

## Kandinsky, Math Artist?

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### Abstract

Wassily Kandinsky (1866-1944), a towering figure in 20<sup>th</sup> century painting, was known as a pioneer of abstraction. He was not a mathematician, but he respected the subject, and many of his ideas were mathematical in nature or he expressed them in mathematical ways. We survey these aspects of Kandinsky, discuss examples, and take note of two small errors he committed.

### Introduction

*The final abstract expression of every art is number.*  
—Kandinsky [1, p. 73]

Kandinsky was born in Russia in 1866. He was prepared for an academic career in economics, but he abandoned that path in 1898 and moved to Germany to pursue art. In Munich, he cofounded the Blaue Reiter group, developed his abstract style, and published the influential book *Concerning the Spiritual in Art* (*Über das Geistige in der Kunst* in the original German, or simply *UGK* [1]) in 1912. He published *Point and Line to Plane* [2] in 1925, while on faculty at the Bauhaus. When the Nazis closed the Bauhaus in 1933, Kandinsky moved to Paris, where he lived and worked until his death in 1944 [3].

Kandinsky confessed that he was never able to overcome his initial difficulties in mathematics [1, p.16]. However, he relied on mathematical terminology quite often to describe his ideas. His ideas on form and color were like axioms. Kandinsky used lines, curves, triangles, circles, and grids as building blocks to achieve artistic results as beautiful as theorems. For these reasons, his work is appealing to mathematicians (see Figure 2). In this short paper we will survey the ways Kandinsky epitomizes the math art aesthetic and consider his ideas from a mathematical perspective. We will also point out a few small mathematical errors Kandinsky made in his writings.

### Concerning the Spiritual

*The life of the spirit may be graphically represented as a large acute-angled triangle.*  
—Kandinsky [1, p.27]

The publication of *UGK* coincides with Kandinsky's great strides towards a non-representational style. He sensed that the world was about to enter a new, less materialistic, spiritual age and that abstract painting was to be a part of it [3]. He was also motivated by the fact that music is ahead of painting as a vehicle for communicating the inner feelings of the artist abstractly. A musical piece happens over a period of time, while a painting's visual effect is immediate, but Kandinsky worked to build up a

“grammar” so that his paintings could be as expressive as a musical performance [1, p.40].

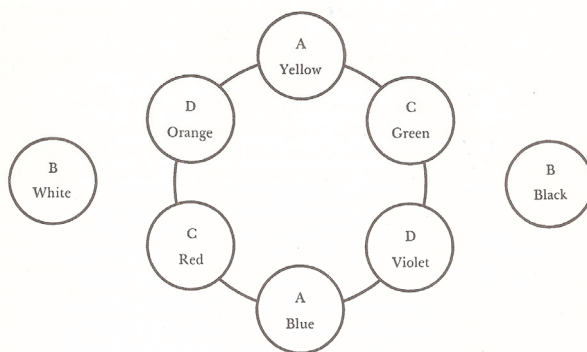
Kandinsky reduced the canvas to its two-dimensional essence [1, p.66] and worked out ideas about form and color as components of abstract work. His color theory is described in *UGK* [1, pp.54-67], and it is founded upon several *antitheses* [Figure 1]. The first antithesis is between yellow and blue, which differ insofar as they are warm and cool, respectively, or light and dark. Kandinsky claims that in yellow there is a “spreading movement out from the center, and a noticeable approach to the spectator,” while blue “moves into itself...and draws away from the spectator.” The second antithesis is between white (“the nothingness that is before birth”) and black (“burnt out, like the ashes of a funeral pyre”). The third antithesis is between red and green, and the fourth is between orange and violet. For Kandinsky, the importance of establishing these contrasts is that using them in seemingly “unsuitable” combinations is necessary to achieve a “harmony of the whole [1, p.49, fn.7].”

*Form alone, even though abstract and geometrical, has its internal resonance, a spiritual entity whose properties are identical with the form. A triangle (without consideration of its being acute or obtuse or equilateral) is such an entity, with its particular spiritual perfume.*

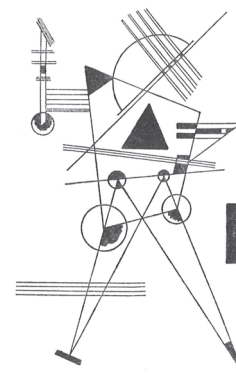
—Kandinsky [1, p. 47]

In the parenthetical above, Kandinsky probably meant to list three mutually exclusive classes of triangles, so “equilateral” should be replaced with “right.” Nevertheless, Kandinsky attached spiritual significance to abstract forms like the triangle so that, together with his color theory (also spiritual in nature), he could create non-representational compositions in two dimensions that faithfully render his inner feelings. See below for a brief exposition of his thoughts on form.

The practice of using contrasts to achieve overall harmony and adherence to “internal necessity” are repeatedly emphasized in *UGK* [1, pp. 39,47,50,53,70]. Kandinsky was also careful to note the risk that abstract painting could become “pure ornamentalism [1, p.72].” He made a practice, at first, of retaining certain images in “veiled” form, hoping that his apocalyptic message about the new spiritual age would be received by the spectator more deeply, that is, in the soul [1, p.73]. Washton Long [4] points out, for example, that in *Composition 4* (1911), there are veiled images of an angel blowing a trumpet, a rearing horse, a walled city atop a mountain, a boat navigating stormy weather, and two figures reclining in paradise.



**Figure 1:** *The antitheses* [1, p.64]



**Figure 2:** [2, p.129]

In broad mathematical terms, Kandinsky used a function to project his inner feelings and intended message onto the canvas. Of course it is difficult for the artist to control the subsequent mapping of the

composition from the canvas to the viewer, but there is obviously some consensus that this stage turned out well as far as Kandinsky's artwork is concerned.

In the pantheon of abstract artists, Kandinsky is considered "experimental," as is Mondrian. They pursued their artistic goals gradually, in small steps, while the major works of "conceptual" artists arise from direct application of their big ideas [5]. Malevich, for example, produced major works immediately once his *Suprematist Manifesto* was complete. It is convenient to describe the distinction between these two types mathematically: The experimental artist works with first principles like axioms and the artwork arises like propositions in a developing theory, while the conceptual artist establishes the fundamental theorem and the artwork arises like corollaries.

### Point and Line to Plane

*...it does not matter that some of the properties assigned by Kandinsky to certain colours and forms seem arbitrary and personal. What matters is these were the attributes he did assign to them [6, p.164].*

This excerpt from Paul Overy's book stresses that the important thing is not whether Kandinsky's theories are measurably correct, but as long as he is faithful to and consistent with their meanings, the art will speak. According to Kandinsky himself, his ideas were based on "feeling, and are not based on any exact science [1, p.57, fn.12]." With that in mind, let us proceed with a look at the mathematical ways that Kandinsky looks at the elements of form in his book *Point and Line to Plane* [6, pp.144-174].

Regarding the geometry of a point, Kandinsky understood that "in terms of substance, (it) equals zero" and it is "the smallest elementary form." In painting, though, a point is the "collision of the tool with the material plane" and so it can occupy an area like a "blob." Qualitatively, it is the "ultimate and most singular union of silence and speech." The point is in balance when at the center of the picture plane, and tension arises when it's moved from there. A repetition of points can induce a sense of movement on the canvas.

When a force "hurls itself upon the point," a line results. "The concentric tension of the point is...destroyed" by the force. Whereas the point signifies silence and rest, the line signifies movement and time. Kandinsky associates horizontal lines to warmth, vertical lines to coldness, and diagonal lines to a combination of both.

In Kandinsky's visual language, angles arise when two forces are applied to a point in succession. Among angles, acute angles are the warmest, the right angle is coldest (also "controlled"), and the obtuse angle is a combination ("clumsy, weak, passive"). He goes so far as to associate the color yellow to acute angles, red to the right angles, and blue to the obtuse. It is possible that these associations are motivated by the results of a postcard survey of the community around the Bauhaus which turned up data indicating that the triangle is intrinsically yellow, the square red, and the circle blue [5, p.163].

According to Kandinsky, curves arise when two forces are applied simultaneously. Mathematically, there is a problem here, because we know that two simultaneous forces induce straight line motion along the path of the resultant. In fact, we only need one force for a curve, but it needs to be variable, like gravity. In analogy to Kandinsky's view of angles, perhaps the more natural description of a curve would be that it arises when infinitely many forces are applied to a point in continual succession. In any case, whereas angles are "thoughtlessly youthful," curves are "mature energy." Kandinsky associates to straight, angular, and curved lines the qualities of birth, youth, and maturity, respectively.

While the straight line is the "negation of the plane", curves carry "the seed of the plane." Continuing a

curve eventually brings closure, ideally in a circle, which is one of Kandinsky's so-called "primary planes." The triangle is the other, formed by three straight lines (or angles). The fact that a circle, in contrast to a triangle, does not have an obvious beginning or end is significant for Kandinsky.

By virtue of these ideas on form, Kandinsky adds antitheses of form to his antitheses of color, giving us the line/curve, the triangle/circle, the yellow/blue, and the white/black antitheses. These are interpolated, respectively, by the angle, the square, the color red, and gray.

### Examples

Kandinsky's painting *Composition 4* (1911) shows Kandinsky working quite abstractly, albeit with the aforementioned veiling of images. He juxtaposes contrasting elements by depicting stormy and pleasant weather side by side. He also plays on his theory that blue recedes and yellow advances by putting a blue mountain in front of a yellow mountain. The blue mountain in the foreground also serves as a background, creating a disorienting figure-ground relationship. Like much of Kandinsky's work in the Munich years, color prevails over form in *Composition 4*, but there are also some bold curves and shapes that anticipate his colder Bauhaus period.

*Above and Left* (1925) shows more emphasis on forms, containing a full complement of triangles circles, points, curves, and interesting figure-ground relationships. The figure-ground relationship is explored on many levels in *Thirty* (1937), which consists of a 6x5 array of square cells. In *Light Blue* (1929), we see all of the central elements of Kandinsky's theory, but its lines do more to depict movement than the ones in *Above Left*, which work to create an illusion of depth.

Self-reference is a powerful notion in mathematics and math art; Kandinsky explores the idea effectively in *Picture Within Picture* (1929) and *Dividing Line* (1923). *Several Circles* (1926) is an example from Kandinsky's celebrated Circle Period. On the other hand, he utilizes squares to achieve interesting perspectives in *Square* (1927) and shows a willingness to study polygons other than triangles and squares in *Colored Hexagons* (1925).

While Kandinsky worked towards abstraction by veiling images, it seems that once he mastered his abstract language, an "unveiling" of images occurred at times, subtly in *Black and Violet* (1923), with its insinuation of facial features, and overtly in *Three Variegated Figures* (1942) and *Black Triangle* (1925), a study for the latter appearing in Figure 2.

Our final example is *Fixed Points* (1929), which is startling, because it evokes graph theory, and the first textbook on graph theory did not appear until 1936! Kandinsky may not have been aware of developments in graph theory. *Fixed Points* is also significant for the importance it places on what is *outside* the canvas.

### References

- [1] Kandinsky. *Concerning the Spiritual in Art*, New York: G. Wittenborn, 1963.
- [2] Kandinsky. *Point and Line to Plane*, New York: Guggenheim Foundation, 1947.
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- [5] Galenson, David W. "Toward Abstraction," *Historical Methods* 39(3): 99-111 (2006).
- [6] Overy, Paul. *Kandinsky: The Language of the Eye*, New York: Praeger Publishers, 1969.