Collaborating researcher

Analivia Cordeiro

THE ARCHITECTURE OF

HUMAN MOVEMENT

Responsible professor

Gilbertto Prado

School of Communication and Arts of the Universidade de São Paulo

October 2018

This is the English version of the thesis
Arquitetura do Movimento presented at the School of
Arts and Communication of the São Paulo University -
ECA USP São Paulo, Brazil in October 2018

Contents

Abstract

After decades researching a notation of human body movement, this postdoctoral project evaluates, practically and theoretically, the results obtained in the last two years: sculptures of the spatial condensation of a body movement, recorded in video and processed by the notation system Nota-Anna.

1.   Introduction

"... Knowing must therefore be accompanied by an equal capacity to forget knowing. Non-knowing is not a form of ignorance but a difficult transcendence of knowledge. This is the price that must be paid for an *oeuvre* to be, at all times, a sort of pure beginning, which makes its creation an exercise in freedom."[1]

This postdoctoral thesis is an analysis of the production of sculptures made between 2015/2016. I will touch on the historical writings from the period of abstract art up till now, to better convey the meaning of this research.

The process of creation and production of these sculptures is a previous subject, outside the specific scope of this postdoctoral work. The visual result of these sculptures was surprising from the spatial point of view: the lines and planes that intersect in an unusual and complex way justify an in-depth analysis.

This analysis will mainly address an area I have been active in for decades: human movement. This embraces all human actions anywhere and anytime. In this postdoctoral thesis I will approach the graphic intelligibility of human movement, a way of writing human movement, as an object that allows for the rereading and reconstitution of human movement, besides opening a new possibility of creativity about it: an instrument of human communication that can be used to write, describe, and print human movement for people, in order for them to exchange messages with each other after the movement has already been made in a past act.

In the realm of sound, this proposal has existed for a long time with the musical score, and later with the invention of other types of experimental recording. A qualitative leap occurred when the possibilities for the recording of music appeared, and information theory provided a scientific approach for the study of sound. Its materiality grew to the point where the musical signal could be materialized in an object: the possibility of a physical representation for sound. The musical piece ceased to be music to become a thing, with dimensions in space, measured as a "temporal product." With the new technology, the musical signal that circulated through wires and circuits, was able to be "transmitted, stored, received and sold."

In the universe of human movement this reality is still a purely theoretical proposition. An effective way of writing human movement is still in the research stage. Some very interesting proposals exist,

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[1] Jean Lescure. *Lapicque*, Paris: Galanis, p. 78.

and in this postdoctoral thesis I will analyze one of these proposals: the condensation of the movement in three-dimensional pieces, which can be called sculptures.

2. A Brief Report of my Researches

"The world is richly strange and profoundly simple."[2]

As a beginning for this postdoctoral thesis I have opted for a first-person narrative of my career path, to contextualize the development of these researches. All research carried out in my artistic career has dealt with human movement in various areas such as stage dance, choreography, video art, educational systems, movement notation research, anthropological studies, and body therapy. All these areas are related to the understanding, knowledge and creation of human movement.

Initially, I will give the reader a sketch of my training, which was done in two areas: visual arts and dance.

My father, Waldemar Cordeiro, was an artist, art critic and theorist. Through living with him at home and in the national and international cultural environment, I witnessed and absorbed key creative concepts for the understanding of human artistic creativity.

I followed the movement of concrete art in Brazil, the *pop-creto* movement, the kinetic works and, finally, my father's pioneering production in computer art.

In long conversations we had, coordinated with readings, I learned to observe the artistic phenomenon according to an objective approach: the visual language has a syntax independent of a subjective interpretation. For concrete art, this syntax follows the principles of Visual Gestalt (K. Koffka), a 20th-century scientific approach of art of twentieth century.

Waldemar Cordeiro was a leader of the concrete art movement in Brazil, an art movement of fundamental importance for creative activities in the urban-industrial context of the 1950s in this country. He was later a pioneer of art by computer in Latin America. Concrete art opened the possibility of a systemic organization of the visual creation, as was later done by Computer Art, that brought algorithms about the processes of human artistic composition in various fields (visual arts, dance and others). A revolution in art.

My dance education began at 7 years old. My teacher, Maria Duschenes, was trained directly by Rudolf von Laban, in Germany. Originally from Hungary, after World War II she came to Brazil. She had a solid knowledge and depth in her work, teaching this posture to children and adults. Her classes were special: warm up exercises, sequences to be repeated, and at the end an improvisation. There was always a moment of the dancer's own creation, directed by the teacher.

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[2] Morrison, Phillip. *Módulo Symmetry Rhythm*, New York: George Brazziler, 1966, p. 19.

In the first year at her school, from 7 to 8 years, rather than improvising I was watching other people. This was very important to me. By the time I started to improvise, I felt like I was already familiar with movement expression. At age 11, Dona Maria invited me to the Merce Cunningham and John Cage dance presentation, in Rio de Janeiro. The modernity and good humor of the presentation was unforgettable and deeply striking for my life. And at age 12, I was already on stage, working with professionals. Everything was very, very fast.

At the age of 15, I had already acquired a very clear notion of composition and space, and I started to develop experimental ways of writing choreography to help with rehearsals, since Dona Maria was always forgetting sequences. I helped the group and at the same time shaped my understanding of the language of dance: the questions of space, distribution, composition itself, music, how dancers may be positioned and their differing individual skills. Seeing my interest, Dona Maria taught me Labanotation and gave me the book *Choreutics* from Laban. I improved my studies watching many Oskar Schlemmer films over and over and observing the photographic works of Moholy-Nagy, both from Bauhaus, as well as looking at McLaren animations.

At 16, I started ballet classes and other types of dance too, which expanded my vocabulary. I was soon invited to participate in Structured Improvisation with the Clyde Morgan Company, which was a group of dancers improvising in front of video cameras. This work was a tremendous frustration because there was no dialogue between the camera and what I was dancing. In other words, when I stopped moving, the camera registered my whole body; and when I gave a wonderful jump, the camera filmed my finger. When I saw the result, I was horrified. And I thought: "Wow! There must be some way to a better dialogue between the camera and the movements."

At that time, the regular dialogue between the TV and dance was hours and hours of the TV crew watching the dance and talking to the choreographer to plan camera shots, which cost a lot money and time. I had the idea of doing this through computer planning. At the time, I often observed my father working with a computer. I was passionate about mathematics and dance language. This was what gave rise to the system I created of computer dance for video -- a coordination of dancers and the TV team through computer programming.

Video seemed to me a wonderful way to travel the world with dance groups, reaching places far away with an affordable cost. Moreover, video was also a very interesting form of communication. I made a first project and was invited to the International Edinburgh Festival. This invitation opened the possibility to record the video on *TV Cultura*, Brazil. Since I was very young at that time, they would never make such an expensive production without an important invitation as that of the Edinburgh Festival.

I ended this production in May of 1973, and I told my father, "You must see this video." He answered, "Wait a little bit, because I'm very busy now." Three weeks later he died at age 48, in his sleep. He did not see my first work, and this made me very sad.

Computer dance for TV was a system for relating the elements of dance language with elements of the TV language through a computer program. The output was a dance notation and the instructions for the TV team. So the dancer knew how it was being seen by the camera, where he had to move within the scene. The camera-man, as well as the TV director, knew what the dancer was doing and where he was, at all times. At the time, this is what the available technology that allowed for the optimization of the dance-TV relation.

During the computer programming, I realized that there were times when the computer program offered more than one possibility to define the aesthetic. What would be the aesthetic reason for choosing among the various possibilities? None. At this point I used the random choice. This feature is present in many computer art creations of that time, and I believe today also. The computer video-dance and its innovative aesthetic proposal solved many practical problems. But others came up.

The computer output was stick-figures complemented by the performer's displacement in the space of the scene, which would be the dance notation. But the reading of movement was unfamiliar to the dancer compared with the reading of words. The dancer's training was based on imitating the teacher or improvising and feeling his own body. Never on reading notations. Moreover, this form of writing movement was not anamorphic with the movement, so the dancer had a mental work, which hindered the kinesthesis of his movement, a factor that created an obstacle to the interpretation of the choreography.

On the other hand, as the notation was static stick figures, the dancer had to create a connection between the positions (stick figures), so he was involved in creating his own movements. This was a positive aspect of this work, and opened the question regarding the rules imposed by the computer and the opportunity opened to the creativity. The freedom/planning dyad permeated my entire career, as it pervades our entire society to this day. Technology is essential to human life. This reality challenges people to position themselves comfortably, emotionally, in relation to the rules imposed by technology, inducing them to create behavioral alternatives. Thus the significance of this work extended beyond art and aesthetics.

In 1975, I lived for two and a half months with an indigenous tribe in Amazonia. This experience was an important complementation in my studies of human movement. I had the opportunity to know early man and the origin of Brazil. It was remarkable and unforgettable. I brought an extensive photographic record and Super-8 movies, which were edited and saved in digital format many years later.

In 1976, I graduated from the College of Architecture, and I moved to NYC to dance. It was a wonderful life for two and a half years, I worked hard and exchanged experiences with other artists; because in Brazil I felt lonely, doing a different art. In NY I felt like a participant of society. I had contact with the generation of postmodern dance: I studied with Merce Cunningham, attended the studio Alvin Nikolais, I took lessons with Viola Farber and Gus Solomons Jr., with whose company I

made "street performances"; I danced in Janette Stoner's company and took part in videos at Merce Cunningham's and Charles Atlas's workshops. I could also present my own choreographies in avant-garde dance performances.

Returning to Brazil, I started a research into video dance (from 1980 till today), addressing the relationship between the act of dancing, video camera and the method(s) to create choreography. Each work explored these relationships in a different way, formalizing my thoughts at each stage of my career. To earn money, I became a teacher of the art of movement to children based on the Laban method, also introducing the video language to them. At the same time, I was in contact with other countries where I could display and disseminate what I was creating, but I never traveled far because of financial issues. Email was nonexistent and communication was slower and more formal.

In 1982, I began my research into Nota-Anna, whose first name was Trajectory-Notation, with an intern at the Polytechnic School of USP named Nilton Lobo. Nota-Anna was born of the deficiencies that I detected in the computer-dance notation. The question that needed an answer was: what is the best way to communicate movement in a writing mode, reaching the lay people beyond the professional, i.e., a broad perspective of communication? The ideal way would be like the eye itself sees the movement, i.e., the trace-forms the movement leaves in the air.

I decided to use video, using its frames to obtain the trace-forms of different body parts in the air. And mathematically speaking, by calculating the angle in the x-y axes of the Cartesian system, we obtained body position on the z axis, i.e., we transformed the two-dimensional video image into a three-dimensional image. This research took a long time because it required several exchanges of equipment since the technology we had available was unable to keep up with our ideas.

In this search, I ended up marrying Nilton. In 1994, after the birth of our son, Thomas, I started my master's degree which finished Nota-Anna as a software and a book called *Nota-Anna: An Electronical Notation of Body Movements based on the Laban method*. For this same thesis, I put the Laban method in video format, which opened me to the possibility of an excellent relationship with international institutions.

I applied Nota-Anna movements to Marilyn Monroe's walk, Bruce Lee's kick, Pele's soccer kick and an Elvis dance move. Watching the old historical films, I transformed the frames of the movements of these iconic figures into three-dimensional space trace-forms. It was an extremely meticulous work, with a very beautiful result.

The Nota-Anna results showed the lines drawn by the joints of the body in space. It was a nonmaterial reality, that visually revealed the ephemeral movement. I was very impressed by these images and found that to proceed I would need to study more deeply the sense-perception of the human body. I needed to know the subtleties of the movements observed through the inward aspect of the body. For several years I practiced Eutony, which is a rather complex technique of body harmonization, and
the Feldenkrais Method. A new perspective of feeling my own body movements and dance moves 8

led me to create new video dances in a more intuitive and introspective process than before. I practice these techniques till today.

I also realized that the union of sense-perception with the visual results of Nota-Anna could be a wonderful discovery for the correct use of technology in teaching and creation in the field of nonverbal communication. These two fields, apparently antagonistic, could work in conjunction. The new generations, who live so intimately with video games, computers, virtual reality, etc., would have no difficulty in uniting these two practices. Glimpsing a future use for this notation research, I did my PhD thesis called "Cyber-Harmony: A Dialogue between Sense-Perception and Technology."

In order to do the thesis I put Eutony practices in video format, developed movement sequences using Nota-Anna to be learned by lay people, and created videos for the training of muscle strength. This content is online as a proposal for a very clear social reason, because many people could never have access to a high-level body education work, which is usually aimed at people who can afford good lessons. This work helps people to maintain good health and to balance the body. A body practice of good quality can bring relief, a life of better quality. This thesis was supervised by Prof. Arlindo Machado (2001–2004) and was highly appreciated by experts at that time.

After that thesis, I spent several years dedicating myself to my family. I ended up going to Rio de Janeiro, a city that fascinated me and also shocked me with the coexistence of social classes: very poor, hungry together with rich people, where the rich do not see the poor. In response, I did my post-doc, which is a literacy system through 242 short videos for mobile phone, made in collaboration with educator Eleonora Sampaio. I wanted to give a real contribution to Brazil, and made it without any financial assistance. Brazil has a huge lack of education, with millions of people who need help and have no place where they can seek it. With the strong popularity of Internet and mobile phones, these devices have become a way to reach people at the most far-flung locations, in the countryside or in cities, often in places with no available teachers, or in places that I could never go. Currently the daily access rate is more than 2,600 people. I have reached my goal.

On the other hand, since the death of my father in 1973, I realized that as an heir I must work to transform my inheritance into a cultural asset. I then took care of everything in the broadest possible way: works, restorations, publications, archive, documents, contacts with researchers and critics, all with financial acrobatics in order to make it happen.

In 2000, I met Luciana Brito, who became a partner in this cultural struggle. In early 2012, finally after several attempts at different institutions, we did a retrospective exhibition and the publication of a book by Itaú Cultural. This exhibition won two awards – best exhibition of the year by APCA (Association of Art Critics of São Paulo) and ABCA (Brazilian Association of Art Critics) – and the book presented my father in his integrity: as an artist, critic and theorist of art and landscape designer. A key stage of my mission had been accomplished.

At this time, my life as an artist began to blossom again. I was introduced to Anita Beckers who has become a partner, encouraging and welcoming ideas to show my work, and encouraging the historical recognition of my research. I started a phase of materializing my videos as installations, sculptures and still images. This is a very elaborate work, which unites all my knowledge since childhood. This is the last phase of my work.

In short: for more than 42 years I have researched the area carried out in the field of expression of human movement and media arts that has at its core the manifestation of the human body, as a complex organism. Moving my body, I understood the meaning of the organic/artificial dyad. The organic factor is spontaneity, improvisation, loose emotion, the unpredictable. The artificial factor is planning, interoperability between different medias, the scientific study of the body, the predictable. Those two "guided or determined" factors have been the core of my artistic researches from 1973 until now.

During my artistic research, I've never signed onto fads just to be up to date. The use of technology in the arts must have a humanist goal, beyond the mere use of new gadgetry for its own sake. I have always prioritized integrity, consistency and long-term time for the maturing of creation, which directed me to the creation of specific software made specially in order for my work to dialogue with the scientific world and the cutting-edge research. (São Paulo/Rio de Janeiro, July 2015)

3. Nota-Anna

"Art is not the appearance of nature. Nature is a question ... art is the answer."[3]

Nota-Anna is a human motion notation software that graphically describes the spatial displacement of 24 joints of the body in three dimensions. The data input can be through video frames or sensors.

To propose a system of movement notation occurs only at the maturity of a study. A researcher can only try to establish control over the movement after decades of practical experience, self-observation, scientific knowledge, and observation of other people. After such a complex and long study, you will surely understand how little you know about the body movement to try to control it to a large degree.

There is a story that illustrates very well the attempt to control a movement: the cockroach asked the centipede how she was able to move her hundred legs with such elegance, ease, and coordination. From that moment, the poor centipede never walked again.

With Nota-Anna, the path in space of the movement that we perform with our body in space is made visible. Technically, it needs the current technology that allows us to record and analyze the movement so that it can be translated into a notation. As art critic Mario Pedrosa said: "Modern man has created an artificial language to apprehend the imperceptible, and the physical universe is reduced to this language today."[4]

With the technological resources we have nowadays, to reconstruct a real movement we need to explore much more the relationship of man with the new technologies until this relationship becomes truly natural. That means using the technology and its devices while respecting the biological nature of our body, without causing physical damage due to its daily use, or imposing patterns of human behaviors psychologically harmful to people, as is currently the case with many devices sold on the market.

In Nota-Anna, from the design point of view, the choice of using spatial displacement of body joints was initially based on the practical experiences of drawing in space with lights in choreographic experiments. Later, in theoretical studies, this option has been scientifically proven, as neuroscientist Mlodinow says: "Our nonverbal sensors are so powerful that only the movements associated with our body language – that is, without the actual bodies – are enough to wake us up the ability to perceive emotions accurately."[5] And he continues in an evaluation of an experiment he conducted

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[3] Theo Van Doesburg, 1916, notations from the person archive of Waldemar Cordeiro, unpublished.
[4] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma.* Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, p. 179. And he also adds to the above statement: "the numerous technical artifacts will be perhaps as inseparable from man as the shell is from the snail or the web from the spider." This is our current reality, which Mario Pedrosa foresaw in 1955.
[5] Mlodinow, Leonard. *Subliminar – Como o Inconsciente Influencia Nossas Vidas.* São Paulo: Editora Zahar, 2012, p. 148.

in a lab: "The observers could decode an impressive amount of information from the moving lights to identify the person they knew only by walking. When the participants were actors, mimes or dancers and were asked to move in order to express their basic emotions, the observers had no problem detecting the emotion portrayed." Through the visualization of the trajectory of the real movement, Nota-Anna reached its final goal: to enable the exploration, in several fields, of the expressive potential of the body's movement.

3.1. Nota-Anna and Sculptures

"For the artist it would be of special importance to see how nature uses these elements and how they combine to form structures. The laws of the composition of nature reveal to the artist more than the possibility of superficial imitation, they reveal possibilities of using these laws to make art."[6]

Nota-Anna, besides writing the movement, allows an analysis and creativity that, without this visualization, would be impossible. It was using this possibility that I began the research on the use of registered movement, in the field of sculpture and drawing.

In plastic terms, Nota-Anna uses as its basis a point that moves in space. The point means the primary element for excellence, according to Kandinsky. "The geometrical point is an invisible entity, which must be regarded as immaterial. When viewed under a material focus, it can be considered as zero. The geometric point found its material form, first, in writing: it belongs to language and means silence. In the fluid discourse, the point is the symbol of the interruption."[7]

The point in physical reality is the result of a collision of the tool with the work plane, paper, wood, plastic, metal, etc. In the technology field, the point is the pixel, or even the shortest moment of the sensor capture.

In arts, "point – stillness. Line – internal mobile voltage, originated from the movement. Both elements form a 'proper' language that it is impossible to define in words."[8]

In an interpretation of body movements, each articulation corresponds a point, that moves in three-dimensional space, describing lines. When the lines move, they form planes, which intersect in space. The movement can in this way be seen as a solid in space. This is the Nota-Anna movement notation.

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[6] Kandinsky, Wassily. *Punto y Linea Frente al Plano.* Buenos Aires: Editorial Nueva Visión, 1959, p. 124.
[7] Ibid., p. 27.
[8] Ibid., p. 136.

The mathematical concept becomes reality, when after reading Nota-Anna we can reconstitute or execute the body movement again. This fact makes us think about the meaning of numbers in our lives. "The interest in numerical expression has two directions: the theoretical and the practical. In the first, the laws play an important role, and in the second, the law is subordinated to the functionality, making the work reach its greatest merit: naturalness."[9]

The relationship between numbers and life is present in this thought of Kandinsky: "Needs are intuitive in nature. The path to their satisfaction is intuitively chosen. The rest is a harmonious union between intuition and calculation: neither can act alone."[10]

3.2. Nota-Anna and the Art Critical Thoughts

"What seems special about humans is our ability to understand what other people think and feel."[11]

The statements above and Nota-Anna make sense when one considers a socially active art, one of the characteristics of our present times. Historically, our era is the continuation of a great innovation that occurred in the second half of the eighteenth century when the steam engine was invented. The machine production was instituted to solve the problem of producing a series of geometric shapes necessary for the parts of the machine: the line, the plane, the circle, the cylinder, the cone, etc. This way, a technique and production of a human cycle was closed. The human hands lost their conductive function in production. Even the most complex geometric figures came to be produced without manual intervention. The fully mechanized technique has attained a formidable degree of progress and depersonalization. "The social work, totally dehumanized, gradually becomes depoetized and its rhythm ceases to be determined by the rhythm of human effort."[12]

Consequently, in the first half of the twentieth century, a new type of art emerged, as Malevitch defines it: "The difference between the new art and the old art consists in that the really artistic of the new does not appear except when life seeks new practical purposes to satisfy."[13] Mondrian complements this by referring to industrial design, a new field at the time, which admits the construction of objects with purely plastic principles. "In the future, the realization of pure plastic expression in palpable reality will replace the work of art."[14]

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[9] Ibid., p. 11.
[10] Ibid., p. 174.
[11] Mlodinow, Leonard. *Punto y Linea Frente al Plano.* SãoPaulo: Editora Zahar, 2012 p. 102.
[12] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma.* Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, p. 117.
[13] Malevitch, Kasimir. "Die Gegenstandole Welt". Munich: *Bauhaus Bucher*, n. 11, 1927.
[14] Mondrian, Piet. *Plástica Pura.* New York: 1942.

Kandinsky synthesizes the artist's relationship with his time: "There are three points that connect art history with the history of culture: art subordinates itself to an epoch; for various reasons, art opposes its epoch and expresses the possibilities contrary to this epoch; until it exceeds the limits of the time and marks the content to come, the future. Abstract art lies in this niche."[15]

In the twentieth century, the tendency of abstraction coincided with advances in science, technology and changes in urban life, eventually reflecting an interest for psychoanalytic theory. Abstractionist theory postulates that the mind obtains its concepts by abstracting them from concepts it already possesses, or from practical experience itself. For example, a generic concept can be abstracted as "vegetable" from concepts already obtained from its instances like carrot, broccoli, onion, etc.

Abstraction in mathematics is the process of extracting the essence of a mathematical concept, eliminating any dependence on real-world objects with which it could have been originally connected, and generalizing so that it has a wider application or correspondence with other abstract descriptions of equivalent phenomena.

Abstraction in philosophy is the process of recognition of some set of characteristics common in individuals to generate a concept of this characteristic. Conceptual abstraction can be formed by filtering the informational content of an observable phenomenon by selecting only the aspects that are relevant to this specific purpose.

In art, abstraction indicates an exit from the reality of image representation. "Abstract art uses a visual language of form, color, and line to create a composition that can exist with a degree of independence from the visual references of the real world." Even art that seeks verisimilitude of the highest degree can be considered abstract, at least theoretically, since the perfect representation is probably always a constructed representation. This relation between abstraction and nature is complex, as shown by the statement: "Many natural phenomena present exact and clear forms, which are strongly reminiscent of geometric constructions, such as the spider's web. Others are of such a nature so that their loose structure hides the geometric construction. In abstract art there are these two types of construction."[16]

The Realistic Manifesto, in 1920, clearly states this position: "In order to communicate the reality of life, art must be based on these two fundamental elements: space and time... Kinetic and dynamic elements should be used to express the real nature of time; static rhythms do not satisfy. Art must cease to imitate, and on the contrary, it must search to discover new forms."[17]

Historically, in the mid-twentieth century, figurative art still had enormous force, the opposition to abstract art was evident. The most common approach was that of naturalism, which defined art as the imitation of the appearance of fauna, flora and human figure. By virtue of the rigid canons of this

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[15] Kandinsky, Wassily. *Punto y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, p. 161.
[16] Ibid., p. 128.
[17] Notations from the personal archive of Waldemar Cordeiro, unpublished.

supposed beauty, the public, in front of a work of art, was deprived of the pure sensation itself, which was replaced by a process of recognition, association, and comparison. People would always ask: what does this look like? Their senses were neutralized and failed to notice the energy of the picture, the relations of color and form, and the physiological reaction of their own perception. Instead, the intellect and reasoning were supposed to draw logical, practical relationships between the represented object and the facts of life. Instead of an expression, the painting was a representation of nature.

Figurative art and abstract art have historically placed themselves as poles of a dyad: the first was conceptual, naturalistic, figurative; the second was visual, intuitive, abstract.

Abstraction in art was manifested by color, freedom of context, reduction of form to basic geometric designs and scientific principles of form. Abstract art has established a closer relationship between science and art, as have other artistic movements of the past such as the Renaissance. "Art is a fact that stops being imitative to discover new ways."[18]

Subsequently, this theory was superseded by concrete art – which is an extension of abstraction. Concrete art stands in a timeless position in the history of art because it is an artistic trend based on scientific visual principles (Visual Gestalt) independent of thematic or semantic content. Concretists, whether geometric or constructivist, try to bring into the world new symbols, forms-intuitions still unknown, from an imaginary or extra-perceptive origin based in science.

The abstract, concrete and constructivist movements went far beyond a reading of geometry, which was only an instrument used by these movements to render their proposals more readable. This proposal leads us to the scientific basis, that is, the study of visual perception. Several artists of that period, in an empirical way and justified by scientific studies, arrived at very interesting conclusions on human behavior with respect to visual perception and its meaning, which today we can find in the studies of the field of Visual Intelligence. (In this postdoctoral thesis, this subject will only be addressed briefly).

The historical background of Art & Technology are the movements of abstract art and concrete art. Now it is time to understand how these movements participate in current art. Art has penetrated into scientific research, into the social media, into the new products launched in the market. This was exactly the proposal of concrete and constructivist art: to exist socially. They did it. Thus the study of art goes beyond the specific field of art, spreads through clothing, market products, social messages and other fields, including body movement.

3.3. Nota-Anna and Researches Concerning Human Perception

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[18] Malevitch, Kasimir. *Moscou Manifest*, 1920.

"For the artist, it would be of special importance to see how nature uses these elements and how they combine to form structures. The laws of the composition of nature reveal to the artist more than the possibility of superficial imitation, they reveal possibilities of using these laws to make art."[19]

Art, which has been part of human existence since its inception, has accompanied human life for millennia. Its discourse has recently changed with the now-surpassed Art & Technology trend, which presented a differentiation of other tendencies when it opened a dialogue of art with studies of perception, and also with biological, neurological and psychological studies. This dialogue provoked a change in social behavior so profound that we have come to change even our organic, biological, neurological and psychological reality.

This social change leads us to the notion of evolution. From the biological point of view, evolution means directed change, a process of adaptation. "Adaptation is the property of an organism, whether it be a structure, a physiological trait, a behavior the organism possesses, which has been favored by natural selection in relation to alternative properties. In each generation, all individuals who survive the elimination process are 'adapted' and the properties that allowed them to survive are called adaptations, after a large number of interactions. When one studies the lifestyle of a particular group of organisms (both biologically and anthropologically), specific adaptations are impressive, without which a lifestyle would be impossible."[20]

Art is part of the adaptation and consciousness to "perpetuate" man on earth and allow his long survival. This is because adaptability and its maintenance can be translated into new creations, present in cultural and geographical plurality. In both biology and the arts, man adapts to new conditioning, changes and creates constantly. Art plays an essential role in human life on earth.

It is curious that there is a term shared in common by the field of the visual arts and that of biology/neurology: plasticity, which touches on man's adaptation. The morphological meaning of this word is interesting. Plasticity, a noun; in the arts: a quality of materials that can be molded; in biology/neurology: the subject's ability to adapt to environmental conditions.

The dynamic relation of man to the environment is highly present in recent studies on perception. Initially perception was considered independent of real life. Today we know that life profoundly influences how we capture and store information. The most recent strategy in the research of consciousness has studied how conscious and unconscious perceptive processes influence thoughts,

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[20] Mayr, Ernst. *O que é evolução.* São Paulo: Editora Rocco, 2005, p. 182.

actions and feelings. "Conscious perception allows the deliberate use of perceived information. Unconscious perception leads to reactions that cannot be controlled by the individual."[21] Perception is a process that occurs only when the body initiates interaction with its environment.

There are works of art that provoke a real change of human behavior and a new apprehension of the world. Nota-Anna can be one case: try to imagine how much our reality can change if we can broadly share written movements in social and private communication.

When we study adaptation and plasticity, both neural and artistic, we can think about human history both on the scale of humankind as well as on that of the individual's growth and development from birth to death.

The understanding of the formation of a person as a whole leads us to a complex approach. Integration, coordination, and interconnection are difficult to understand, suggesting a nonlinear analysis. Thus, we can, for example, observe the relation between the internal processes and the changes of our body. "The state of the cortex is directly visible on the periphery through the attitude, posture, and muscular configuration in which we are connected. Any change in the nervous system clearly translates through a change of attitude, posture and muscular configuration."[22]

Recently, this study has deepened in scientific research, reaching our expressive reality: the truthfulness and authenticity of an expression. There are movements that we make for social reasons, and they are very different from those that are true with respect to their expression. An authentic smile, for example, is different from when it is only for social purposes, only to be nice or polite to someone. Both look similar though in the brain they occupy very different positions. "Our facial expressions are also subliminally governed by muscles over which we have no conscious control. Therefore, our true expressions cannot be feigned."[23] Just as in the face, in the rest of the body as well, anything we feign can be detected as such when accurately observed.

The meaning of movement in life is very broad. I point out a fact that touches directly on the subject we are investigating. "The activity of the human mind begins before the crystallization of the verbal symbols, before the development of the logical-discursive way of thinking. Before the verbal symbol, the image is the first vehicle from which human intelligence is served."[24]

The meaning of visual information is so wide that today there is a field of study, Visual Intelligence, dedicated to study the relationships of our brain, body and behavior with visual images. "Vision is such a large intelligence that it occupies almost half of the cortex. Our visual intelligence interacts

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[21] Freeman, Walter J. and Skarda, Christine A. "Mind/Brainscience: Neuroscience on Philosophy of Mind," in the book: *John Searly and His Critics.* England: Blackwell.

[22] Varela, Francisco J. and Shear, Jonathan. *The View from Within – First Approaches to the Study of Consciousness.* Imprint Academic.

[23] Mlodinow, Leonard. *Subliminar – como o inconsciente influencia nossas vidas.* SãoPaulo: Editora Zahar, 2012, p, 138.

[24] Ibid., p. 176.

richly, and in some cases even precedes or directs our rational and emotional intelligence. By understanding our visual intelligence, we understand ourselves."[25]

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[25] Hoffman, Donald. *Visual Intelligence: How We Create What We See.* London – New York: W. W. Norton & Company, 1998, p. XI.

4. Sculptures based on Body Movement

"It is said that God took in his hands a little clay and did what everyone already knows. If the artist wants to do a creative work, he can never imitate nature, he must use the elements of nature to create a new element."[26]

According to etymology, plastic art is the art that is expressed by the creation of plastic shapes in volumes or reliefs, either by modeling malleable and/or moldable substances, by cutting solids, or by assembling various materials and/or objects. Sculpture is a noun, while sculpting generally means impressing, chiseling, incising or carving on some material.

In the process used to make these sculptures, the material is layered (as with 3D computerized printing) rather than worn away or carved. Even so, respecting these differences, I still use the term sculpture.

In a general overview, historically, sculpture, like the other artistic fields, has undergone a semantic change within the arts and daily life. From the second decade of the twentieth century, without the support of the cathedral wall or pompous pedestals, sculpture came to apprehend the empty spaces, to incorporate in itself the proliferation of new materials and vehicles of communication. As proposed at that time: "What is the number one problem in modern sculpture from [Henry] Moore? The answer is to model, sculpt space instead of volume and mass. What is the method to achieve this effect? Movement. This is the value that space represents for us, which causes us to have a phenomenological, even sensory awareness."[27] The creation of the sculptures studied here is part of this historical approach.

As was the case with visual artists from constructivism, the composition of these sculptures respected the natural organization of our movement in space. To paraphrase Kandinsky: "Composition is an organization of exact regularity of the living forces which are contained as a tension of the forms of the pictorial elements."[28] Pictorial elements, in the broad sense of the term, include the materiality of the parts of a three-dimensional piece, such as sculpture.

From a theoretical and universal perspective, "the artist is, above all, an object-maker, an object producer, a producer of things not expressly solicited by the market or produced directly for the market."[29] The artist aims to provide a new experience for the public in the broad sense of the word, both syntactically and semantically.

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[26] Gauguin, Paul. *Escritos de um Selvagem.* Madrid: Daniel Guérin edición, 1989. Original edition 1892.
[27] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma.* Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, p. 279.
[28] Kandinsky, Wassily. *Punto y Linea Frente al Plano.* Buenos Aires: Editorial Nueva Visión, 1959, p. 109.
[29] Pedrosa, Mario. *De la Naturaleza Afectiva de la Forma.* Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, p. 247.

Beauty is always present in these artistic experiments, even when it is an aggressive and violent art. The notion of beautiful is resignified to each period integrated with the social life. In the case of these sculptures, the beautiful is the revelation of a reality that our perception captures but which is still outside the systems of social communication: the written human movement.

Beauty reminds us of the plurality of creativity. Throughout the history of art, there have been various methods and instruments of creation, which resulted in diverse relations of mind/emotion with various procedures of production of the artistic objects – methods that we can call creativity. The conception of creation is independent of its verbalization, and it is precisely in the quality of this action wherein lies the quality of the work of art itself. "Like any fruit of mental activity, the work of art arises from the symbolic nature of human thought. Only its symbolic essence differs much from that of the discursive verbal symbol."[30]

These sculptures are a product of the symbolic nature of thought above all else. A thought fully integrated with our current technological and social reality.

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[30] Ibid., p. 155.

5. The Production System of the Sculptures

"How can we express ourselves? There is another kind of beauty, created, invented by men for men. The visual beauty of a setting that washes over us without being that of the ocean; a jewel that enraptures us, without being similar to a beautiful woman."[31]

Between 2015 and 2017, seventeen sculptures were produced. A project elaborated directly on the Nota-Anna notation of three movements: the bicycle kick executed by Pelé, recorded in video, in 1958; the volley kick performed by Pelé, recorded in video, in 1958; and the yokogueri kekome hit performed by Bruce Lee, recorded on film in the 1960s. In the Architecture of Movement video, one can see the graphical variations of Nota-Anna for Pelé's kicks. Looking at those images together with the sculptures, the close relationship between movement and sculpture becomes clear: these are the material condensation of the movement with great accuracy. These sculptures were made in 3D printers with diverse materials, always in small size, between 12 and 26 cm in height, as shown in the illustrations and the video indicated below.

A movement is a drawing in space, that outlines an ephemeral form making an impression on people who see it. The movement disappears, but the impression remains.

If the movement is surprising, endowed with beauty and efficiency, the impression that remains is one of admiration. People talk, trying to describe it with emotion, to explain the reason for this admiration. This is how some movements perpetuate themselves in the history of man, as extraordinary deeds. Prime examples of this are found in the bicycle and volley kicks performed by Pelé, remembered in a poetic way, as unforgettable moments. The aim to transform them in materialized memory is what gave rise to these sculptures, faithful to the movement.

 Stages of the Creative Process:

. Digitalization of video sequences, recorded in 1958 and in the 1960s.

. Tri-dimensionalization using the Nota-Anna software together with other tools of movement visualization.

. Modeling the sculpture. This is the stage of artistic creation of the sculpture, where we choose the visual option. A visual program created for the composition of the sculpture faithfully using the data of the reading of movement, using Nota-Anna.

. Application of 3D printing software to each of the geometric interpretations obtained.

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[31] Cordeiro, Waldemar; *Arte Moderna e Naturalismo.* São Paulo: *Folha da Manhã*, 1950.

. Checking technical problems in the modeling.

. Correcting the technical problems and refining the creation of the piece from an artistic point of view, as well as support solutions such as pedestals.

. Choice of the material for the 3D impression and evaluation of the aesthetics.

. Project of graphical pieces that come along with the sculptures.

Technical Options

Video: H.264 format, created with the softwares Nota-Anna, Rhino3D, Final Cut Pro;

Sculptures: 3D printing using copper/brass/gold, polyamide and alumide;

Drawings: paper, transparent acetate, ink and metal;

"The balance of any aspect of nature is based on the equivalence of its opposites... On the subject of dimensions and equilibrium: it replaces the old static concept of symmetry with the 'adjustment of the unequal but equivalent parts.'"

concept of abstraction I

upper point of view / front point of view

white poliamide 25,5 x 21,6 x 18,5 cm

source: bicycle by Pelé
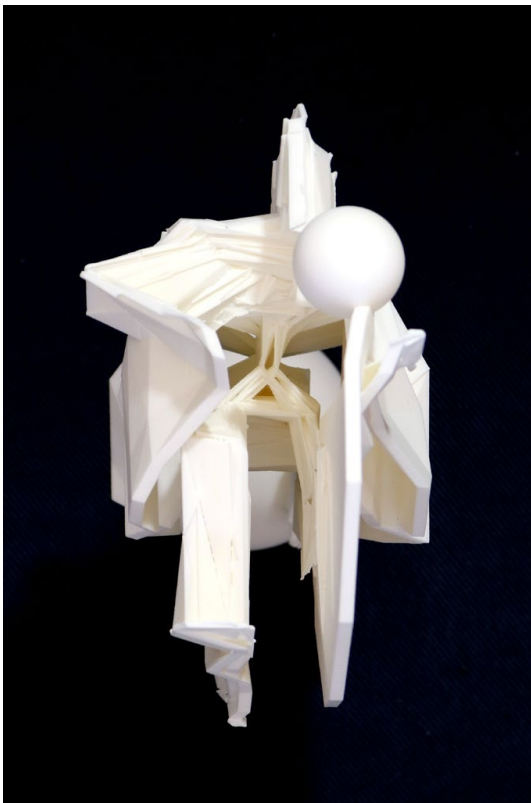
concept of abstraction II

upper point of view / front point of view

white poliamide 25,5 x 21,6 x 18,5 cm

source: volleio by Pelé

poetics of the human movement

Upper point of view / frontal point of view / side poin o view lateral

alumide 23,5 x 11,6 x 19,8 cm

source: bicycle by Pelé
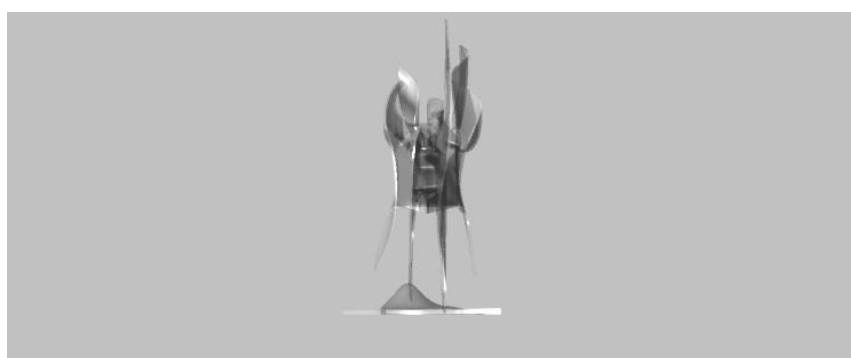
(in)visible moving II

Upper poin of view / side poin of view
alumide 25,5 x 28,5 x 18,3 cm
source: yokogueri kekome by Bruce Lee

(in)visible moving I

Upper point of view / side point of view

Red poliamide 24,5 x 21,6 x 18,5 cm

source: volleio by Pelé
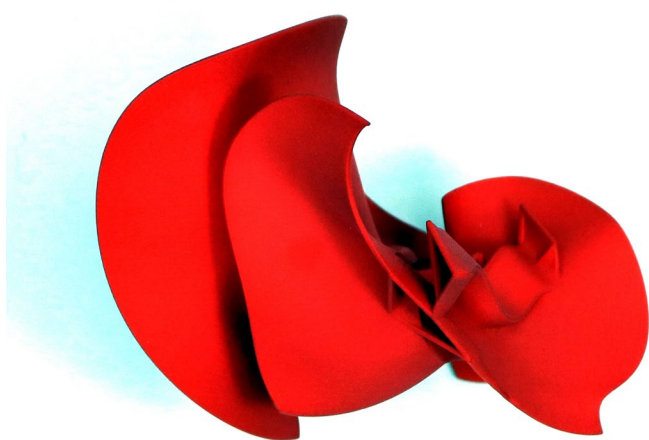
ephemerality of movement

upper point of view / side point of view

translucid resin 24,4 x 20,7 x 19,1 cm

source: volleio by Pelé

materialization of movement geometry

side point of view / upper point of view

copper 12,5 x 6,8 x 5,0 cm

source: volleio by Pelé
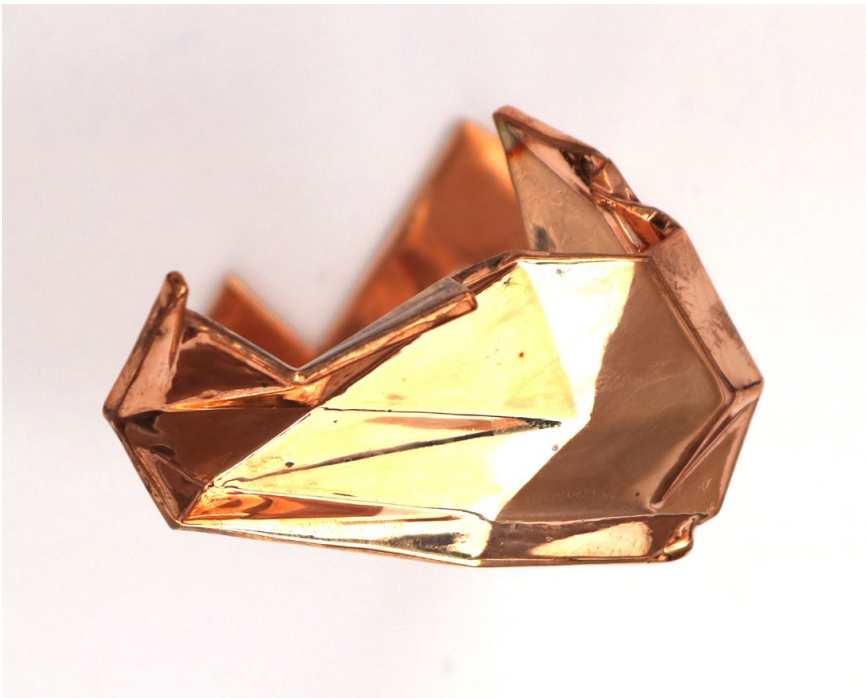
gold kick

front point of view / upper point of view

brass and gold 12,5 x 8,4 x 6,3 cm

souce: volleio by Pelé
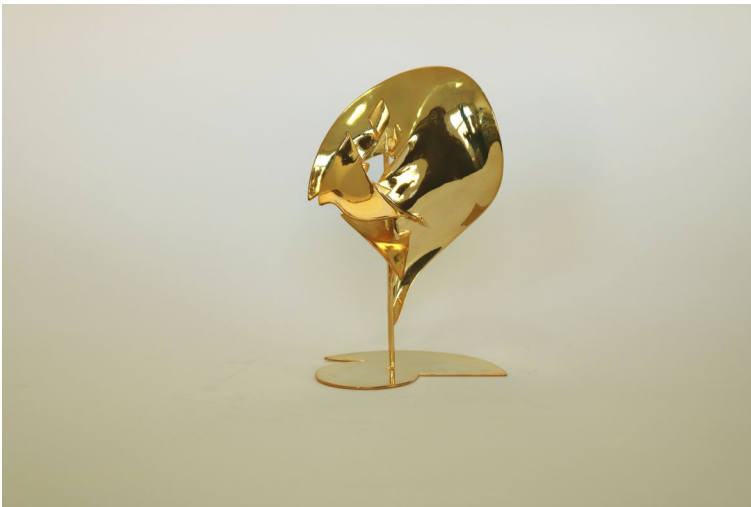
in out

upper point of view / side point of view

brass and gold 19,5 x 4,7 x 7,9 cm

source: yokogueri kekome by Bruce Lee

I saw it

Upper point of view / side point of view / front point of view

black poliamide 24,7 x 25,1 x 14,0 cm

source: yokogueri kekome by Bruce Lee

visible empty

side point of view / front point of view / upper point of view

black poliamide 24,2 x 21,0 x 18,0 cm

source: volleio by Pelé

organical kaleidoscope

side point of view / front point of view / upper point of view

black poliamide 25,5 x 10,8 x 18,5 cm

source: bicycle by Pelé
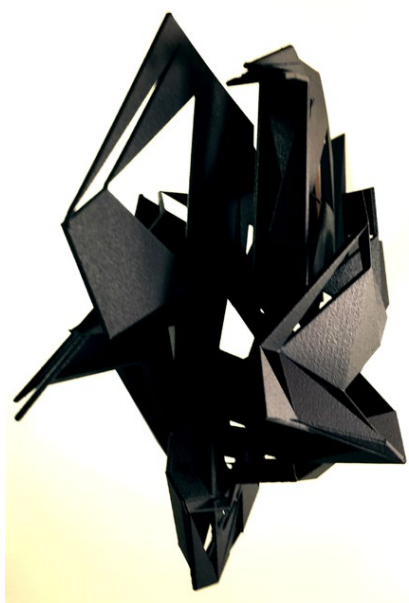
Tribute to oskar schlemmer III

Side point of view / upper point of view /perspective point of view

blue poliamide 18,3 x 22,1 x 12,9 cm

source: yokogueri kekome by Bruce Lee
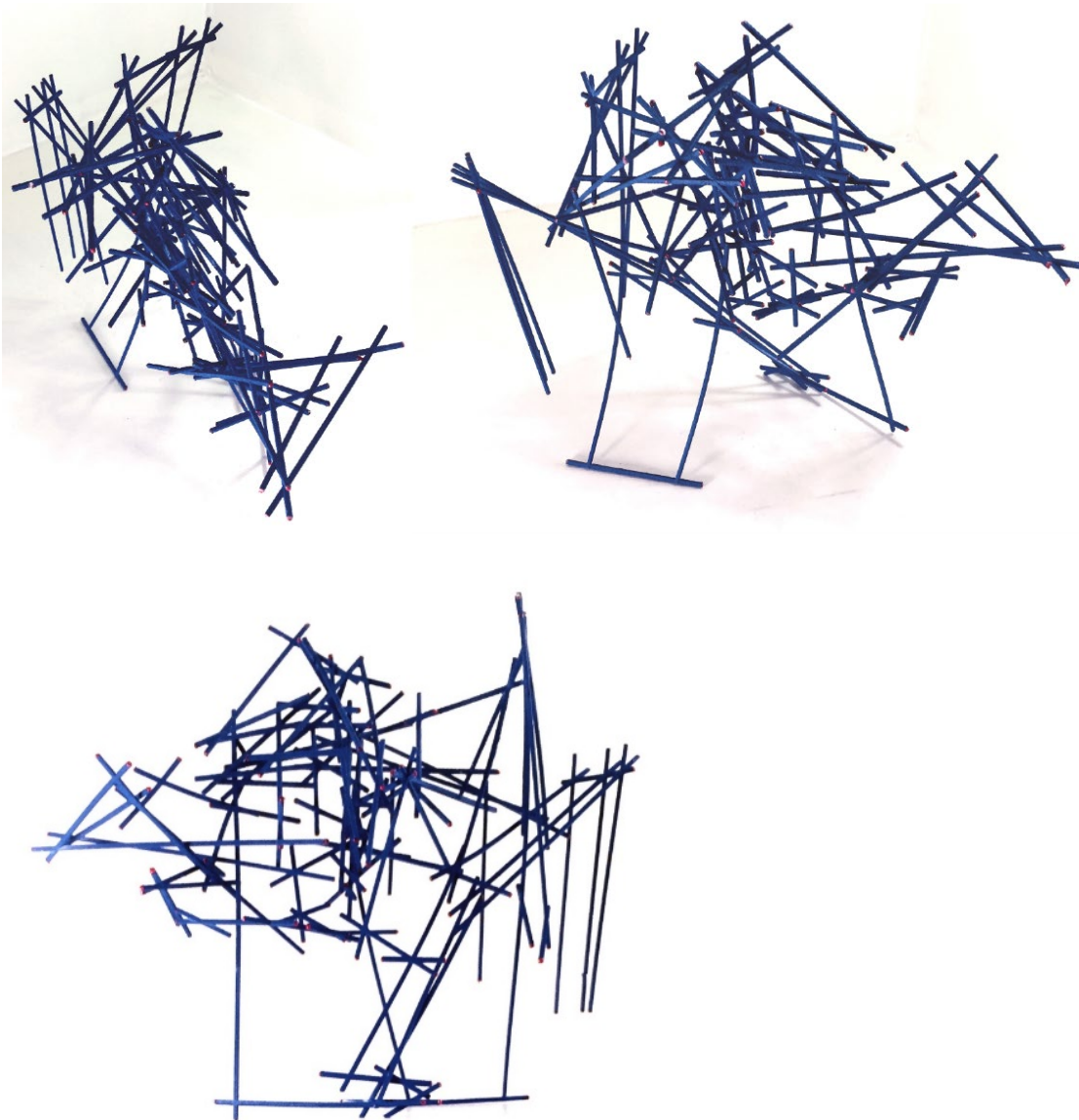
tribute to oskar schlemmer II

side point of view / upper point of view / front point of view

yellow poliamide 23,5 x 11,7 x 19,8 cm

sourcee volleio by Pelé
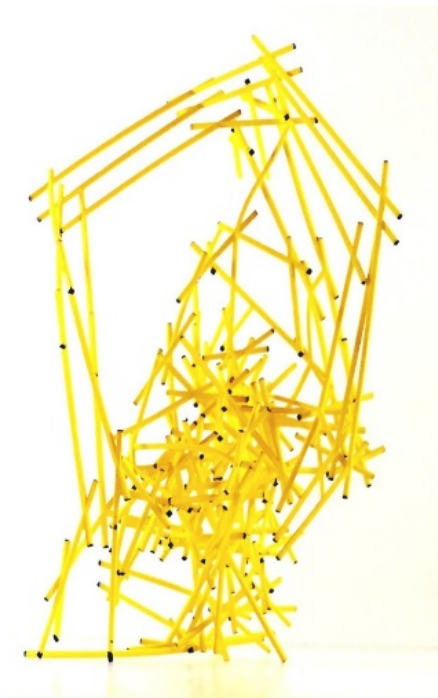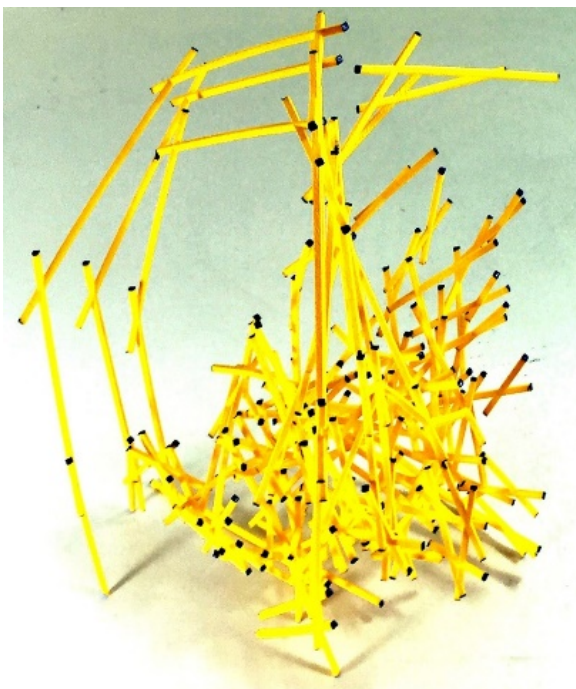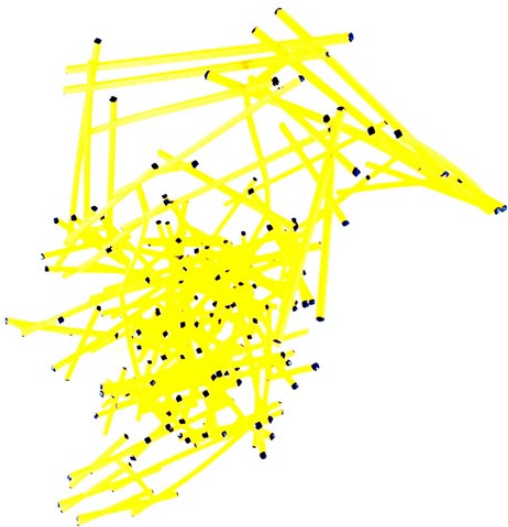
Tribute to oskar schlemmer I

Side point of view / front point of view / upper point of view

red poliamide 23,3 x 10,4 x 16,7 cm

source: bicycle by Pelé

materialization of sight II

upper point of view / two perspective points of view

white poliamide painted blue 25,5 x 28,5 x 18,3 cm

source: volleio by Pelé
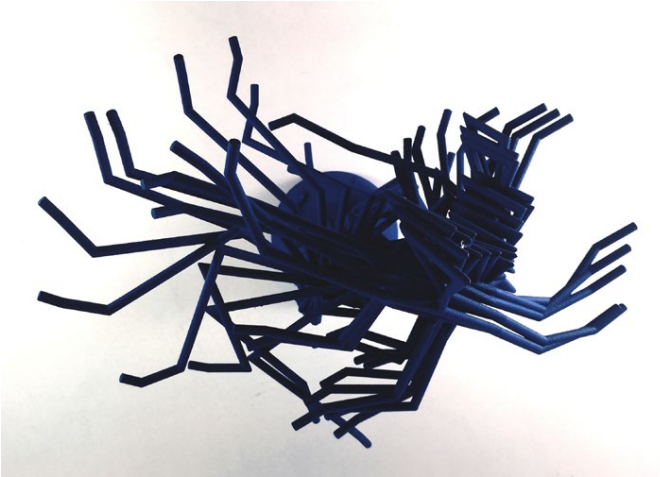
materialization of sight I

side point of view / front point of view

white poliamide 25,5 x 28,5 x 18,3 cm

source: bicycle by Pelé
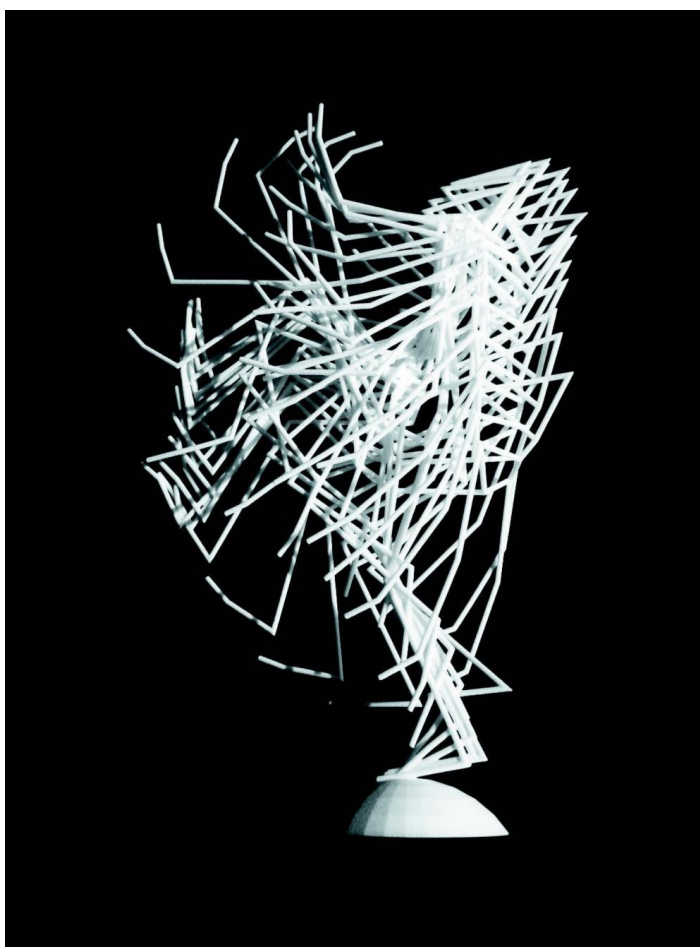
Summarizing:

Movement is ephemeral, it disappears in the air. Our visual persistence allows the recording of movement in our brain. As an artist, I visualized that Nota-Anna software and notation could be transformed into sculptures, an innovation never done before. A unique and genuine design, it offers surprisingly beautiful results.

Sculptures / drawings show:

. The geometry of the body is complex.

. In the human body there are no straight or parallel lines.

. The movement in the air materializes with the dust deposited in the void of its spatial trajectories.

. Sculptures embody the evanescent movement.

. Our movement is a drawing in the air, poetic and expressive.

7. Analysis of the Sculptures

"The soul dreams and thinks, only then imagines."

The visual result of these sculptures was surprising from the spatial point of view. We can observe three points in common to all the sculptures: the complexity of lines and planes that intersect, the lack of a long straight line and the absence of any parallelism between the lines.

This is new information for the eye because it reveals the movement of the body in space. The fidelity of forms to the real movement of the body in space makes us think and re-watch the movements of people, trying to find these lines in our visual perception of the movement in everyday life. Our eye, which is educated to see, will look differently at the movements of people in the future.

Where exactly is the artist's free creativity in this research? With all the technical data, the artist creates spatial interpretations of the movement described by the trajectories, planes and points. This creation gives meaning to the condensation of the movement in the form of sculptures. The 17 sculptures can be grouped into five types of composition, which I will describe without judging or evaluating:

. Lines: there are invisible threads that delineate the trajectories of the movement, and it seems that the straight lines were thrown onto these trajectories, stuck together, and became supported by the trajectory. I called these sculptures *Tribute to Oskar Schlemmer* because they resemble one of his dances in which sticks are tied on the limbs of the body, with a length greater than the member itself, making the dance appear like straight lines in movement. The sculptures of this group are: *Tribute to Oskar Schlemmer I*, *Tribute to Oskar Schlemmer II*, *Tribute to Oskar Schlemmer III*.

. Whole polygons: as if they were folded papers opening as the figure moves. The sculptures of this group are: *Concept of Abstraction I*, *Concept of Abstraction II*, *Ephemerality of Movement*, *Geometry of Movement Materialization*.

. Polygons with cutouts: The zombie version of the entire polygons. A percentage of the polygons is removed at random, without harming the stability of the sculpture. The sculptures of this group are: *I Saw It*, *Visible Empty*, *Organic Kaleidoscope*.

. Continuum: these are flexible, as soft fabrics like pure silk that define movement in space. The sculptures of this group are: *Poetics of the Human Movement*, (*In) visible moving I*, (*In) visible moving II*.

. Partial Continuum: some body articulations members have a path in space endowed with great beauty, like the left leg with knee and foot articulations in the volley kick performed by Pelé. In these cases, I took these members separately and transformed them into sculptures. The sculptures of this group are: *Gold Kick*, *In-Out*.

. Body: the movement sequence captured by Nota-Anna and transformed in stick figures of the body. The sculptures of this group are: *Materialization of Sight I*, *Materialization of Sight II*.

7.1. Comparison with scientific researches: microscopic images

"Only by a microscopic analysis will the science of art arrive at a vast synthesis, which will extend beyond the frontiers of art, to the region of the 'unity' of the 'human' 'with the' divine."[32]

This analysis is justified by the plastic characteristics of these sculptures producing thoughts and questions that dialogue directly with the works of the abstract/constructivist/concrete period. To create these sculptures I used new technological resources and new human cognitions: software, microscopes and electronic photographs and others. It is thus possible to establish a direct relation between the real movement and the exploration of this movement in the sculptures. This result raises a question: what resources were available to the abstract/constructivist/concrete artists, which enabled them to interpret in their works this reality invisible to the naked eye? The answer I obtained is in the very discourses and affirmations of these artists, as evinced by the above quote. They cultivated the profound capacity for introspection, spirituality, mentioned already in the above pages.

Did these artists have an exceptional ability to visualize the microscopic realm of the material world, even without knowing its actual (microscopic) images, which we know today? Looking at the images created by these artists compared to the images made by current electron microscopes, the resemblance between them is impressive.

When we read the writings of abstract and constructivist artists we often come across the word *spirituality*. Analyzing the use of this word, we see that it has a relation different from the

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[32] Kandinsky, Wassily. *Punto Y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, pag. 21.

traditional spirituality/materiality dyad. In light of the current knowledge of psychology and perception, we can give spirituality and its dyad some other meanings and implications. Subliminal, unconscious/conscious, intuitive/calculated, inner/outer, and the more controversial objective/subjective.

Subliminal, in Latin, means "below the threshold." Kandinsky said: "Not everything is visible, not everything is conceivable, or rather, under the visible and the conceivable there is the invisible and the inconceivable."[33]

Another possible meaning for spirituality is the unconscious/conscious dyad. For current biologists and psychologists the branch of the unconscious is the most fundamental. While most species can survive with little or no capacity for conscious thought, no animal can survive without the unconscious. According to Peirce: we do not consciously perceive everything our brain registers, so our unconscious mind can perceive things that the conscious does not perceive.

One specific result is of great interest in this postdoctoral work. One of the most important functions of our unconscious is the processing of data sent by our eyes. While our eyes convey much detail, the conscious mind cannot remember all of it ... "The key to one of these experiments to investigate this disparity was the fact that when one studies an image containing many objects, the eye shifts constantly between the different objects shown."[34]

The so-called "blind spot" is a gap in the data that our eyes give us, a point at the back of the eyeball where the link between the retina and the brain is located. This creates a dead region in the field of eye sight. "Usually we do not even realize this, because our brain completes the image based on the data obtained from the surrounding area."[35] Notice, then, that the vision uses multiple paths. This should be considered when an artwork is analyzed or shown to the public.

About the intuition/calculated dyad: according to the philosopher Benedetto Croce, intuition is a sudden definition, the instant understanding of an impression that follows very different paths. Mario Pedrosa states: "To be aware of intuition, one must pause, separate oneself from one's own thinking or logical mental effort in which one concentrates, and observe it from the outside. Both abstraction and interpretation are spontaneous, natural ... and intuitive."[36]

In this sense intuition is opposed to the rational and calculated. Kandinsky said: "The artist goes from intuition to expression; the geometer goes from intuition to axiom ... The artist works with

[33] Kandinsky, Wassily. *Punto y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, pg 162.
[34] Mlodinow, Leonard. *Subliminar – Como o Inconsciente Influencia Nossas Vidas*. São Paulo: Editora Zahar, 2012, pg 116.
[35] Ibid.pg 57.
[36] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma*. Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, pg.180.

the intuition recorded in his sight, and also in his hands and in his senses...the need and a balance of creative forces must be distributed between two schematic parts: intuition and calculation."[37]

"What the work of art conveys is a formalization of the unknown nature, a new symbolic, perceptive, or imaginary organization. As it never consists of a proposition, regardless of its classification by schools, trends or styles; the work ...belongs to the sphere of the intuitive forms of thinking and feeling."[38] This quest for the understanding of human nature reaches its peak with one of Kandinsky's best-known phrases: "The point, the line and the plane are 'objects' by which intellectual rigor proposes to raise the intuitive to the category of knowledge."[39]

The subjective aspect, sometimes in opposition to the objective, sometimes in opposition to the unobjective, is emphasized in concretist texts. Mondrian said: "Both science and art are discovering and revealing to us the fact that time is a process of intensification, an evolution from the individual to the universal, from the subjective to the objective, until the essence of things and of ourselves ... by means of intensification deeper planes are successively created."[40] Waldemar Cordeiro, a leader of concretism in São Paulo, in his personal notes, quoted Malevich, who painted a black square on a white background in 1913: "... the spirit of the unobjective sensitivity, which permeates everything ... the feeling of satisfaction I experienced for having freed myself from the object, leads me ever further into the desert, where only feeling is real... and that is how sensibility becomes the very substance of life. This square I set out was not just an empty square, but the sensitivity of the absence of the object."[41]

About the inner/outer dyad, Kandinsky proposes to study the double aspect of visual language: the exteriority of the sign and the interiority of meaning: "The whole phenomenon can be lived in two ways: interiority and exteriority."[42] According to Cordeiro, "since religion, science and thought (by the rigorous hands of Nietzsche) are shaken and the outer supports threaten to topple, man withdraws his gaze from outer things and looks deeper into himself, according to Kandinsky."[43]

This concept is important in the history of modern art. For Cordeiro, the age of constructivism and concretism has a profound meaning. "The great bouleversements: the displacement of the

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[37] Kandinsky, Wassily. Punto y Linea Frente al Plano. Buenos Aires: Editorial Nueva Visión, 1959, pg 168.
[38] Ibid. pg 156.
[39] Ibid. pg 9.
[40] in Nicholson, Ben. Gabo, Naum. Martin Leslie (edit). *Circle: An International Survey of Constructive Art*. New York: 1937, pg 172.
[41] Personal notes of Waldemar Cordeiro, without publication. I make an aside to remember that the binomial subjective / objective was very significant in Brazilian concrete art, especially in its final phase. In many discussions the term subjective was confused with emotion. On this Waldemar Cordeiro was positioned: "the emotion is still far from characterizing and knowing the art. And emotion itself must be known and characterized. Emotion is the expression of the direct nature of art. "
[42] Kandinsky, Wassily. *Punto y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, pg 17.
[43] Waldemar Cordeiro personal notes without publication.

center of gravity in art, literature and music; the diversity of forms – the constructive factors contained in the forms; the intense orientation towards the interiority of nature… Such are, in broad lines, the features of the new Inner Renaissance."[44]

Today the question of interiority has developed very much in all fields of human life. Kandinsky predicted what happens to us today. "Despite all seemingly invincible contradictions, man today seeks more than just the outside. His vision sharpens, his ear is tuned, and his desire to see and hear the interior is growing."[45]

As a brief conclusion, we can consider human creativity from this point of view. In man, both explicit aspects of life and implicit aspects combine to create our mental experience. The key word is to create. Our brain, more than recording a taste or another experience, creates an experience. This concept may seem new, but it was defined a long time ago, I quote Kant: "Our perception is not only based on what exists, but is somehow created."[46] I say that, from this point of view, creativity is the result of a sum of factors: intuition + interiority + inspiration + precision + focus.

7.2. Differences in the process

The main difference between the processes of the abstract and constructivist art and the process of architecture of the movement and Nota-Anna is the spirituality and introspection in the historical moment of each. The definition of spirituality has changed over time, assuming different concepts. These have always been in accordance with forms of humanism of each era. In the process of the architecture of movement, the notion of humanism is present as the exact materialization, technically and visually, of a human language, bearing new possibilities for observing our reality regarding a little explored language: the movement of our body. The visual result of this technique is presented to the public, which uses its imagination, just like the artist himself. This coincides with the concept of interactivity, posterior to abstractionism and constructivism. It conserves a similarity to these art tendencies regarding the purity of forms seen as a spiritual element.

7.3. Comparison between the sculptures and abstract/constructive works

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[44] Waldemar Cordeiro personal notes without publication.
[45] Kandinsky, Wassily. *Punto y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, pg 163.
[46] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma*. Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, pg 39.

In biology, "the most frequently used indicators are the morphological and embryonic similarities when one approaches kinship and common origin."[47] In art, morphological similarities exist, both in painting and sculpture, when we compare scientific images to abstract, constructivist, and contemporary pictures. This parallel reveals interesting similarities between images of art and science. I wonder how artists could create images so similar to microscopic reality without ever having seen any of these images, as they did not yet exist in their time. They could only see them in their imagination. This is a subject for another study, but I found it interesting to mention, on this occasion, this observation I made some time ago, and which without any doubt touches on the spirituality in art.

Meteorite from Mars

Manabu Mabe

Caffeine crystals: this image shows a coffee bean.
Credit: The Wellcome Awards

Marc Chagall
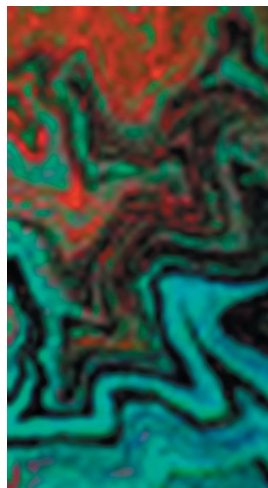
Alzheimer's Disease,

microscopic image.

Lázlo Moholy-Nagy
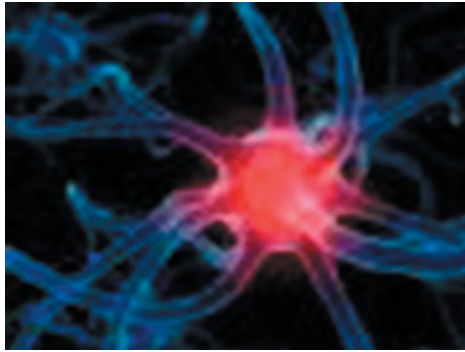
Microscope view of bacteria

Rubens Gerchman
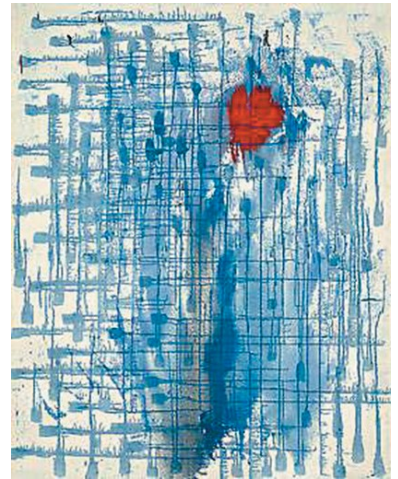
Microscopic image of water

droplets

Juan Miró
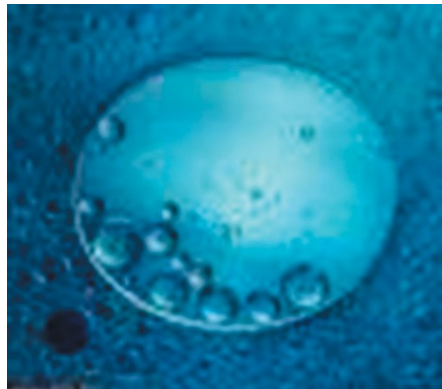
[47] Mayr, Ernst. O Que É Evolução. São Paulo: Editora Rocco, 2005, pg 46.

e growth of the cortex.
The primary osteons are seen.

Georges Seurat
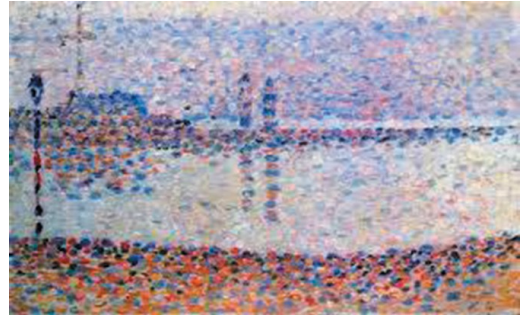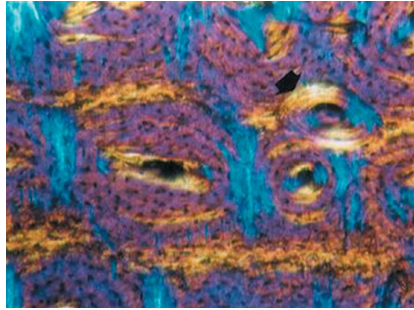
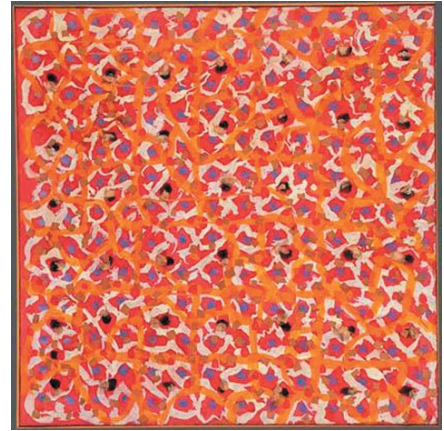Cells from a human kidney section

Paul Klee
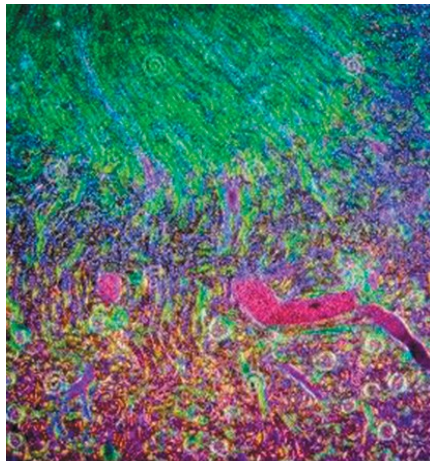
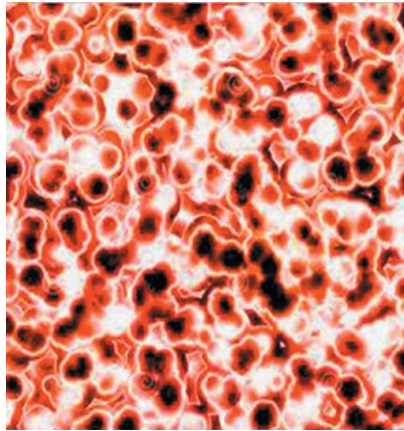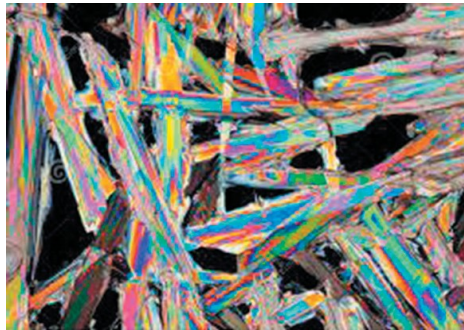This image obtained through an electron microscope shows the cells

Josef Albers
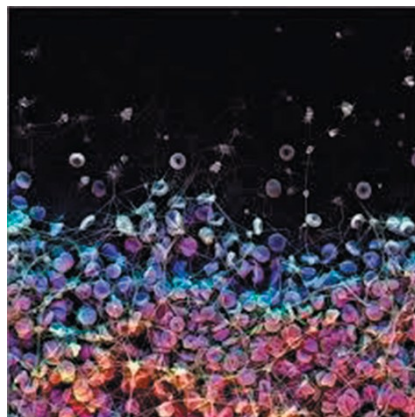
coherence tomography (OCT)
of the retina is high-precision imaging
exam, that uses light waves to generate
section images of ocular structures

Waldemar Cordeiro, 1962

Microscopic View of potassium

nitrate crystals in polarized light
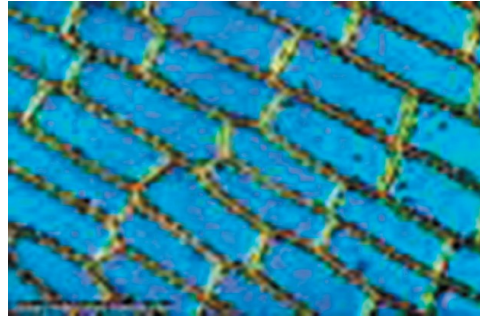
Maria Helena Vieira da Silva

Neurons magnified 40x (Jan
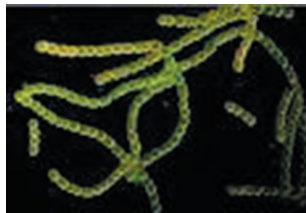Schmoranzer)

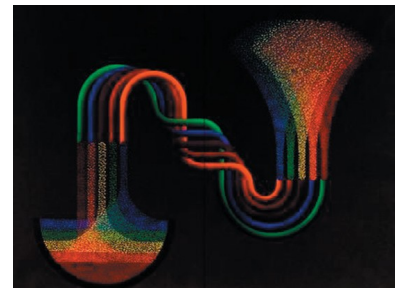Wassily Kandinsky
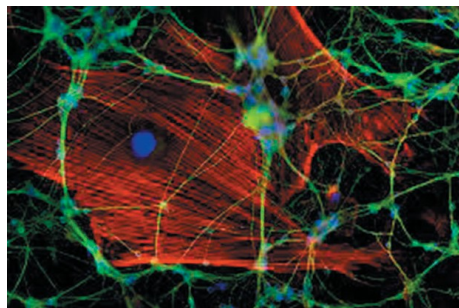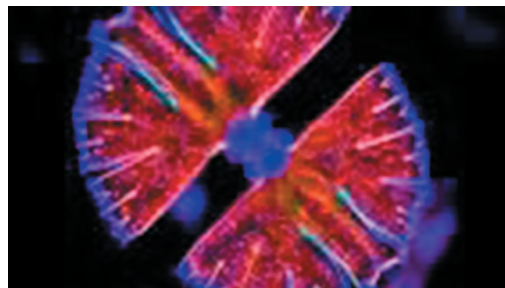
Cell wall

Helio Oiticica, 1958

Microscopic algae are not plants,
cyanobacterias are organisms capable of
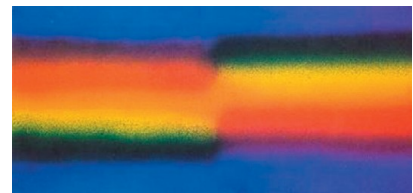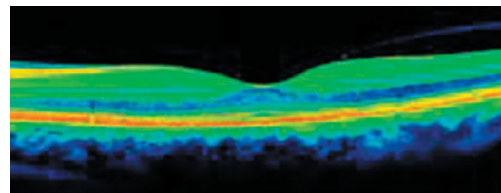photosynthesis
Henry Matisse

Common blue dragonfly eye
(Enallagma cyathigerum) microscope
image captured by Igor Siwanowicz,
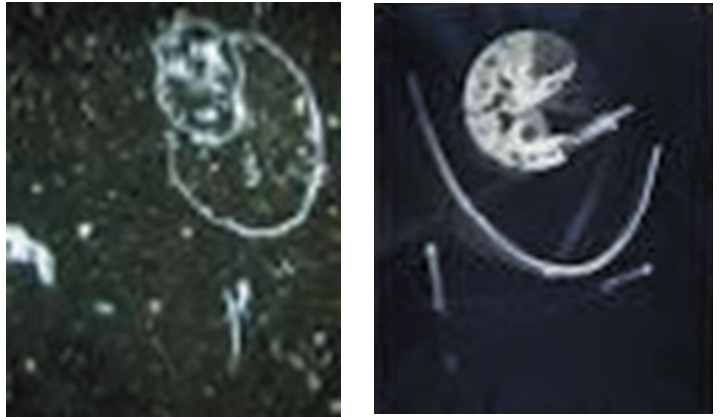Max Planck Institute of Neurobiology
(Germany)

Julio Le Parc

Optical coherence tomography (OCT)
of the retina is high-precision imaging
exam, that uses light waves to
generate section images of ocular
structures

Waldemar Cordeiro

The Cañizar formation

Lázlo Moholy-Nagy

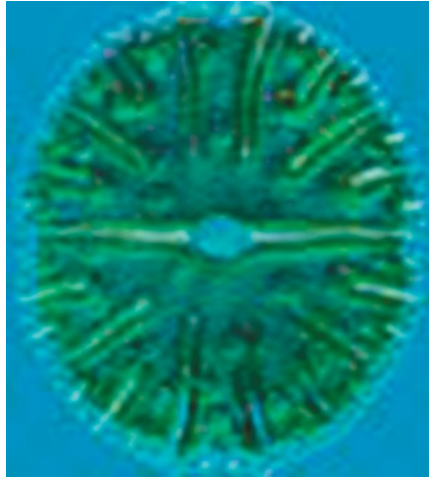Dragon Ballin

Robert Rauschenberg

Motion trace image of a kick of the player
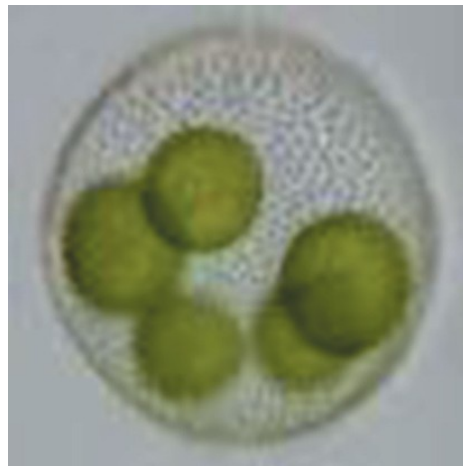Pelé 1968 by Analivia Cordeiro

Antoine Pesvner

This false-coloured scanning electron micrograph shows caffeine crystals

Theo Van Doesburg

Microscopic bacteria:

Volvox carteri

Robert Delaunay

We need to define terms that we use freely in everyday life so that greater accuracy is possible. Imagination is the creation of images in one mind that do not exist in reality. Abstraction is to eliminate everything that is superfluous and to stay with what matters at that moment. These two words help to understand a visual art in which the images ceased to be figurative and began to show their visual essence, both from the point of view of meaning and structure.

According to Kandinsky: "the difference between abstract and figurative art: in the latter, the element 'in itself' is veiled and repressed, in the former, the point it is in full flight and free."[48] And he adds: "The characteristic of artistic behavior nowadays is freedom."[49] At that time, abstraction was considered an attitude of freedom, more precisely a freedom of the imagination.

In other words, Malevich reinforces this point of view: "Sensitivity is the only thing that matters, and it is on this route that art, in Suprematism, serves pure expression without representation."[50] And he adds about a painting he created: "I did not invent anything. I only felt the night in myself, and in it, I saw the new thing that I called supremacy. This is expressed by a black surface representing a square."[51]

In this painting, black is a color, without the connotation of the darkness of figurativism. "In painting nothing is true but color. Color is a constant energy determined as opposed to another color. Color is the primary matter of painting; there is not another meaning outside of itself. Painting is a means of realizing thought optically: each painting is a thought-color."[52]

Thought for this generation meant an approximation with the mind, in the sense of control and theoretical formulation. "Painting in particular has made a fabulous leap in recent years. It has risen to a standard that requires a scientific examination of the pictorial means and its goals."[53]

[48] Kandinsky, Wassily. *Punto y Linea Frente al Plano*. Buenos Aires: Editorial Nueva Visión, 1959, pg 62
[49] Ibid. pg 253.
[50] personal notes of Waldemar Cordeiro without publication
[51] Ibid.
[52] Theo Van Doesburg, 1930 in personal notes of Waldemar Cordeiro without publication.
[53] Kandinsky, Wassily. Punto y Line Frente al Plano. Buenos Aires: Editorial Nueva Visión, 1959, pg 18.

In this postdoctoral thesis I have exhaustively explored the writings of Kandinsky, for the importance he had in the theoretical formulation of our visual perception allied to the look into the interior of our mind with the keen sensibility and an attitude of freedom.

Nowadays we have developed the principles launched by this generation, reaching the understanding of the human being as a unity of opposites. The dichotomies of the generation of these precursor artists have become the complementary sides of a unity, in this case the conscious + unconscious unity. Today's biology states, as Mlodinow says "Language is a useful thing, and we human beings have emotional and social attachments that transcend words, and we communicate – and we understand each other – without conscious thoughts."[54] And completing this thought: "conscious perception performs its miracles with a strong dependence on the unconscious."[55]

7.4. Accessibility to Knowledge

Accessibility to online knowledge and the current use of intuition in relation to the amount of information received is a characteristic never before seen in human history.

Nowadays, almost a century after the beginning of the abstract and constructivist movements that transformed our approach to the gaze, we observe, at each corner, the influence of these artists in the visual language of our products and in the aesthetics of our social communication in daily life. A package, a household product, a book, a car, a building ... just look around. In addition, current scientific research has proven many of the principles experimentally defined by these artists.

What we have learned is that much of our social perception – like vision, hearing, and memory – seems to follow paths that are not only associated with consciousness and intent. The unconscious has constant participation. The territory we have started exploring now is the understanding of how the subliminal programming affects our lives, our communication, our judgment of people, the way we react to social situations and the way we treat ourselves.

Recently, concepts of psychology such as the id and the ego have given way to structure, connectivity, and brain function maps, allowing for a new study methodology. As Kosko says: "The more we look at nature, the more information we see in structure. Structure is information.

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[54] Mlodinow, Leonard. *Subliminar – Como o Inconsciente Influencia Nossas Vidas*. São Paulo: Editora Zahar, 2012, pg 96.
[55] Ibid. pg 94.

The neural networks in our brain, our spine, and our muscles encode, store, and decode information. Our culture and our economies are just stores and flows of information."[56]

These proofs shed light on the production of abstract, constructive and concrete art. Unconscious processes were visually translated and achieved results similar to the most current microscopy images we have today, and which at the time of these creations were totally unknown, as we have seen above. In addition, many paintings of this time resemble the images of Visual Intelligence studies that are being made today.

Scientific studies carried out starting after the first constructivists and continuing to the present have revealed much about how we absorb and store information in our body/brain. In the sphere of painting, the focus is on visual perception. "Visual perception apprehends the whole without an exploratory mode, in a succession of details of sensations that gather and accumulate a posteriori in another mental operation. Thus the word is captured by visual jumps instead of letter by letter, or a page without being read word by word. The global perception of elements 'is not the product of any casual combination."[57] Understanding the meaning of this behavior in our lives is still being explored.

Visual perception occurs in conjunction with other forms of perception, simultaneously over time, in a duration that is nearly as immediate as life is long. Moments in time may be forgotten forever, or just glimpsed. Something of them always survives within us, permeating our unconscious ... "although imperfect, our brain can communicate a coherent image of our life experience."[58] With these capabilities, we can communicate and create throughout a whole life.

In these studies, one of the main protagonists is technology. Besides conducting all activities and operational experiences, it also socializes, par excellence, these same activities. For this reason it is present in all moments of our life, becoming part of us likes organs of extension of the body, which we carry everywhere, in public and private spaces.

One of the characteristics of today's technology is the acquisition and manipulation of much more data than our brain ever could. In addition, the simulation of reality is also increasingly sophisticated. This enables man to try to control and also change his assimilating faculties, including his sensory, psychic, and mental faculties. The most difficult task in this context is to determine the process of discrimination and selection of information. "If 'perceiving is selecting,' this is equivalent to saying that knowing the world means knowing the rules of perceptual

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[56] Kosko, Bart. *Fuzzy Thinking – The New Science of Fuzzy Logic*. New York: Hyperion, 1993, pg 279

[57] Pedrosa, Mario. *De La Naturaleza Afectiva de la Forma.* Madrid: Museo Nacional Centro de Arte Reina Sofia, 2017, pg. 194.

[58] Mlodinow, Leonard. *Subliminar – Como o Inconsciente Influencia Nossas Vidas*. São Paulo: Editora Zahar, 2012, pg 93.

selection."[59] I ask: what kind of change occurs in our perception and in our concepts with the enormous amount of information we receive continuously? What is the meaning of this question for the new machine learning and deep learning systems that are currently in use? To facilitate? Giving meaning to a large amount of data? The machines make their decisions based on averages. This makes mediocre the actions that are based on these types of selection, based on recognition by number of occurrences? These are questions that will remain unanswered in this text, and may lead to further reflection.

Observing people, intuitively, I remark that our selection is, in most cases, superficial, because the amount of information we have to "throw away" is huge and constant. Without this selection we are unable to absorb new information. This establishes a continuous cycle that permeates the life of almost all of us today. This behavior exists in all spheres and fields of our society, including the arts. That is, the quantity suffocates the quality. Deep and time-consuming analysis gives way to fleeting and facile judgment.

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[59] Kosko, Bart. *Fuzzy Thinking – The New Science of Fuzzy Logic*. New York: Hyperion, 1993, pg 195.

8. Conclusion

"An artist does not create the way he lives, but lives what he creates."[60]

The points raised in this postdoctoral work are the result of observations I have made over many years – since my childhood in fact, as I grew up surrounded by concrete, constructivist and abstract art. My background in this area was not academic. And in this thesis, it was impossible to study in depth all the points raised. My intention was just to put them clearly.

I believe in art as a transforming element of people and society. Today we can point to many works and artists that are commercial and run counter to this statement. At the same time, we can see that the art of quality still exists and it is a field of reflection and understanding of our life. Quoting Kandinski again: "It is a privilege of art to offer us an image of life that is much deeper and more complex than that transmitted by any other means of expression. Its forms reveal to us unrealizable virtualities by a simple causal nexus, discovering in ourselves new ways of feeling, and therefore of being."[61] Experiments have always been in the sense of enlarging, intensifying or interpenetrating the perceptual thresholds.

"The law of art and life: balance."[62]

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[60] Bachelard, Gaston. *The Poetics of Space- the classical look at how we experience intimate places.* USA: Beacon Press, 1994
[61] Kandinsky, Wassily. *Punto y Linea Frente al Plano.* Buenos Aires: Editorial Nueva Visión, 1959, pg 198.
[62] Phrase by Mondrian in unpublished personal notes of Waldemar Cordeiro.

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Videos

https://www.youtube.com/watch?v=zTNSh01TmBQ

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https://www.youtube.com/watch?v=XAfV-d8cVFk