with his world. Their relevance with reference to aesthetics and more specifically to visual arts concerned the vital question whether or not an inherent universal symbol behind the represented image acts as a guiding force in aesthetic creation and appreciation. The debate regarding the innateness or experiential acquisition of this Ideal image started since Plato and gradually the neurological foundations were built in the analyses of these concepts. The current neuroaesthetic propositions state the highly interactive influence of both the innate propensities and the experiential modification of the highly flexible human brain where neurons and synapses show a massive level of plasticity. Visual art is now regarded as an extension of the visual brain which follows the same perceptual principles of abstraction and constancy. The instinctive attraction towards a super-stimulus is not distinctly of human origin but has its ancestry rooted deep into phylogeny. Advances in ethology, neurology and genetics can help us in making careful correlations between genetically predisposed pattern recognition and some of the basic principles of archetypal psychology. The development of rationality and judgment as unique attributes of human consciousness often interferes and dictates the instinctive preferences. Plato's Ideal or Jung's Archetype thus can have a distinct neurological and genetic basis.

'You are your brain'- misunderstandings and oversimplification

The problem of neuroscientific investigation of consciousness (including aesthetic consciousness) is that the interpretations can easily be oversimplified. Views of a section of neuroscientists are responsible for this oversimplification and a general belief has developed that neuroscience is bent upon creating the dogma that a person is a functioning assembly of brain cells and so is consciousness. The proposed 'astonishing hypothesis' by Francis Crick (Crick 1995) has further fuelled this erroneous belief stating that a person's mental activities are exclusively due to the behaviour of nerve cells, atoms and molecules. The notion that contemporary neuroscience still holds the Cartesian dogma of the 'thinking thing inside' (Noe 2011) has created a huge block in understanding the more practical and fundamental problems of consciousness and aesthetics alike. It must be understood that the concept of neural Darwinism of Changeux, the global-neuronal workspace theory or the views of Zeki or Ramachandran explained here in the context of neuroaesthetics does not for once deny the fact that the dynamic interaction between the brain and environment is absolutely critical for generation of aesthetic consciousness. Neuro and molecular genetics as well as branches of epigenetics also unequivocally support the role of man-environment dynamism in the development of consciousness as well as in aesthetic appreciation as is evident from the works of Changeux described before. The discovery of neural correlates is definitely a step forward and unquestionably more realistic than trying to explain a mystery by another mystery. We need to be aware though

of the limitations of each and every disciplines of search and thereby strive for holistic synthesis.

The limitation of current neuroaesthetics research leads us to the possibility of cultivating areas beyond neuroscience. This is because the ultimate questions still remain to be answered– what governs the neuro-genetic circuitry to generate the Ideal representation out of infinite possible representations? How can an electro-chemical circuitry generate the feeling of a subjective experience? Is it something beyond neurons and genes operating at a more fundamental level? Is quantum physics involved in collapsing the range of possibilities? May be the final answers will be found once the ultimate problem dealing with the generation of consciousness is solved.

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