Minimalism, Math, and Biology

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Abstract

We are living in an exciting time in history when we daily witness the exponential explosion of scientific knowledge and hear of unorthodox interdisciplinary collaborations. Unexpected teams of professionals like artists and scientists, or biologists and mathematicians, or biologists and architects, through their research and discoveries, are reshaping not only the ways in which we think of our present and our future, but also the way in which we see our past. Looking back into art history with this interdisciplinary approach, we are now able to see the connection between cubism and the theory of relativity, or between the paintings of Jackson Pollock and quantum physics. In the process of analyzing the patterns and principles of minimal and neo-minimal art, contemporary mathematics, and biology, I found interesting parallels and connections, which I will present in this paper.

Beginnings

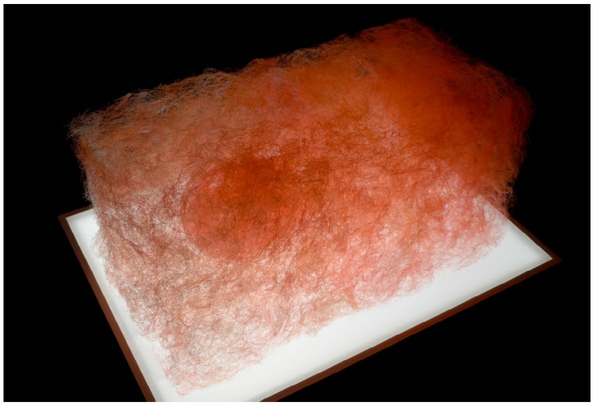
The father of conceptual art, and one of the founders of the modern artistic direction called minimalism, Sol LeWitt (1928-2007), summarizes the essence of conceptual art in his sentence: "The idea becomes a machine that makes the art." The artist, as a composer, would come up with an instruction, and based on this instruction, the composition, an art piece, would be made. For example, one of Sol LeWitt's instructions would be to use the mathematical formula 8.5:1. Simple. The formula is the ratio between the thickness of wooden beams and the space between them. Based on this idea, the piece would be made. What is fascinating is that this simple mechanism, which is shared by conceptual art and mathematics, is also characteristic of nature. In the same way, life builds its forms. At the core of every living being, no matter how simple or complex, is an instruction in the form of DNA, by which organisms are assembled into living sculptures. At their origin, conceptual minimalism, math, and biology share operating principles.

In formally analyzing the work of Sol LeWitt and other minimalist artists like Donald Judd (Figure 1), Carl Andre, or Robert Morris, we notice two distinct visual forms. One is an individual solid, such as a simple polyhedron (cube and rectangular prism), and another is a structure built by the addition of simple polyhedra. These outrageously simple forms were deliberate, rebellious reactions of artists against the illusionism of painting. Simplicity of form draws an attention to the materiality of work, which is not illusion or representation, but stands for what it is. As we look into these geometric systems from almost four decades of distance, we can see that they reflect the times in which they were created: the blossoming of empirical sciences, and the crystalline structure of new industrial materials.

New Forms

Like some other contemporary artists such as Tara Donovan or Antony Gormley whose work echoes modernism, I create cubes, rectangular prisms, and structures. I found that there are both similarities and differences between my works and the original works of minimalism. The greatest similarity I found is in cubes and other simple polyhedra. However, the materiality of early minimalist cubes and new cubes are different. Built out of solid chunks of material, the original minimalist cube was a compact unit. Tara Donovan's cubes, on the other hand, are made out of multitude of small pieces like toothpicks or tiny pieces of glass. Composed out of organic wool that is stretched almost into a nonexistence, my cube is a system in itself, a network. The transparency of the object invites the viewer's eye directly into the deepest constructs of the material. There, I expose the organic universe of tiny knots and tangles. These tangles continue endlessly into the microstructure of wool, all the way down, to the knotted molecules: keratin and DNA.

Figure 1: *Untitled, Copper and Aluminum, 3x5x5 Ft., Donald Judd, 1972*



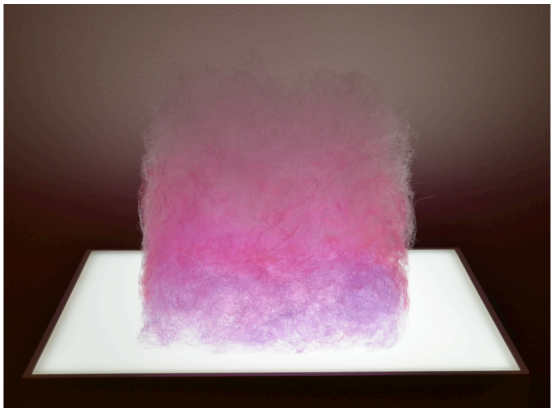
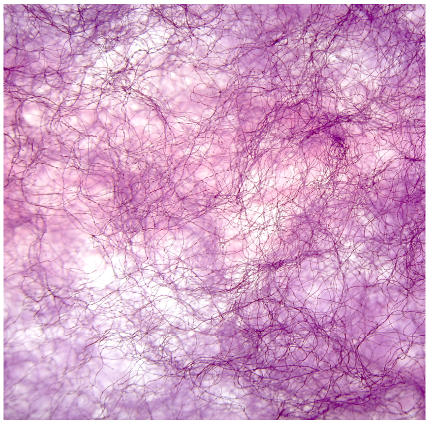


Figure 2: *(left) Synaptic Kiss 2, Wool, LED, 12x9x9 In. Bojana Ginn, 2012;* **Figure 3:** *(right) Three Flavors of Neutrino, Wool, LED, 9x9x9 In. Bojana Ginn, 2012;*

This same place where I find the knotted fibers of wool, is the place where I find new mathematics: maps of random tessellations and mathematical knot theory. 2D and 3D random tessellation models, like Poisson-Veronoi, Poisson-Delaunay, or Dirichlet, are now widely used in biology and in medicine as models for better understanding keratin and filament networks, cellular proliferation, and other complex, organic "tessellated" structures.



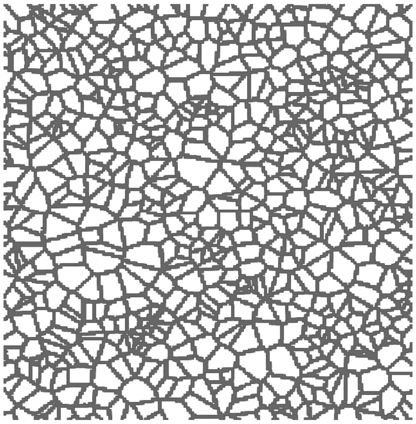


Figure 4: *(left) Synaptic Kiss 1, Detail, Wool, Adhesive, Bojana Ginn, 2012;* **Figure 5:** *(right) Poisson-Veronoi Tessellation*

While the simplicity of the minimalist cube accentuated surface of the industrial materials, the bio-cube aims to envision the world in which industrial is replaced with organic. Still, the natural fiber is packed into an invisible mold of a polyhedron. This elegant mathematical imprint onto biological material creates a utopian synergy of the two, daring to visualize a mathematically influenced organic future. As machines are increasingly able to print human organs, and biomathematics gives us an insight into the most intimate characteristics of DNA and proteins, we may already be living in a future where mathematics and technology create life. In his book *The Mathematics of Life* writer and mathematician Ian Stewart talks about the most significant discoveries of the twenty-first century that will define our time in the way that the Theory of Relativity or the discovery of DNA defined their time. It is a connection between what seemed to be disconnected and opposite, a symbiosis of mathematics and life. Stewart reveals new mathematical methods that are not just analyzing biological data, but providing working models for the most intimate, organic processes at the core of life: cellular growth, replication of DNA, and the creation of proteins.

As in the work of minimalists and neo-minimalists, a second defining form of my work is structure. Rather then being built as numerous additions to a basic unit, my structure is built as a dynamic process of the basic unit. An abstract knot situated in a painting is mirrored in a three-dimensional structure, which is reflected in a knot of its shadow and echoed through the image of its projection:

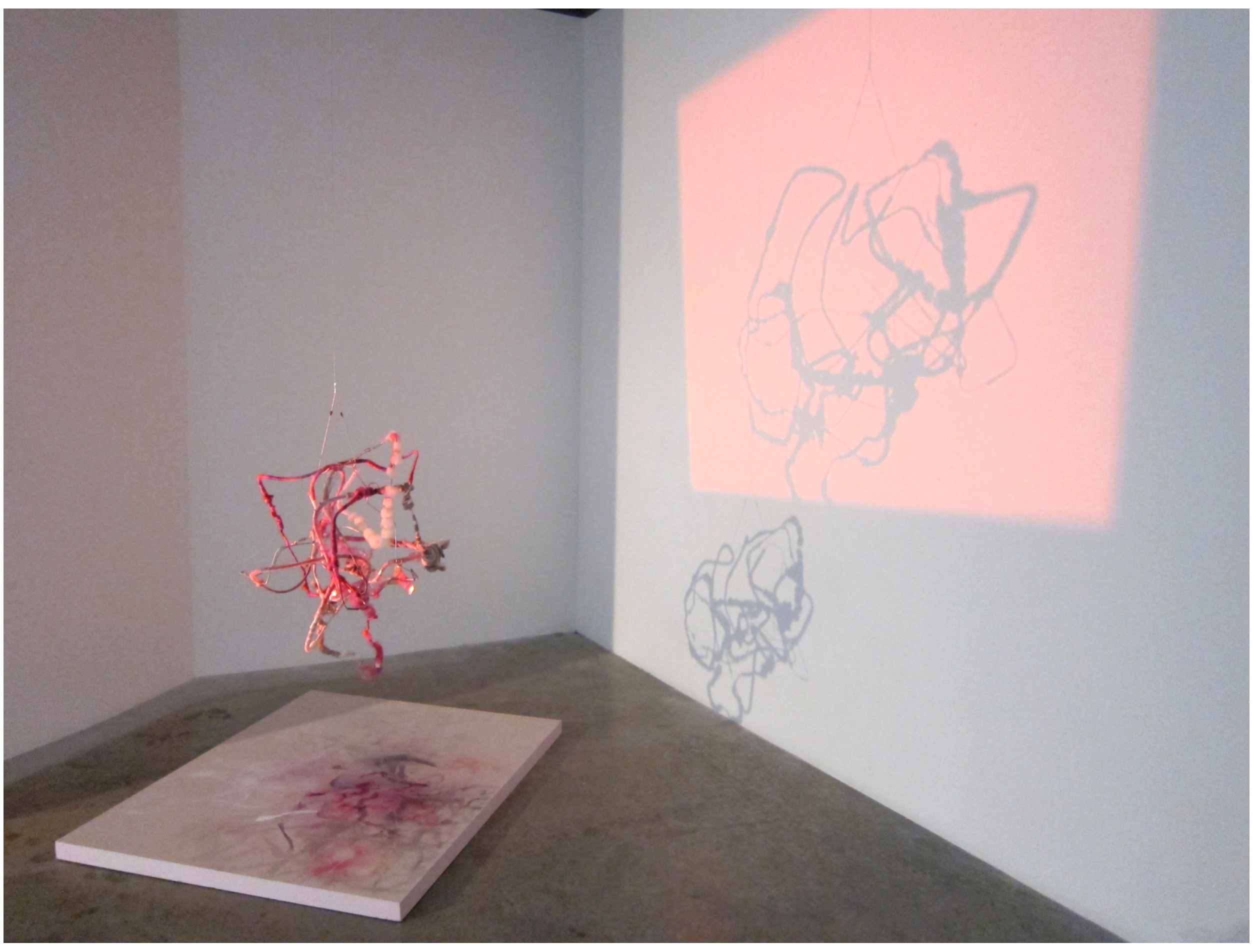


Figure 6: *Shadow Tessellations, Mixed Media Installation, 6.5x9x9 Ft., Bojana Ginn, 2012*

When writing about the revolutionary role of mathematics in decoding life, Ian Stewart accentuates the word process. Through movement, activity, and transformation, processes are at the core of life. Some of the most mysterious ones are found in the wiggly transformations of the molecule of life, DNA. These processes profoundly inspire the ways in which I build structures.

New mathematical disciplines, like the mathematical theory of knots, provide outstanding, dynamic models representing the behavior of this most important dynamic knot: DNA. In the patterns of mathematical models, which define the transforming forms of DNA, once again I find links between my knot-based process structure (Figure 6), the biology (of DNA), and mathematics:

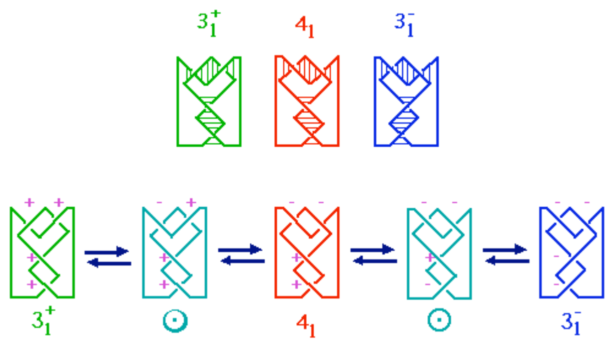


Figure 7: *DNA Knots Interconverted by Type I DNA topoisomerases, Nadrian Seeman*

Conclusion

Shared visual patterns and the conceptual similarities of minimalism, mathematics and biology, provide an insight into the interconnectivity of seemingly separated fields. Artists, biologists and mathematicians analyze different aspects of the same life and it should be expected that their conclusions resonate as a harmonic system.

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