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The Mathematical Nature of Curves in Relation to Art

Olubunmi, David

Abstract

The paper's aim is to connect the dots between mathematics and aesthetics by investigating how the nature of curves aid beauty features in the world of art. The mathematical properties consisting of shapes and sizes, where curves are concerned, take centre stage in explaining how the senses interpret curves in the human form, sculptures and paintings. The paper's findings include the fact that the object of art in this sense possesses mathematical attributes that are of significance to the aesthete. The paper also probes into the problem of how we mentally construct judgment of objects possessing the mathematical feature of curves since they emanate from mathematics but factor in aesthetics as well. The submission of this paper is that a synthesis of reason and sense experience is required for our comprehension of curves. Employing the phenomenological method, this paper looks at the mathematical nature of curves in the presentation of beauty in objects by standing back from the phenomena of experience in getting rid of bias and prejudices in order to comprehend the mathematical reality of beauty in curves.

Keywords: mathematical, curves, art, object, aesthetics

Introduction

Curves feature in art objects, so it is paramount that their mathematical importance in defining beauty is understood. By understanding how curves enhance the beauty of an art object in terms of creating delicacy and balance, the role of the senses is promoted in the aesthetic enterprise. Beginning with Pythagoras, Russell posits that:

He discovered the importance of numbers in music, and the connection which he established between music and arithmetic survives in the mathematical terms of 'harmonic mean' and 'harmonic progression'. He thought of numbers as shapes, as they appear on dice or playing cards. We still speak of squares and cubes of numbers, which are terms that we owe to him. He also spoke of oblong numbers, triangular number, pyramidal numbers, and so on... He thought of the world as atomic, and of bodies as built up of molecules composed of atoms arranged in various shapes. In this way he hoped to make arithmetic the fundamental study in physics as in aesthetics (Russell, 1979:59).

The crux of the matter is that there is beauty in mathematics (Russell, 1979), which is what provides impetus as to why we can probe into its rigorous nature in order to understand how it factors in aesthetics.

The symbolic nature of curves in mathematics is in itself *a posteriori* as it is within the context of sense experience. For objects of mathematical knowledge to confirm to our faculty of experience, therefore, their aesthetic merits must be conceived in symbols. And by symbols, here, we mean empirical features that are represented symbolically in terms of shapes and sizes. Wassily Kandinsky's concept of synaesthesia—the correspondence of the senses—maybe with respect to how the colours of a painting produces musical effect; however, it is in semblance to how the senses perceive the features of curves in sculptures, painting and in the human form. The sensory feelings that come from being in wonder and awe as we observe the form of an art object due to its delicate curves and detectable shape is what we shall explore next in this paper.

Forms and Beauty

Qualities in beautiful objects concentrate on the form of objects, such as intricacy and balance in components or harmony of parts (Ome, 2012). We find this approach in mathematical theories from Pythagoras to Kant. It is interesting that Kant (1997) referred to pyramids or the interior of St. Peter's in Rome as the mathematical sublime. Denzel Washington, for instance, is said to be handsome due to the symmetry of his facial features and Beyonce is said to be beautiful because her body possesses curves. William Hogarth (1753) concluded that beauty always has a mathematical basis. His "line of grace" was invoked by Edmund Burke (1757), who speculated that the appeal of beauty has an erotic origin in the curves of the ideal female body. Francis Hutcheson (1984) offered a more flexible formula: the pleasure of beauty is aroused by a "compound variety of uniformity and variety." Monroe Beardsley (1981) generally posited some canons for aesthetic judgement in a more contemporary version: unity, complexity and intensity.

The form in which the object assumes presents a symbolic depiction of its beauty patterns. Through a display of the formal properties of an object, the appeal to sense experience is essentially relayed in the physical. Therefore, shape, symmetry, lines, and curves can all be attributed to mathematical dimensions in an object's formal properties. Since relishing the object's presentation to the senses and to the imagination is what beauty depicts, the way our senses interpret mathematical curves is very important. At various places in the scriptures (2Samuel 11:2d, Genesis 26:7d; Genesis 29:17) we are told that "...and the woman was beautiful to look upon." The questions is:

what, indeed, is it that makes the woman beautiful to look upon? It is in the embodiment of the shape – that the object assumes – that beauty appears to us. The projection of contours and lines in the outline of a landscape or a sculptural piece spells out the aesthetic merit of the object. The likes of Tolkien and G.R.R. Martin were known for the imagery they employed when it came to describing landscapes. The interaction of lines in the colourful tapestry of a painting puts form and beauty in the picture framework.

Form is an independent property of an aesthetic object (Beardsley, 1981). As a primary quality, the shape of the object of art belongs to it. It is with respect to this philosophical notion that we may say the form of an aesthetic object provides distinctive features to make it beautiful by virtue of its shape, thickness and contours. The science of curves in this regard provides the object with visual density with reference to size (Beardsley, 1981). A woman's body, as a work of art, is a classic epitome of this. The perception of form in the physical world can be made explicit through its sense of balance. The likes of Pablo Picasso and Henri Matisse were influenced by the geometric qualities and abstract forms of African sculpture (Ome, 2012). It is within this context that it would suffice to say that there is a resemblance of sculptures to human beings in a way that the aesthetic statement of symbolic forms are well expressed. It is in the quest to attain beauty, balance and proportion that the form of an art object is crafted to begin with.

The art object assumes the quality of its shape or figure. In this regard, the beauty of the object becomes much more pronounced. This primary quality resonates in figurative expressions of art that are often embodied in design features that produce not just balance and harmony but also exaggerated features. Some sculptural pieces, for example, are presented with exaggerated shapes that give the impression of a caricature. Art, as understood in such measures, becomes highly visual. The beholder of art in this sense has to make use of the sensation of sight and touch in order to appreciate the use of curves whether in paintings or in sculptures. The celebration of curves therefore lies with how the sculptural piece is carved and how lines are used in paintings to express their visual sensations. Some artists even go as far as using the forms of a bottle or an hourglass to perfectly exhibit the nature of curves in relation to art (Beardsley, 1981). The formal property of curves in any art design indicate how beauty is expressed since, symbolically, curves of various shapes and sizes define beauty whether in an ideal human form or in the contour slopes of a mountain.

The Aesthetic of Curves

Curvature is a key factor in visual aesthetics (Allan, 2017). Husserl's phenomenological epoche aids in our understanding of this since—after we bracket our bias as we go into the aesthetic object—perception begins to open up to us so much so as we try to comprehend the nature behind curves. Nietzsche, for instance, posited that the senses could validate truth by grounding aesthetic experience in the body's libido. The woman's anatomy, in terms of her breasts and buttocks, provide credence to the fluidity of the aesthetic nature behind curves. In pop culture, the likes of Beyoncé and Kim Kardashian are taken as models where curves are of primary concern. Consequently, females engage in plastic surgeries to enhance their feminine curves. Human physiology becomes significant in this context because beautiful things, we are told, are feminine in nature (Christopher and Piero, 2010). Nietzsche (2010) particularly took value in the object's perception of woman as the *other*, a libidinal energy flowing from the unconscious. Reference to curves, even in the erotic sense, can be found in literature; for instance, Wole Soyinka wrote in *Death and the King's Horseman* (1975:19): "Not even Ogun with the finest hoe he ever forged at the anvil could have shaped that rise of buttocks..."

When an art object is symbolically projected with curvy features, it bears fundamental hallmarks of luminosity as found in figurative sculptures, for example. It is the projection of these curves that present a definite figural representation regarding the sculpture since the object becomes much more elaborate and realistic. Although this in itself appeals to experience, it also provides some of the highest quality to the art. Curves depict so much realism in aesthetics. The realistic and figurative nature helps provide expressions for landscapes, mountains, rivers, valleys and the ideal of female beauty. The interpretation of natural phenomena in this sense cannot be divorced from understanding the pattern of curves and the forces that shape it.

Curves are also represented in paintings through a variety of shapes. When painters build a world of reality through their works, they make shapes dance through a pattern of curves. The viewer's eye is guided by light as a reason for the perceptual powers logically comprehend the movement of curves. The likes of Ilya Repin and Johannes Vermeer are painters who employed curve motifs to articulate their works. The curves on the human body, the twists and bending of a tree as the wind blows, and the landslide of the mountains, all exhibit curving moments. The art form behind paintings may require stripes to be self expressive, nevertheless rounded curves also provide aesthetics with meaning that makes paintings a beauty to behold. In approaching a painting's composition, if reality is to be forged, the aesthetic of

curves enables our perception of the natural world to encounter harmony in the complexity of the art form.

Symbolic Nature of Curves in Mathematics

The mathematical possibility of curves is symbolic because curves are derived from the form of the object. It can be spatiotemporal (Kalar, 2006) since its objective qualities requires empirical perception. The objective, perceptual representation of an object of art presents curves as a feature of the object. According to William Hogarth in his *The Analysis of Beauty* (1753), the serpentine line is the line of grace, and is represented by a “fine wire, properly twisted around the elegant and varied figure of a cone.” Our interest here lies with the serpentine line of grace. It makes sense that when analyzing the serpentine line of grace, it is reminiscent of the snakelike calculus symbol that is usually applied to explore the minimum and maximum values of a curve, mathematically speaking.

The mathematical intricacies and complexities of curves imply that beauty is intrinsically related to how symbolic curves can be. Mathematical truths, being necessary in nature, make the symbolic nature of curves indeed appealing. Mathematical objectivity in this sense provides the subject with a prior knowledge regarding the art object. Except in art genres like painting and architecture, it is not soothing to talk of curves as *a posteriori*. The human figure or a work of sculpture seemingly appears *a priori*. Elucidating on Kant’s view on this matter, Linnebo (2017:17) states that:

On the ordinary, “pre-Copernican” conception of knowledge, objects have their properties independently of us, and our mental representations must conform to these objects in order to count as knowledge. But according to Kant, this conception is unable to accommodate synthetic *a priori* knowledge. Since the knowledge is synthetic, it is about objects, but if our representations must conform to their objects, then these objects must somehow affect us, thus rendering the knowledge *a posteriori*.

Empiricism, which is knowledge that is *a posteriori*, therefore becomes a veritable tool for understanding how curves factor in where art objects are concerned – since empiricism itself is a classical approach in the field of mathematics. Where curves are said, in colloquial terms, to defy the laws of physics, the statement’s mathematical conformity is reminiscent of Plato’s world of forms since they are in relation to each other. The doctrine of the forms makes scientific knowledge possible (Stumpf, 1994). This mathematical dimension of curves finds validation in qualities of beautiful objects that concentrate on the form in order to find intricacy and balance.

The Mental Construction Problem in the Assessment of Curves

The emotional experience of synthesis allows the mathematical sublime nature of curves to delight the subject. Therefore, curves are seductive, according to Allan McRobie (2017), focusing the origins of their taxonomy in the catastrophe theory of mathematician Rene Thom and how it influenced a number of artists. In this analysis, while mathematics itself is *a priori* in nature, aesthetics on the other hand is *a posteriori*. Hence, this creates a mental construction problem in our assessment of curves in aesthetic objects. Socrates' inquisition from a slave boy on geometry—eventually showed that he knew some things about squares—comes to mind. Although the faculty of reason enables us to have knowledge of mathematical concepts, in order to enjoy these mathematical concepts in an aesthetic sense, we need sense experience to do that. Besides, since mathematics deals with objectivity, the position of aesthetics in handling mathematical objects possessing curves becomes even more intriguing. Perhaps we should take solace from Kant in this regard, who noted that while all cognition begins with experience, all cognition does not arise from experience (Kant, 1997)

Of course, curves are a manifestation of phenomena. Within this context they are much inclined to appearances. Nevertheless, to comprehend curves as mathematical entities is not exactly one dimensional. To get to the basis of appreciating curves in aesthetic objects, there is a great need for sensibility, reflective understanding and reason to sum it up. To mathematically figure out curves is to realize that the aesthetic object will transcend the subjectivity of our individual experiences. In the design of cars and the aeroplanes, for example, the mathematical requirement for beauty involves much more than *a posteriori*. And even when dealing with the ideal female figure, such intricacies appear – just like Ngozi Adichie Chimamanda's description of a young beauty in *Purple Hibiscus*: "Her School Skirt was tight at the waist, dividing her body into two rounded halves like the number 8" (2006:58).

Transcendental aesthetics therefore becomes a way in which we can study and comprehend curves since the synthesis between *a priori* and *a posteriori* is required in the grand scheme of things. Since mathematics is based on a science that constructs concepts (Julian, 1967), aesthetics can be applied to examine curves even as they are found in spatial figures. The presentation of curves provides aesthetic pleasure as they are part of the intrinsic properties of objects. The size and shape which curves assume cause the beholder's sense and imagination to form an assessment of it. The evocative power of

objects in the world of art often lies in the unity of opposites, and herein lies how knowledge based on synthetic *apriori* becomes very significant for our appreciation of curves in aesthetic objects.

A Correspondence between Curves and the Senses

Although formal properties of objects appeal to sense experience, in the case of curves in aesthetics, it can even appeal to erotic desire. The formal arrangement of objects, as advocated for by Clive Bells, Roger Fry and Clement Greenberg, among others, simply emphasizes that pleasure is derived from the intricate pattern that curves take in the dialectical relationship between matter and form. Commanding such aesthetic interest, the phenomenology of the beautiful object resides in how we delve deeply into the object itself. The hypnotic effect that curves have upon the subject is, interestingly, mathematically effective. To perceive an object's mathematical properties in the flesh gives room for fantasies and erotic sensations in the subject. Freud's psychoanalysis established that a subject's individual psyche occurs through a consciousness of gender (Christopher and Piero, 2010). Our sensibility is therefore affected by the object's curves. In addition, since Nietzsche (1976) posited that we value the object because we perceive it as a woman, our libidinal response comes from the unconscious. How men feel about a woman's shape reveals the emotion the subject puts into art being that a woman's body is a work of art. The mathematical implication for beauty borders on how hypnotic curves are to the senses.

Classified under primary qualities of objects, curves become fundamental to how we perceive and appreciate art. A sculptural piece thrives on a mathematical basis that involves shapes and lines which produces sensations that can only be experienced in the percipient. And in cases where these sculptural works imitate reality, there is a correspondence between their qualities and what the senses reveal. Our appreciation of curves follows from the fact that one size may be larger or smaller than another, while one shape may be more or less regular than another (Beardsley, 1981).

In a visual design, since the shape and size of curves are independent properties of the art object, these physical properties provide the visual field with a sort of blind spot by showing that it is impossible for the subject to fully grasp the entirety of the phenomena of curves. According to Christopher and Piero (2010), "Lacan felt that experiences, occurring in the blind spot of our knowledge and perception, can be the source of a libidinal pleasure." This is integral to the pleasure we derive from an object's curves since we may be experiencing this libidinal pleasure without knowing anything about it. As established that beautiful things are feminine in nature, the enjoyment

of a woman's lush curves can be unregulated and beyond consciousness, according to Lacan. Lorenzo Bernini's *The Ecstasy of St. Theresa* typically exemplified this aspect of eroticism and art in a sculptural piece. Therefore, the philosophical perception of art here is not only in the reliance of the eyes to capture beauty but also in the feelings that come through touch. Curves are waiting to be discovered in the object by the percipient of art. In his *The Story of Philosophy*, Will Durrant (1961:5), speaking about how the shape of an object corresponds to the senses, said:

.....maybe a cuboid or an ovoid-shaped face. We then ask: is there anything pleasing to the eye about it? In appreciating them as aesthetic objects, we begin to take proper cognizance of the angles and contours that these shapes possess... a series of numbers 2, 5, 7, 9, 11,... follows as a mathematical pattern like $n^2 + 1$.

The beholder finds curves attractive because the angles and contours they convey in objects find an emotional appeal—whether it is the shapely bottom of a woman or the inviting slopes of the mountain. Even when curves are employed as imagery in literature or adopted in paintings, the beholder is struck by its grandeur. Although the appreciation of curves may vary from culture to culture, it's very interesting that art objects receive critical acclaim based on the aesthetic property of curves. The sculpturist, for example, may apply the use of curves in how the human form is shaped in carving out his image's busts. This is precisely when the subject of pleasure in aesthetic experience takes centre stage in terms of comprehending the very characteristics behind the form of objects with respect to intricacy and harmony of parts. When analyzing women who have indulged in plastic surgery, for instance, aesthetics often calls their supposed curves into question due to the waist-to-hip ratio due to their body proportion. The problem in this case lies with balance as most times the bodies of those who have gone under the knife appear rather disproportionate.

The correspondence between curves and the senses is based on mathematical theories that ground our aesthetic experiences—just like Russell's analogy between pure mathematics and the empirical sciences. This view, according to Linnebo (2014), is summarized as “mathematical axioms stand to mathematical data as the laws of nature stand to sensory observation.” Godel went as far as comparing the relation between mathematical objects and mathematical data with the relation between physical bodies and sensory observations (Linnebo, 2017). With respect to these sensory observations, it implies that curves – as symbolic representations of physical beauty – play a fundamental role in shaping beautiful objects. The curvaceous features of

these objects attract our interest because while they are empirically important, the rational basis for forcing our judgements about them cannot be simply ruled out.

Conclusion

Explaining and exploring aesthetics, as well as understanding the philosophy of art in terms of purely mathematical entities, like the curve that emanate from shapes, is based on a determinate concept which yet pleases (Havil, 2019). Bertrand Russell's position regarding beauty and mathematics was summed up this way:

Mathematics, tightly viewed, possesses not only truth but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show (Will Durrant, 1961:6).

Whereas one may think of logicism when it comes to Russell, especially for the fact that he didn't put his eggs in aesthetics per se, the fact that he viewed mathematics as a discipline that interprets beauty buttresses the thesis behind this paper. Pythagoras had claimed in on this, too, by establishing his postulation that the foundation of all things in the mathematical entity of numbers. The aesthetics of curves in mathematical objects shows a close connection between matter and form. For this reason, delicate sculptures, realist paintings, architectural designs, natural landscape and the human form all embody curves.

Modern engagement in aesthetics gives primacy to the mathematical idea of curves. The requirements of the sense of sight and touch, while they provide an *a posteriori* dimension in our knowledge regarding curves, *a priori* knowledge, too, cannot be ruled out in the grand scheme of things. It is mathematically significant to point out here that an object's form, being platonic in nature, ensures that our knowledge of curves can also be *a priori*. The synthesis of this throws the spotlight on Kant where synthesis *a priori* knowledge appears to have helped solve this tug of war that practically led to a philosophical brouhaha. The juxtaposition of mathematics and aesthetics makes this epistemic endeavour very significant.

The study of curves in our appreciation of beautiful objects indicates that there is a mathematical basis for the aesthetic enterprise. Consequently, our mathematical belief, regarding objects in the world, puts us in a position in which we do not perceive objects only as abstract entities. Maddy (1997) posited that we can have sets of concrete objects that occupy spatial tempo-

ral location and experience causal efforts from their elements. Mathematical objects in this sense are real and our contemplation of them in aesthetics can be sensual, to say the least.

This objectification in mathematics makes our response to the object's beauty a complicated affair. The mathematical possibility of concrete objects as we have shown in this paper, suggests that this complicated affair is structured on our mental construction of assessing curves, taking into cognizance the *priority* of mathematics. It is within this purview that mathematics, which thrives on objectivity in its search for truth, becomes rather problematic for the aesthetic of curves as we know that aesthetic judgement can be either objective or subjective.

Nevertheless, since curves provide objects with distinctive shapes, the sense of allure that follows them in this regard can aptly fit what Kant referred to as "mathematical sublime" Features of objects such as roundness, contour, thickness and slope all provide an aesthetic appeal for admirers of art. Interestingly, it is the business of mathematical science to probe into these various concepts in order to understand objects. On this basis, the connecting dots between philosophy of mathematics and the aesthetic enterprise are not as faint as some may assume.

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