Art and its Connection to Scientific Discovery Processes: The case study of Mihalis Papadakis' "The Girl with the Mirror"

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"The Girl with the Mirror"

Most art historians and almost all theories of art focus on perception of the artwork, that is, on the part of the receiver of the message. Not many scientific texts consider the actual creation of a work, the ideas and images the artist had in mind, the formulation of the concept—what would later be the content of the artwork—, the inspiration, the process of the creation, the milestones he/she had to overcome in order to give birth to the specific form. When someone sees or tries to study the side of the artist, it is usually with an eye on the historical and social instances that influenced his surroundings and shaped his personal experience. We will try to follow the actual process of making an artwork in an artist's lab, in order to firstly understand its essence, its necessity and its contribution to human knowledge. For this specific research the author chose to follow the sculptor Mihalis Papadakis, while creating the natural-sized sculpture "The Girl with the Mirror".

The choice of both artist and work was not a random one. Mihalis Papadakis[1] has extensively worked and written on the nexus between art and science, on the role of art on knowledge, etc. "The Girl with the Mirror", which I chose to present in this paper, is a sculpture which was inspired by and created during the procedure of an ongoing longtime research. It was conceived as a continuation of the artist's previous work.

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"The Girl with the Ball" or "Movement-Development of the Point" is a series which started in 1987. According to the artist, "the theme of the series is a girl in puberty, namely the transition from childhood to maturity, and at the same time a point in space and time. I am treating it as the structural element (part) of a Whole. … A human being, being the most developed form of Nature that we know of, can also be Nature's Measure because it contains all its properties. … The process of entering adulthood under the pressure of the wider space-environment calls for a re-examination of the facts of experiential knowledge which contains the main elements of the final destiny. The ball and the hoop are playthings as well as perfect forms (in three or two dimensions - sphere, circle). "The Girl with the Ball" is the whole of existence" (Papadakis).

During his work with "The Girl with the Ball", Mihalis Papadakis started to realize that a mirror would probably help him to study reflection and therefore analyze the point as an extreme form of matter. "In front of the mirror the axes that are extended to both sides, composing the reflectional symmetry, provide it with the particular meaning of a 'functional' relation, which we meet often in nature... That functional relation is my subject of research but as catholic quality and cause of the Existence" (Papadakis).

Then there came a series of sculptures called "DESMOS". The artist continued to work on the structures of transition-movement in the point itself. The point is, for Mihalis Papadakis, "the non-existent that exists" and therefore the being, onto which geometry is based. After "The Girl with the Ball" (1987-1995) and "In Front of the Mirror" (1996-1997), "Desmos" studied "movement-energy as a property (Content) of matter. If, however, movement-energy could be seen as a property of matter, it had to participate in the formation of its geometric structure (Form-shape) and to be imprinted on it. The synthesis was based on the antithetical connection of two regular tetrahedrons embodied in the cube. … The work (series) searches for the geometry of the microcosm and macrocosm. The geometry of the

dynamic fields poses the question of Movement and Change, in other words, of Time" (Papadakis).

After "Desmos", the artist continued to work on the point and its relation to the universe, the human as a whole, the relation with and the reflection in the self. He started working on "The Girl with the Mirror". It was once again a continuation of a quest. After studying the point in space and time, its reflection and cause of existence, and after making his thoughts and research visible through subsequent artwork-images, the artist continued his research in different levels. Just like every scientist, the artist never stops working on the notions that he/she desires to perceive. In every work he/she makes a step towards solving the enigma, but also remains with the question: is that all there is to it? And he/she continues the research until the point when he/she thinks the subject is exhausted or the problem solved. Maybe this is the reason why it has been said that the artist actually creates only one artwork in his/her lifetime.

"The Girl with the Mirror" evaluates the world, as every other image in fact does. The work makes some statements to its gazer:

- The world as infinite refers to itself. Its movement is self-oriented.
- This, as Mihalis Papadakis wants to show, is an attribute of the universe.
- Consciousness is also an element of self-reference. And so is self-knowledge.

In the Introduction to his *Aesthetics*, Hegel argues that, before he/she creates, the artist ponders on his/her theme deeply and intensively. During the making, the subject-creator and the object-creation are in a perfect dialectical relation with each other. The process of creation is long and painful. How, however, does it all start? Does the artist have from the first instant the finished work in his head?

To actually create it, the artist works analytically (in detail) and synthetically (in order to connect all the details he/she has worked on as a whole). Dessoir (1970) argues that the artist carries the work as a pregnant woman carries her child, until he/she gives birth to it. As we have already seen, every artwork continues the

former and prepares the ground for the next one. All (or most of) an artist's artworks sum up a continuous whole. They all provide abstract, metonymic images of a research in development.

Aesthetic and scientific discovery and creation

Both art and science can be seen as problem-solving processes. They entail cycles of generation, evaluation and revision aiming at discovery and creation. Seeking after discovery and creation, artists and scientists alike follow careful steps in newly-explored pathways in mind and time. The previous section characteristically described how the artist works on specific concepts for many subsequent years—most of the created artworks functioning as continuations of the former and tests for the new ones. Holmes (71) shows how scientists leave more or less coherent trails on the pathway of their lifetime, pursuing specific research goals for years and years. In 1905, at the age of twenty-six, Einstein outlined the foundations for his theory of relativity, which he did not arrive at triumphantly until 1916. Even so, as Chandrasekhar has shown in his 1975 Ryerson Lecture entitled *Shakespeare, Newton, and Beethoven or Patterns of Creativity*, the artist evolves while maturing, while the scientist explodes his/her genius at a relatively young age and then slows down. On this account, Beethoven confessed his confidence on compositional knowledge only at the age of forty-seven, while the mathematician G. H. Hardy, in his essay "A Mathematician's Apology", writes: "no mathematicians should ever allow himself to forget that mathematics, more than any other art or science is a young man's game…". By 1926, Einstein "was letting the newer developments in the quantum theory, initiated by Heisenberg, pass him by" (Chandrasekhar, *Shakespeare*, 104). Papadakis' pathway seems still ongoing at the age of 70.

For every general rule, there are, of course, exceptions. Rayleigh, a classical mathematical physicist, is, according to Chandrasekhar, a striking example. His productivity was steady and uniform: 446 scientific papers (among other

publications) are gathered in six volumes, each one of them contributing to the science of physics, not one of which is trivial, and their results are characterized by J. J. Thompson in the 1921 memorial ceremony as "beautiful".

However different the patterns of creativity between artists and scientists, they all seek to find beauty in Platonian or/and Heisenbergian terms: the proper conformity of the parts to one another and to the whole. The discovery of Pythagoras,[2] Kepler's laws of planetary motion, Heisenberg's quantum theory are all widely seen in scientific bibliography as "beautiful".

Many scientists have based their scientific work on aesthetics. For Einstein, aesthetics was a scientific given. Both artists and scientists follow common strategies in the creative process—they both try to solve a problem. Both artists and scientists have a strong desire to solve the problem posed by their research. Arthur Miller compares the lives and work practices of Albert Einstein and Pablo Picasso in his book *Einstein-Picasso. Space, Time and the Beauty that causes Havoc* (2001). He argues that in the moment of creation, in both science and art, the cognitive fields fall apart; aesthetics dominates. Kant underlines the importance of knowledge that comes from the senses. For Schiller (2004), what differentiates knowledge that comes from the senses from knowledge that comes from noesis is form. For Chandrasekhar (*Truth and Beauty*) the role of imagination and intuition is as crucial as the role of knowledge and experience in any human discovery. For him, what the human mind perceives as beautiful finds its realization in external nature.

Science and art (as every kind of creative thought) have a common starting point: abstraction. Art makes truth real, making visible that which is invisible but nevertheless exists. It all works through abstraction—the essential tool for all research. Art can benefit from scientific breakthroughs, but aesthetic abstraction is a must for all science. The ability to deduct one theme into a framework of basic dynamic characteristics should be common to both artists and scientists.

The Creation of an Artwork

The conception of the idea for the creation of an artwork may arise on many occasions, often phenomenologically random. In every case, however, it is directly connected to the way each artist understands and seeks for meaning in the aesthetics of the images of abstraction. That is generally a law of aesthetic thought, as it consists of the anagogic classification of the numerous images of sensuous perception. This happens regardless of the subject's—artist or viewer—knowing of the existence of the specific law. Therefore, either from the beginning, or some time afterwards, every work of art appears as another one of humanity's momentous steps towards knowledge.

The artwork in our study—"The Girl with the Mirror"—is an approach to self-reference—the reference to the self as a position and as a denial. The artist considers self-reference as a basic element of movement in general. In the specific artwork, self-reference is expressed through the mirroring of the image of the self in thought as the eternal return to it (the image) and the always necessary phase towards the development of the realization of the self as a whole (process of self-consciousness, part of the process of knowledge).

Figures 1 and 2 show some of the artist's sketches and notes before the creation of the work. The artist already has in mind the general schema of the abstract notion, the turn to the self, as a precondition for the extension of the thing. He seeks for the basic relations that establish every existence (according to Mihalis Papadakis, the point is the product of two intersecting lines), which, in mutual relation with other existences, create the elements of centrifugal dynamics.

Figures 3 and 4 show the first sketches with the model. At this point the abstract notion (general schema) is tested in its interaction with partial schemata, which are deducted from the images that a known object-model gives out. During this phase, the general schema is verified and enriched; it acquires individual

hypostasis. That verifies the way through which the universal exists in the individual.

Figures 5, 6 and 7 show the skeleton (construction with iron and wood), on which the work is built. The skeleton has the scheme of the abstract notion, but now in three dimensions, which influences in different ways the general formalization of the artwork.

Figures 8, 9 and 10 show the adding of mass (plasticine) on the existing skeleton. This procedure is made in such a way that in every phase of a scale it keeps pace with the seeking of the basic elements of the character of the form which, in its generality, will be maintained and will be the connecting element of the work's plasticity, whichever its role in the development of smaller scales.

Figure 11: when the model made from plasticine has reached such a point that the problems of the form in its basic scales have been solved, the artwork is turned to plaster through a forming block (made from plaster), which is destroyed afterwards.

Figure 12: the work on the plaster sculpture has more to do with the relation of the big scales with the smaller ones and with the problems of the plasticity of the form's rhythms—and this is the phase in which the sculpture is finalized. The next step is for the sculpture to be sent to the art foundry.

Figures 13, 14 and 15 show three views of the final artwork in bronze.

The whole process goes from the abstract to the specific—and the specific is a combination of abstractions. The representation of the general idea could stop, be considered final, in many phases of the procedure. For example:

1) as a general relation between systems of lines (figures 1, 2 and 4),

2) as a construction of the structure of these systems in three dimensions (figure 6),

3) as a structure-base, onto which unsymmetrical and random micro-masses (figure 7) sit,

4) as plastic forms and schemata, which add some references to other ideas to the general idea (figures 8 9),

5) as the identity of the plasticity which offers a particular form of the material world (model) and which, when combined with the plasticities and schemata of 4, give to the individual the notion of the general idea as a cause (figure 10 in plasticine, figure 12 in plaster, figures 13, 14 and 15 in bronze).

In phase 5 the cycle is, according to Mihalis Papadakis, completed. The general idea is drawn from the observation of innumerous particular forms of our world. When someone manages to give that general idea its representation and its function as a cause for the representation of the individual, then it completes the cycle of aesthetic abstraction, while drawing, at the same time, a new one.

This seems to be in general the way in which aesthetic abstraction is developed. Art, as a unique function, simply makes this way its own and cultivates it. This unique function, however simple it may seem, when drawn apart from the others due to social allocation, gave human culture an indispensable boost for its exponential development.

Sketchbooks, models and methods

"The scientist's *intellectual intuition* operates with *productive imagination* on scientific background knowledge to solve its difficulties in explaining reality. This is done by *productive imagination* operating by instinctive and practical self-control to recombine the iconic and indexical imagery meaning-contents of background knowledge to discover a new imagery picture of reality" (Nesher 235). The scientist forms, after that, an abstract hypothesis, which he tests, re-phrases, re-tests, molds and shapes until he reaches a satisfying outcome. In mathematics, experiments are attempts to try and test, prove or improve a theory. "Proofs in informal contentual mathematics do not justify us to accept a result unconditionally, but they justify us to accept it provisionally till it is improved by a newthought-experiment" (Glas 59).

This means that the mathematician might not stop, as Papadakis could, at some stage of the artwork, but he/she might pause, for others or himself/herself at a later stage to continue.

Both for the artist and the scientist systematization and method are crucial. In their route towards discovery, they need to find problem-solving strategies and constraints. They both have at their disposal many resources provided by the artistic and scientific community respectively: from concepts and accepted theories to empirical knowledge, tested methods and formulas, aesthetic and intellectual intuition, imagination and a history of past endeavors. Sketches aid both artists and scientists in the discovery process, as they vividly portray the known and point the gaps, inconsistencies or problems that need more work and/or revision. "The value of an imagery representation is that it makes some structural relations immediately evident" (Magnani 103). Both artists and scientists use visual abductions (along with many other abductions involving sketches, diagrams etc) in what Magnani calls *model-based research*. This kind of strategy—as well as mental-modeling[3]—is central in innovation for many scientists.

Science and art

Nesher, following Kant, sees a dichotomy between science and art—an epistemological division between theoretical (logical) judgment and aesthetic (reflective) judgment, when the former is an objective and true representation of reality while the latter is subjective though universal to human nature in aesthetic experience without representing reality (Nesher 235). For Nesher, "artism" presupposes artistic free productive imagination in creating fine arts, while "scientism" is guided by "determinated mechanical rules of formulating theories" (Nesher 234). Art is about fantasy and the senses, while science works with intellect—any random or unverified outcome is out of the question. Science is about the necessary. For an artist, the role of intuition and fantasy is important, but

not easily or necessarily explainable. The senses, the experiences, the personal elements that determined the artist's past and present and formed his/her personality are interrelated in the work, together with a more or less deep perception of the history of Aesthetics (from the individual to the collective). The mystique of the work of art lies on the fact that, despite referring to the collective meaning of Aesthetics, at the same time it holds tight the individual element. Science denies intuition in the final result—it all has to be tested and proven with the use of specific and unmistakable technology, depending on the field of research. However, no great scientist has ever denied the role of memory and intuition during the process of solving a set problem. According to Miller (*Insights of Genius*), creativity needs guidance: from aesthetics, from visual instances in fantasy, from tradition in the field of work, from stored visual ideas, from intuition. Information and knowledge are drawn from memory—logic symbols and visual signs are brought together in fantasy. Unconscious thought brings notions from phenomenologically unconnected cognitive fields to mind as bridging truths. As Ribot has pointed out, the logic of the images is actually the flourishing power of productive fantasy.

For many important theorists, art is a form of knowledge. For Hegel, it is a knowledge given in images. For Fischer, it is a work and only as such does it entail knowledge—much research is needed from the artist for a work of art to be made. The work of art includes, according to Fischer, a paradigm of the relation between the human and the world. It uncovers the real being of things, according to Heidegger. Art tries to affiliate its viewers to wholeness by unveiling to them the catholic truth—hence the ecstasy in front of an artwork.

Art is therefore necessary in order for man to be able to deeply understand and change the world. In order to understand the world, we need to study it first. That means scientists could use art to make science. For Arnheim (*Visual Thinking*), art is the most powerful medium for enstrengthening the perceptual factor, without

which no meaningful thought can be produced in any field. The possibilities provided by images are necessary for the mind to function.

Afterthoughts

We think through images. Images are the tool for abstract thought. A child needs to find images for the notions he/she wants to understand. Abstraction is a fundamental ability of the human brain. The human being is from birth exercised to think through images. The classification of an unending world through images is an element of survival—this is how both humans and animals survive: through these anagoges they can understand good and bad, utility and danger etc.

According to Arnheim (1969), thought tries to find the basic structure of the things it studies—their necessary qualities. As seen while observing Mihalis Papadakis create his work "The Girl with the Mirror", so does art. In addition, with the power of his/her illuminative fantasy, the artist makes these qualities visible. From a basic idea-image, the artist tries to find the generalities that apply to universal truths. He then gives the general a specific (the model's) form, specific properties. The final work has a specific form, but is also the visualization of the basic structure of the universal, that which entails several partialities.

The scientist also needs to make abstractions—he/she does not choose his/her samples in any random way. The sample needs to have the qualities of the universal he/she desires to study. The scientist, too, seeks for universal truths, the structural abilities of that which is studied. A finished work of art could offer to the scientist visual structures for the characters of things, relations, or anything that could be placed on canvas and under the microscope.

A work of art is a product of thought, but it also proposes a way of thinking. It entails and provokes visual thinking. As explained above, during the process of making an artwork, the artist comes across problems of choices and organizations—what is proposed is valued equally to the way the proposal is formed. Most

importantly, the making of the artwork entails cognitive processes, interplay between vision and thought.

Science is forced to adopt the notion of beauty, beyond the countable. Wassily Kandinsky has offered many clues for the psychology of vision. Albert Einstein believed that when an equation was "too beautiful" it could not but be real. Henri Poincaré has said that we prove through logic, but we discover through intuition. As every other human being, the scientist, too, thinks and works with the help of images.

Art evaluates the world as one image. The "Girl with Mirror" explicitly says that the world as infinite refers to itself. Its motion is set by itself—it is self-moving. And that, the artist proposes, is an ability of the universe. This is the proposal of the specific artwork to its gazers; and possibly a problem posed to science.

We should stop, therefore, seeing art and science as two parallel activities, comparing their practices, phases and/or research results. We should perhaps see art as an irreplaceable help for science, providing it with tools (abstract images) for fruitful thinking. Art images may provide new information. Art is a visual form. If visual forms are the main media of productive thought, then artists, as experts on organizing visual information, could help people practice perceptive thought. If humans think through images, then art could, by creating new images, guide thought (and science) to new undiscovered passages, proving a helpful—if not necessary—step towards knowledge. That means that not only the "making", but also the "sensing of" and the "writing on" art gain—or should gain—a whole new perspective.

Figures

Figure 1:

Figure 2:

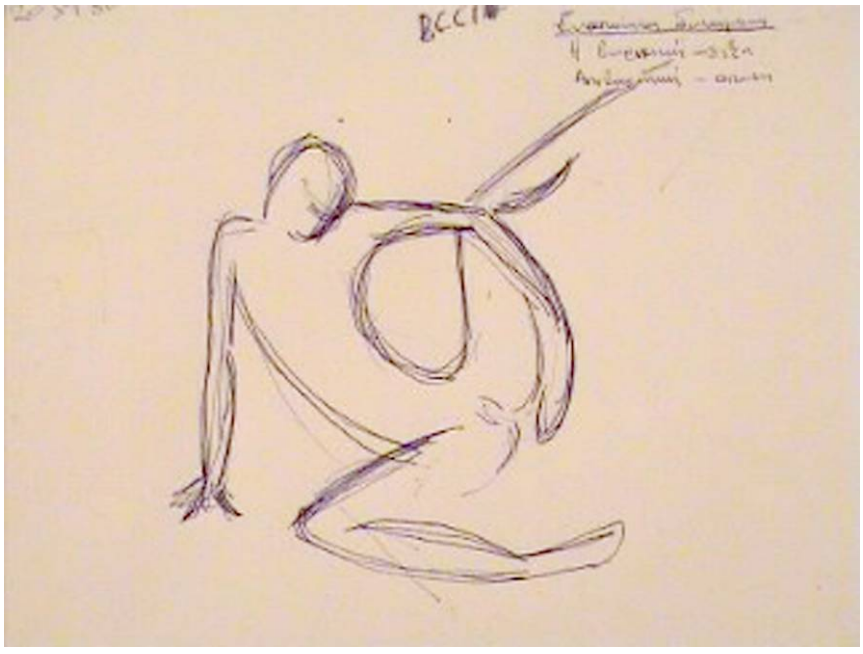

Figure 3:

Figure 4:

Figure 5:

Figure 6:

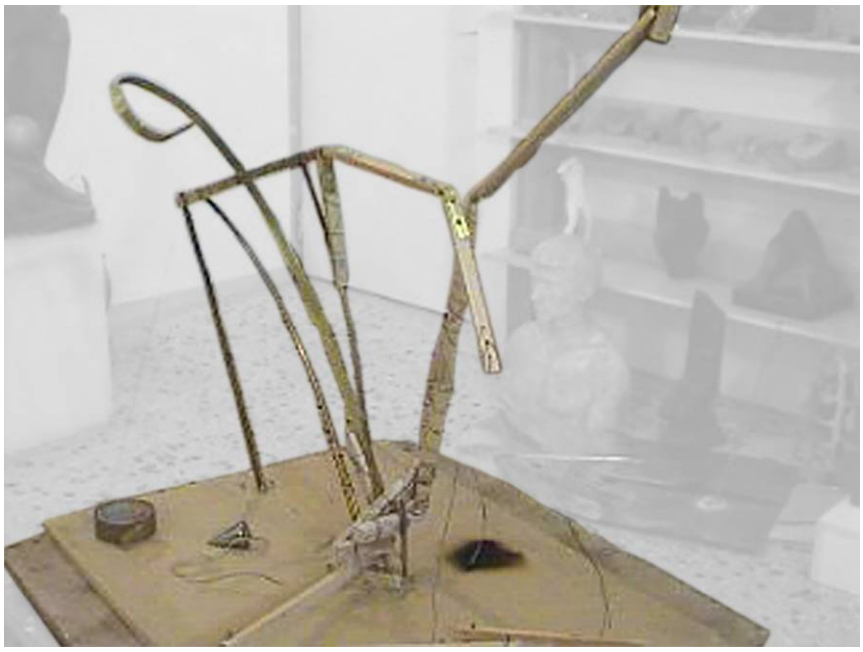

Figure 7:

Figure 8:

Figure 9:

Figure 10:

Figure 11:

Figure 12:

Figure 13:

Figure 14:

Figure 15:

[1] I met Mihalis Papadakis in 2000 (we are not related, despite the identical surnames!). He was serving as a president of the Chamber of Fine Arts of Greece and at the same time he was organizing exhibitions and theoretical discussions at his artistic lab, together with other artists and art historians. For the last ten years he is also a member of the Advisory Board of the National Museum of Contemporary Arts. For more information about the artist's biography and work see his web site www.mpapadakis.com.

[2] Vibrating strings, under equal tension, sound together harmoniously, if their lengths are in simple numerical ratios (Chandrasekhar, "Shakespeare", 105).

[3] "In the first place, a mental model is a form of knowledge organization. There are two main usages of the term 'mental model' that tend to get conflated in the literature: (1) a structure stored in long-term memory (LTM) and (2) a temporary structure created in working memory (WM) during a reasoning process" (Nersessian 154).

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