# The Mathematics of Art: An Untold Story

Project Script
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Math 2590
Nov 9, 2010

Art is a creative venue that can, and has, been used for many purposes throughout time.

Religion, politics, propaganda and self-expression have all used art as a vehicle for conveying various messages, without many references to the technical aspects.

Art and mathematics are two terms that are not always thought of as being interconnected.

Yet they most definitely are; for art is a highly technical process.

Following the histories of maths and sciences – if not instigating them – art practices and techniques have developed and evolved since man has been on earth.

Many mathematical developments occurred during the Italian and Northern Renaissances. I will describe some of the math involved in art-making, most specifically in architectural and painting practices.

Through the medieval era and into the Renaissance, 1100AD through to 1600AD, certain significant mathematical theories used to enhance aesthetics developed.

Understandings of line, and placement and scale of shapes upon a flat surface developed to the point of creating illusions of reality and real, three dimensional space.

One can look at medieval frescos and altarpieces and witness a very specific flatness which does not create an illusion of real space.

Frescos are like murals where paint and plaster have been mixed upon a wall to create the image – Michelangelo's work in the Sistine Chapel and Leonardo's The Last Supper are both famous examples of frescos.

The beginning of the creation of the appearance of real space can be seen in Giotto's frescos in the late 1200s and early 1300s.

His figures still maintain a two-dimensionality within their space but he starts overlapping the figures in a more convincing manner and looking at proportion.

He paints the figures in the foreground larger than the various smaller elements in the background, displaying an understanding of distance in relation to proportion.

He even starts to angle images linearly, that while not mathematically precise, work towards creating depth, with all the “lines” moving towards the centre.

This is the start of perspective in general which eventually leads towards linear perspective.

Linear perspective is the organization of objects in a space along parallel lines that converge at a point, creating the illusion of depth and distance – real space.

Around 1413, Brunelleschi, an architect from Florence, more completely developed the idea of perspective – specifically One-Point Linear Perspective.

In the linear perspective that Brunelleschi further developed, it is understood that there is a single vanishing point where all the parallel lines in a plane will meet.

This vanishing point is where images will recede, or vanish, into the distance; creating the illusion of depth.

Brunelleschi also understood the importance of scale and proportion in successfully creating the illusion of real space within a flat plane.

All the images on the surface must be relative to each other in size in order to trick the viewer into believing in the images.

This means that objects that are to appear further away from the viewer will be smaller and closer to the vanishing point than the images that are to appear closer to the viewer which will be larger.

Brunelleschi was trained in geometry and was a skilled architect, and was involved in art practices as well.

These were skills that he applied to his understanding and development of linear perspective which have aided many artists during and after his time in creating the illusion of real space.

Math is extremely important in the development of art history and in art making throughout time, and now.

Ratios are integral in understanding size in relation to proportion.

Geometry and trigonometry are a significantly involved in the process of comprehending and correctly using linear perspective to create depth and distance on a flat surface.

The combination of ratios, geometry and trigonometry in art, work towards creating a successful illusion of real world space.

References

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Math Problems:

1. One point linear perspective is based upon 2 or more straight lines joining in one specific location to create the illusion of depth and distance.
   Create your own one-point linear perspective diagram. Lay your blank page length-wise in front of you. First draw a horizontal "horizon" line in the middle of your paper. Draw a dot in the middle of your horizon line – this is your vanishing point. From your vanishing point draw 4 straight lines out to the corners of your page. Within the V's created on the sides you can draw trees/hydro poles etc from the top of the V to the bottom from the edge of your paper in towards the middle – make sure they are evenly spaced!

   Look at your diagram – something beyond the use of lines is occurring to create the illusion of depth and distance. What is the additional math that is being used? Why is it successful?

2. Ratios are used to figure out proportions of objects all the time in art. For example, to keep the human body in proportion when rendering it, an artist can use the head as a basis. Whatever the size of the head, the rest of the body + the head should equal 7 to 8 head lengths, the breadth of the shoulders will be approximately 1 head width and so on.
   a. Using this type of relational math, work out what would be the best unit of measurement in the picture below to keep everything in proportion if you were to render this image.
   b. Demonstrate how this portion of the entire image relates to maintaining proportion within the image.

Math Problems Solved

1. Linear Perspective diagram – refer to sheet after this one.
    a. The Additional math being used is ratio and proportion. The foreground will have larger images than the middle ground and the middle ground will have larger images than the background. As the image “recedes” the objects being portrayed become smaller and smaller. This is successful because it creates the illusion of depth on a flat surface, mimicking how we view things in real space.
2. The larger pyramid would be the best part of the diagram to use as a relational device to maintain correct proportion. It would be used as follows: