Preface: Why Math and Art are Important to Me

My relationship with math is somewhat different than most of my peers. I have been home-schooled my whole life. My mother was always excited to teach math and she found ways to make it interesting. In college, my mother majored in math and philosophy and studied the original texts of Euclid, Ptolemy, Copernicus, and Plato. I studied math through an eclectic approach – using games, independent study, discovering in the garden and on the local waterways, exploring and trying to understand nature and number. Once, in a Civics class we took a surveyor's tape and measured the ratio of pedestrian space to automobile space in our town. My upbringing instilled in me a great appreciation for the wonders of mathematics.

My mother's fascination with the beauty of math has transferred to me. I am amazed by how beautifully abstract, intangible ideas can be described using math. The concept of a line or a point cannot be represented perfectly in the physical world. But by using math, things like this are possible to express and to understand. Mathematics is very conceptual and idealistic and it allows us to describe beautiful, conceptual ideas. When I started researching for my Final Project, I was fascinated by the philosophical side of math—the part of math they do not teach most kids in school. I learned about a different type of geometry where parallel lines can cross, and how math and geometry are essential to the natural world.

I have grown up surrounded by artists and art. I live in a house that is neighbor to and owned by the Lucid Art Foundation, an organization founded by the late painter Gordon Onslow Ford. Onslow Ford was one of the last surviving painters involved with the 1930s surrealist movement in Paris and a close friend of my father and grandfather. Over the summer I worked for the Lucid Art Foundation, scanning letters and artifacts of Onslow Ford's correspondence with his friends and colleagues, including the well-known surrealist painter Alberto Matta (father of Gordon Matta Clark), who was a dear friend of Onslow Ford. My grandfather, J. B. Blunk, was a wood, stone, and clay sculptor, and my father is also a sculptor, a gardener, and a problem-solver. I am surrounded by art on many levels. Even the town that I live in is full of artists, ranging from photographers and painters to sculptors and inventors. Art plays a central role in my identity.

Since I was little, I have always enjoyed drawing and painting with my friends and at home, and have occasionally worked with my father making things out of wood, stone, and clay. I love creating, and artistic activities continue to shape me. My experiences of math discoveries and my experiences of art seem to come from a similar source. In this paper I seek to understand what that source is.

Introduction: How Math and Art are Related

How are math and art related? To many people, math and art seem like opposites. Math is analytical and left-brain oriented; there is a right and a wrong. It's hard and factual and "accurate." Art, on the other hand, is creative and right brain oriented. Artists themselves are unpredictable. A critique of art, or more specifically the judgment of beauty, might seem to pit art against mathematics. The critical or analytical mind—the one we associate with mathematics—seems to be in conflict with the creative mind—the one that we commonly associate with art. All of these characterizations are true to an extent. However, math and art are also complementary in many ways. Math and art are very similar in the sense that each try to explain or express abstract ideas and make sense of the world.

Another way to look at the confusion that first appears when placing art and mathematics beside each other is by understanding “reductionism” versus “holism.” Reductionism seeks to take apart a thing in order to understand it. Holism says that the thing can only be understood as a complete thing. A common belief is that math involves dissection while art is about making things whole. This is true; however, fundamentally, math and art are actually very similar. Both math and art deal with patterns and structures, and while the way they deal with them is different, they both require the same *fundamental creativity*. Math and art share the same concept of beauty. Not beauty in the sense that something is necessarily pleasing or attractive, but beauty in simplicity and perfection. Math and art reveal an essential, indeed a necessary, communication.

So how, specifically, is math used in art? There are endless ways that math and art can be combined. Some artists use mathematic ideas as the subjects of their artwork, while others use math to express form and composition in a way that is pleasing to the eye. One way that artists have used mathematical ideas is as inspiration for their work. A mathematical idea could be a beginning point for an artist’s creative path.

Math is also often used as a subject of art. Some people have attempted to describe difficult mathematical ideas such as fourth-dimensionality in their artwork. Throughout history, math has also played a central role in the creation of art. An example of this is using mathematical principles to give the illusion of three dimensions on a two dimensional canvas. Math can also be used to analyze artwork, particularly in painting. Art theorists have come up with ways of using math to analyze and offer a new level of appreciation of artwork. Math is essential to the inspiration, creation, and appreciation of artwork.

Context: Math as a Philosophy

Many might think of math as being very quantitative. Who wants to do math if it’s just crunching numbers and trying to find answers to meaningless problems? The way math is approached in modern society has drastically changed since ancient times. Early Greek mathematicians were actually philosophers, and their study of math was an extension of their philosophical exploration. Math was considered a partner to philosophy. It was a way to better understand the world. Mathematical ideas arose from fundamental questions.

Plato, a Greek philosopher and mathematician, presented a type of philosophy called Philosophical Idealism, or Essentialism. Essentialism is basically the belief that the only things that truly exist are *ideas* or *forms*, and that the objects that exist in the physical world are simply distorted and changeable shadows of these permanent unalterable essences. An example of this is a chair. The idea of a chair is real and unalterable. A physical chair is variable and changeable, but not real or intact in the way that the idea of it is (Miller 21). The idea is more real—more knowable—than the thing. This form of philosophy directly relates to mathematics: for example, there is no such thing as a perfect circle in the physical world, but in math, the idea of a perfect circle is absolutely real and expressible. We use these ‘essential’ ideas such as circles or parallel lines to create things in the physical world.

Artistic Analysis: Inspiration, Creation, and Appreciation

Perhaps the most common application of mathematics in art is as the inspiration and subject of artwork. Artists will often use mathematical ideas as the subjects of their artwork. Mathematical figures or geometric shapes can provide interesting elements to an artwork and are commonly implemented in everything from sculpture to photography. In my research I became interested in surrealist paintings. I have always found them very visually interesting. I discovered that using mathematical ideas is very common in this surrealist artwork. One topic of artistic exploration is the fourth dimension. Many artists have created representations of fourth-dimensionality in their artwork, using a range materials and styles to create the illusion of another dimension. One representation of four-dimensional space is in what is called a "tesseract," or "hypercube." A hypercube is a four dimensional cube, it is to the cube as the cube is to the square. In one representation of the hypercube, it appears as a three-dimensional cross. The famous surrealist painter Salvador Dali used this image of the hypercube in his 1954 painting *The Crucifixion* (appendix, fig 1). This painting uses math as a subject in a number of ways. In *The Crucifixion*, Jesus Christ is suspended from a hypercube, which takes the place of the cross. The figure in the bottom left corner of the image is standing on a platform with distinct square edges. The ground is a checkerboard of black and white squares. Mathematics is present in the composition of the painting as well. The image is full of lines and edges; most of them are created by the hypercube. Vertical lines lend a feeling of stability to the painting, while the horizontal lines ground the image and provide a base for the subject. There is also an inverted triangle formed between the hands of Christ and the horizon in the background. While triangles are usually associated with strength and stability, an inverted triangle gives an element of dynamism and tension in the picture. The more one looks, the more one realizes how much math can be incorporated into art, and how essential it is. So you see, math can be used in many ways as a subject in art.

Math is also inherent in sculpture, whether deliberate or not. Space, center of gravity, symmetry, and geometric shapes are often if not always a necessary component of sculpture. One mathematical concept that is inherent to sculpture is center of gravity. All sculptures have a center of gravity, which can be either within the sculpture, such as in Michelangelo's *David* (appendix, fig.2), or at a point of space outside the sculpture, such as in Isamu Noguchi's *Red Cube* (appendix, fig. 3). Center of gravity is just one example of how, even if the sculpture is not created around a mathematical idea, mathematics is inherent in it, just as math is inherent in the natural world.

Many great artists consciously use math in the process of making a sculpture or painting. Mathematical understanding is often required to create art, especially in the case of sculptures where balance or symmetry is necessary to create the desired effect, or in a painting where correct perspective is needed. Leonardo Da Vinci mathematically analyzed and planned out his artworks before making them. He carefully studied math because he understood how vital it was in order to create the things that he wanted to make. Another famous artist, M.C. Escher, also carefully researched tessellation and optical illusion, which allowed him to create such accurate and intricate designs and insured that his artwork would come out as he expected. Few artists have explored mathematics to the extent that Escher did. His deep understanding of math, specifically geometry, made it possible for him to create such precise tessellations and optical illusions in his prints and woodcuts (Pappas 69-70).

Albrecht Dürer (1472-1528) was a German painter, printmaker, theorist, and mathematician. Early in his career, he became fascinated with the use of mathematics in art. He studied the works of great mathematicians such as Euclid and used what he learned to create extremely conscious representations of space and relation in his woodcuts. In his woodcut titled *Saint Jerome in His Study* (appendix, fig. 4), the viewer feels as if they are in the room; the atmosphere is intimate. The figure of Saint Jerome is quite off center, and Dürer did not conform to the architecture of the room, and instead replicated the perspective of someone who had just entered the room. Dürer's work reflects how careful understanding of mathematics can aid in the representation of perspective and space in two-dimensional (or three-dimensional) artwork (O'Connor).

Math can also be used to analyze artwork and add to its appreciation, particularly in painting. Some people have come up with ways of using math to analyze artwork. One example of this is Wassily Kandinsky's analyses of the emotional value of colors and shapes in painting. Kandinsky (1866-1944) was a Russian painter and art theorist, and credited with being the first truly abstract painter. He wrote a number of analytical theories about the appreciation of painting based on colors and shapes. For example, he theorized that certain colors evoke specific feelings or emotions, such as yellow colors having a warm feeling, and blue colors evoking feelings of cold. Also, yellow colors feel closer to the viewer, while blues feel further away. Kandinsky also theorized the idea that shapes and lines evoke emotions in the viewer. He said that lines convey a feeling of calmness, and vertical lines feel warm, while horizontal ones are cold (Rabinovich). Kandinsky's theories about the emotional value of colors and shapes could be used both in the creation, and analysis of artwork. Often this type of analysis can add to the appreciation of the artwork.

Conclusion

I have always loved how math and art can be combined. I think math makes art more interesting. At the beginning of the semester, I thought of art differently than I do now. I used to think of it as a very visual exercise. I would look at something and I would replicate it as best I could on paper. My encounter with art was more literal; I felt attached to – and in some ways limited by - a particular reality and I was sometimes apprehensive about questioning (or deconstructing) that solid-seeming edifice. Perhaps this was in part because I was afraid I would find nothing underneath. Yet, I think the mathematical reality does lie underneath and lives beside or within the creative fountain. My early impression changed over the course of my Oxbow semester. Now, art is much more complicated, and in a good way. Art is a way of experiencing the world, a way of understanding or perhaps more honestly, a search for understanding. It is a form of philosophy.

For my Final Project I am creating a series of oil paintings focused around incorporating geometry into artwork. There are many ways I could do this, from using math to create a realistic and accurate perspective to exploring geometric form in an abstract painting. I want to see what I can do with math and art.

While mathematicians and artists approach their work in different ways, they are dealing with some of the same fundamental concepts. Both math and art involve patterns and structures, and they are different, but complementary, ways of understanding the world around us. I will always think of art when I work on my math, and I am sure math will appear somehow in my future artwork.

Appendix

Figure 1. "The Crucifixion" (Salvador Dali, 1954, oil on canvas)

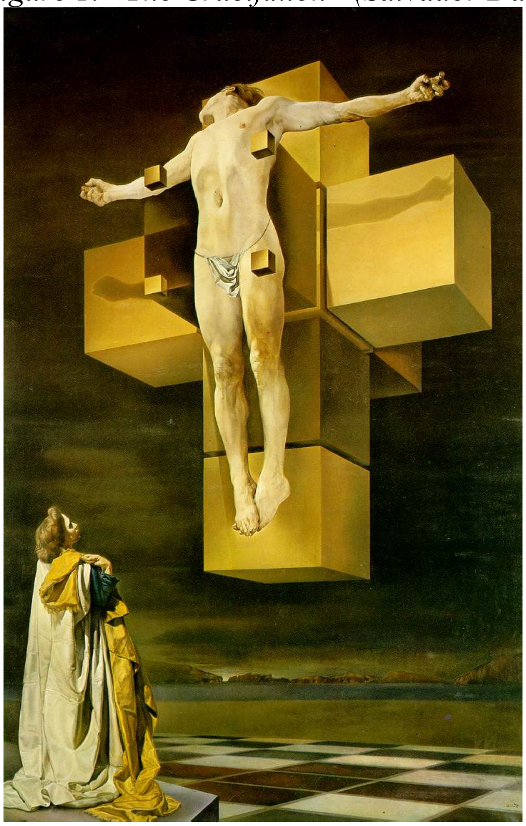

Figure 2. "David" (Michelangelo 1501-1504, marble)

Figure 3. "Red Cube" (Isamu Noguchi, 1968, painted steel)

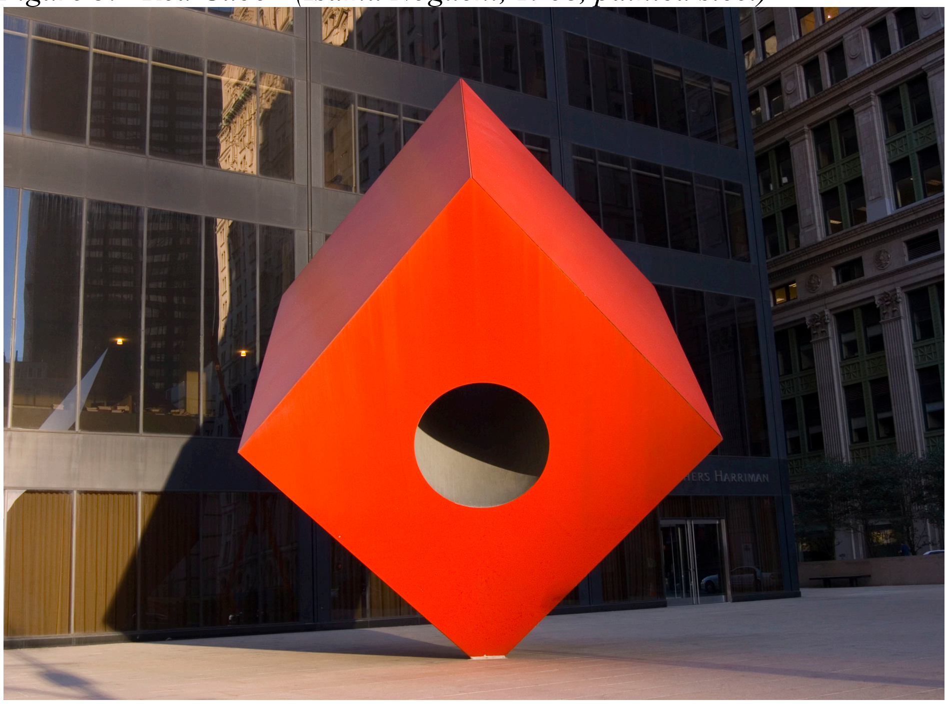

Figure 4. "Saint Jerome in His Study" (Albrecht Dürer, 1514, engraving)

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