

The Relationship between Art, Science, and Technology

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Abstract

Artists are the most who influenced by the different aspects and situations around them. Through their endeavors to express this, they use different techniques of creation, consciously and unconsciously. The involvement of science and technology for using these techniques is inevitable, which led to the argument of how scientists and artists collaborate and contribute in promoting culture and knowledge. Art is always associated with emotions by looking into the 'why', while science has to convince through raising the question of 'how'. While artists are using science as an available mean to express their vision, scientists use coherent lines, shapes, and models to explain the world. This paper will explore the relation of art, science, and technology as three inseparable concepts through various works of art since the second half of the twentieth century, how they were able to explore new perceptions of the world, and how this relation has been useful in promoting culture and knowledge.

Key-words: Artistic Practice, Scientific Theory, Digital Art, Contemporary Art, Technology

Introduction

There is an opposite attraction between Art, science and Technology. Artists have become interested in concepts and methods of science and technology. They integrate them in ways that are considerably different from conventional media in their art. On the other hand, scientists tend to create coherent models for exploring the world, which rely on imagining ideas and concepts through shapes and lines.

There was a clear resemblance between artistic movements and scientific revolutions. This can be shown in some examples which include; Kepler's discoveries of the theory of ellipse and the oval structure in Baroque, Newton's experiments of prism which allow the light to pass through it to a room via a narrow aperture and the interest of the way light enters buildings, the idea of Light Quantum and Seurat's quest to create Pointillism, Units of time and space in the theory of relativity and Futurism through which artists created several consecutive shots like Marcel Duchamp's painting "A Nude Descending a Staircase", the scale relativity theory and the spatial variation in the work of Cézanne, and the list goes on.

The painter Patrick Heron argued that art defines how we see the world. He says that it provides us with the creative vision and perception, and this goes back to the strong connection between the changeable art movements and our consciousness. What proves Heron's statement most is that Art and artists were the first to be affected by the unprecedented technological development in the digital media that has been emerged since the late 1950s till date, in which called "The Digital Revolution". This was in addition to the emergence of the "World Wide Web", which became an important factor for the global communication since the mid-1990s.

"Digital Art" became an affirmed term in the late twentieth century. Its emergence coincided with several idioms and names of technological art forms. In the 1970s, it was referred to it as "Computer Art", and later became "Multimedia Art. With this regards, there are significant principles that differentiate between art that is produced by using digital technology as a tool for the artistic creation; like photography, printing, sculpture, and music, and art that is created by using these technologies as their main way of expression, which is saved in a digital form with an opportunity of developing interactive environments. Through the latter, the audience is an integral part of the artwork. Despite both types of art share the same inherent features of digital technologies, they are clearly different in their expressions and aesthetics.

Interactive art is one of these types of Visual Art that depends on digital technologies, with a changing operational framework. The constant interaction of the artwork components and the audience is a major factor, through which the visual production of the artwork is more substantial. For instance; the artwork "Grace", in 1996, created by "Jack Dollhausen", is a wall hanging device. It releases a whistle every hour, as it senses the distance and movement of the audience. It produces the sound which it has made during its stillness. This sound is different every time, as it does not reproduce the same sound again.

One of the most significant types of digital arts, of a very unique visual impression, is Holographic Art which depends primarily on holographic technologies. It is a form of three-dimensional optical formation that provides intensity to light, takes a 3D shot of the object, and display it. Consequently, the holographic scenes give the objects a spectral transparent shape.

This paper will discuss several types of digital art that reinforced the tripartite relation of art, science, and technology since the second half of the twentieth century. However, some examples will be mentioned from earlier, as an evidence of the old endeavors towards this relation.

The Mutual Relation of Art, Science, and Technology

Robert S. Root-Bernstein discussed the visual thinking by describing the mutual aspect of both art and science as "the creative process and the synthetic thinking".^[1] For instance, Albert Einstein was a proficient at the "visual imagining of thought experiments", and this was of a considerable significance to his work.

Artists and scientists also have a mutual desire, which is their contribution to the "welfare of humanity". The period of Renaissance was characterized by the collaboration of art and science, which led to the emergence of Greek philosophy and the artistic and cultural improvement. It was also incorporated in the work of Leonardo Da Vinci (1452-1519) who was a practicing artist of physical and natural sciences, through which he accomplished numerous achievements, as his notebooks included "art, architecture, philosophy, astronomy, and engineering".

Another example of the Renaissance is Galileo who lived a life of an intellectual enrichment, represented in his studies of music and perspective drawing. This is in addition to being an expert in mathematics, physics, and astronomy. His scientific achievements were parallel to the scientific and intellectual prosperity in the 17th century, as astronomy, microscopy, and optical phenomena were the impetus for the development of lenses and mirrors, which in turn has provided artists and scientists with a new perception of nature.

1. The Role of Photography in Art

In the modern science and art, photography offered a new interpretation to the world. It changed the artistic perception, "both technically and philosophically" in a few years, and rapidly became an art movement on its own. The artist Eadweard Muybridge (1830-1904) studied "running horses' motion". He captured - for the first time - the four horse's hooves are "off the ground at one stage of its stride". This considered as an unrealistic shot that realism artists were trying to avoid. In other words, this artwork led to a new perception for artists for seeing the "physical world".

Photography also was a tool of drawing in the 17th and 18th century. It diffuses all the visual details that may confuse the eye on a "flat surface". "Dutch still-life and the topographical paintings" are examples of this practice. Painter Johannes Vermeer is one of the most significant artists of this genre in the seventeenth century, and Canaletto in the eighteenth century.

From the 1850s through the 1870s, was the emergence of "illustrative Photographs", which was similar to the "storytelling style" of painting at the time. Henry Peach Robinson was the most famous artist of this type of photography who created many illustrative and metaphorical composite photographs.

In 1862, a group of French artists formally protested photography. They considered it a mechanical process. Some even considered painting was dead. However, the evolution of photography accompanied with the emergence of Impressionism.

While impressionists were fascinated by painting the nature, especially, landscape, photographers were affected by impressionists. This led to the emergence of "Pictorialism", which is a style of photography that concerns with aesthetics and personal emotional response to a subject. George Davidson was an impressionist photographer who created "The Onion Field", in 1889, through using a Pinhole Camera that softened edges giving a dreamy haze, and it was printed through a specific soft focus technique preferred by Pictorialists.

2. The Role of Modern and Contemporary Art

Modern and Contemporary Art are extremely important concepts of the relation between art and science, which explore several aspects of science and technology. Marcel Duchamp in his work *The Large Glass (1915-1923)*, shows a great interest in science. (Figure 1) This artwork which is also known as "The Bride Stripped Bare by Her Bachelors, *Even*" was created from "lead wire, lead foil, and dust" rest between two glass panels, set in a metal frame with a wooden base.^[2]

For creating this artwork, Duchamp made many studies and notes of physics and perspective rules, and created what he called "*The Green Box*", which is a small box that included "notes and clippings" describing the work through myth along with rules of physics. The small container contained pieces of paper that "can be read in any order", which made endless meanings. He also created his own language for describing or calling the elements of his artwork.

The nine forms in the lower left that represent the Bachelors are called by Duchamp "Malic Molds", as Malic refers to the word Male. The word Bride which is part of the work's name means *Mariée* in French, and the word bachelors means *Célibataires*. The upper side of the artwork represents the "female realm" and the lower side represents the "male realm", and the first three letters of each word in French consists the word *Marcel*, which is the first name of the artist.

Several artists in the contemporary life are creating artworks through the integration of art and science, developing a "critical thinking". The Brazilian artist Eduardo Kac discussed this issue through his artwork "GFP Bunny", 2000. He described his work saying: "*It is a transgenic artwork and not a breeding project*". (Figure 2) As the artist mentioned on his website:

"The transgenic rabbit has no skin pigment; under ordinary environmental conditions she is completely white with pink eyes. Alba is not green all the time. She only glows when illuminated with the correct light. When (and only when) illuminated with blue light (maximum excitation at 488 nm), she glows with a bright green light (maximum emission at 509 nm). She was created with EGFP, an enhanced version (i.e., a synthetic mutation) of the original wild-type green fluorescent gene found in the jellyfish Aequorea Victoria."^[3] (Kac, 2000)

The artwork was created with the assistance of "zoo-systematician Louis Bec, and scientists Louis-Marie Houdebine and Patrick Prunet". The abbreviation "GFP stands for green fluorescent protein".^[4] This artwork shows the relation between performance as an artistic field, and biology and physics as a scientific and a technological field. The relation between art and biological sciences has not stopped at this point. The Portuguese artist Marta De Menezes along with the assistance of scientists Radu Aricescu and Nuno Micaelo, in the laboratory of Professor Yvonne Jones has developed the artwork "*Proteic Portrait (Retrato Proteico, 2002)*", in 2002.^[5] (Figure 3)

De Menezes has used proteins as an art medium to create a representation of a 3D self-portrait. According to the artist's explanation, Protein is constructed from 20 different amino-acids. Each of them has a single letter. The artist created a protein with her full name:

MARTAISAVELRIVEIRDEMENESESDASILVAGRACA

In order to create this protein, she had to produce a gene that would be added to bacteria, which in turn would make this protein. As the artist mentioned in a conversation with the author:

"Proteins are strings of amino-acids in a sequence; each amino-acid has an electric charge. As a consequence when they are produced they will fold on themselves and take a unique 3D shape to the protein. It has not the objective to look like me, but to represent me because it is my name, and my name is (in a very important way) me." ^[6]

Internet has also a great impact on the mutual relation of Art and Technology, which is represented in the field of digital art. The project K., in 2007, was developed by the Portuguese artist André Sier. (Figure 4) Through which he created multiple modifications of "imagery experimented by K. in "The Castle by Franz Kafka". The Castle is a novel of a character called only K., who arrives in a village and struggles to gain access to a castle where the mysterious authorities who govern the village live. The user goes through a "browsable" endless journey of "spatial abstraction". ^[7]

The Relation of Art and Science in an Academic Context

The previous examples show the contemporary contact of art with scientific and technological fields. However, there was always a need for discussing and exploring this subject in an "academic context". The works created by artists such as Teresa Almeida, Rosa Oliveira, and Isabel Azevedo are the most influential in the application of scientific theory to the artistic practice.

Teresa Almeida's research discussed the "light and color in Luminescent artworks" through some new materials like glasses that are provided with "Lanthanide Oxides" which are used in artworks, as "they emit light with different colors under ultraviolet light". Almeida explained that the development of these materials has taken place at "Research Unit VICARTE" - a partnership between the Faculty of Sciences and Technology of the Universidade Nova de Lisboa and the Faculty of Fine Arts of the Universidade de Lisboa - which is used for teaching and for glass research. ^[8] One of its aims is to develop the contemporary art of glass and ceramics with new materials, as it has accomplished significant results through the interaction between art and science students.

Rosa Maria Oliveira and Isabel Azevedo have been collaborating with artists and scientists of different fields for supporting their research about "materiality and immateriality in New Media Art" which debates "holographic techniques and its integration in artworks". ^[9] Both researchers find that the artistic interest in light, Kinetic art, electronic art, video art, and new media art, and the interaction between artist and audience through the artwork are very important issues for art and art education.

Another example as a continuation of the academic context of art and science collaboration is the work of artist Adam Zaretsky, who obtains a PhD of Integrated Electronic Arts, 2012. The artist tested the activity of a type of Bacteria called "E. coli" settled in Petri dish by playing "a certain Anglo-Indian pop music for 48 hours". The result was the increase of antibiotic production of the Bacteria. ^[10]

Virtual and Analogous Environments in the Context of Art and Science

Scientific facts can be discovered through a work of art that creates a display of a virtual world, which provides not only the information, but also the aesthetic aspect of objects or experience. One example, the work of Prokop Bartonicek "Worlds as Fragments" describes the "behavioral Dynamics" of objects through focusing on time processes of motions in different entities "when changing the magnetic field". This microscopic atmosphere creates a virtual space like a "fluid Planetoid". ^[11] (Figure 5)

"Deep Data (2009-2016)" for Andy Gracie is another example, which receives data from Pioneer and Voyager probes and recreates "elements of the solar system environment" within microorganisms that are used for space and astrobiological research. (Figure 6) Through monitors that display the incoming data and the live video of the microscopic species experiencing the "shifting magnetic fields", the artist can observe the interaction of the organisms. ^[12]

In 2011, Gracie created another work titled "Drosophila Titanus". (Figure 7) The work explains the endeavors to develop a specific species of the fruit fly that is "theoretically" capable of living on "Saturn's largest moon Titan" that is considered to host an environment, to some extent similar to Earth. "Drosophila Melanogaster" is a "model organism" that has "95% genetic similarities to humans", and has been used in space based experiments. For executing this experiment, Gracie created a technological system designed to interact with natural living systems of Titan. The artist explained that it is a virtually impossible project to be completed successfully in "pure scientific terms". However, this project is an endeavor to extract artistic metaphor through a process within the debatable "complex relationship" between art and science. ^[13]

Conclusion

Based on the previous, art, science, and technology cannot be separated. Many issues are reflected by this tripartite collaboration by many artists and students of both artistic and scientific fields who debate various issues brought out by technology itself. These entire attempts to generate specific results are useful for accepting different possibilities, for taking advantage of new technologies to pursue more development, or to define “ethical boundaries”.

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Figures



(Figure 1) Marcel Duchamp, *The Bride Stripped Bare by Her Bachelors, Even (The Large Glass)*, 1915-23, 277.5 × 177.8 × 8.6 cm © Succession Marcel Duchamp (Philadelphia Museum of Art), Source: Essay by Dr. Lara Kuykendall



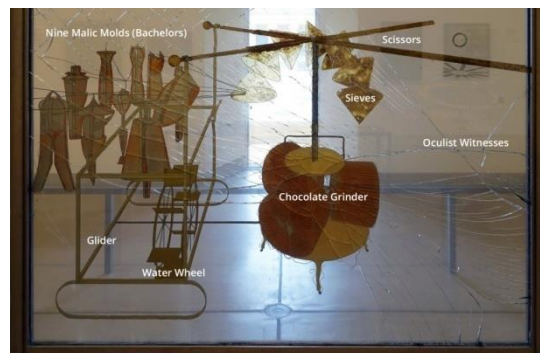
(1)

(Detail 1) Marcel Duchamp, Male Realm and shattered glass.



(2)

(Detail 2) Marcel Duchamp, Female Realm.



(3)

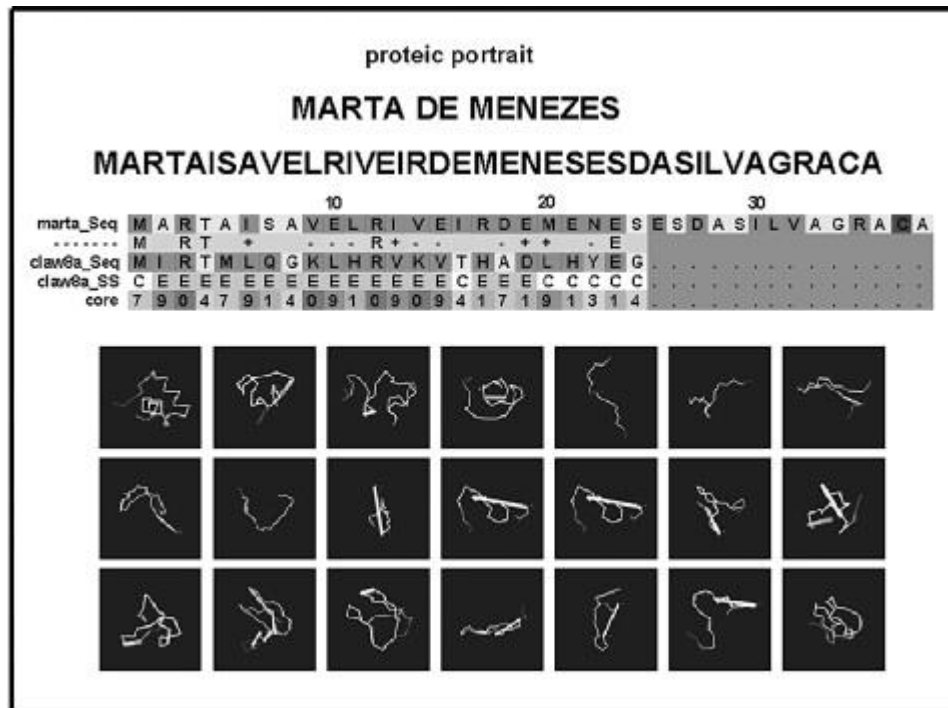
(Detail 3) Marcel Duchamp, Male Realm.



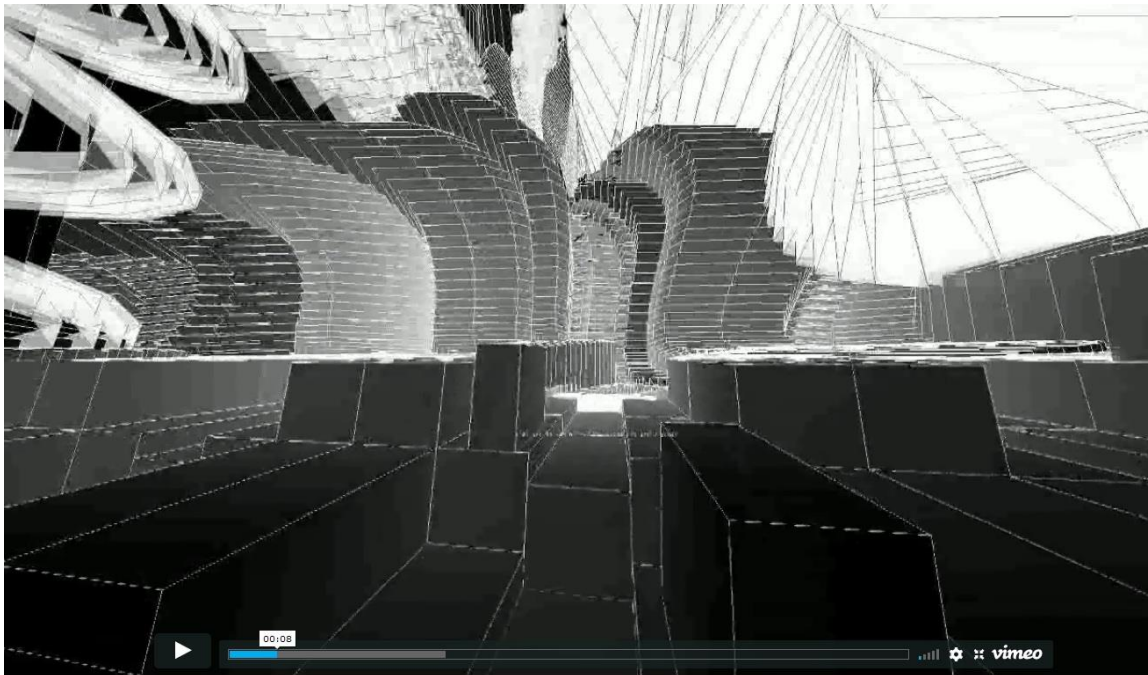
(Figure 2) Alba, the fluorescent bunny, GFP Bunny, 2000, by Eduardo Kac,
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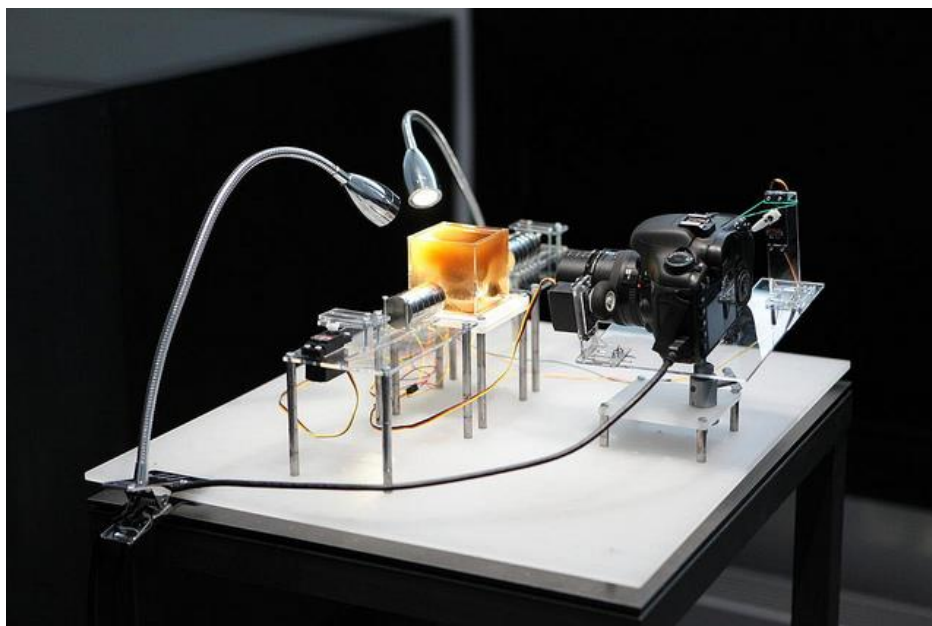
(Figure 2) Eduardo Kac and Alba, the fluorescent bunny, GFP Bunny, 2000, by Eduardo Kac,
©<http://www.ekac.org/gfpbunny.html#gfpbunnyanchor>



(Figure 3) Marta De Menezes, Proteic Portrait, 2002, ©Marta De Menezes



(Figure 4) André Sier, Project K., 2007, ©Andre Sier

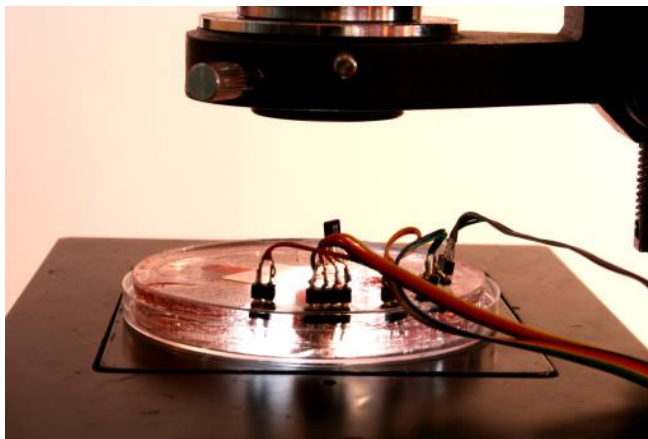
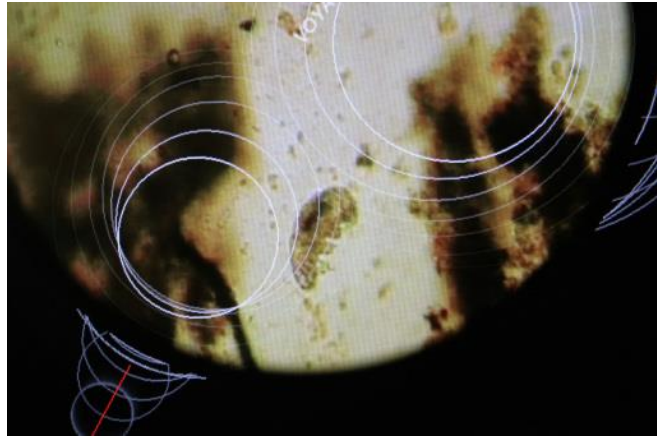


(Figure 5) Prokop Bartonicek, *Worlds as Fragments*, 2010, ©Prokop Bartonicek



(Detail Figure 5), Prokop Bartonicek, *Worlds as Fragments*, 2010, ©Prokop Bartonicek

(Figure 6) Andy Gracie, Deep Data (2009-2016), ©Andy Gracie
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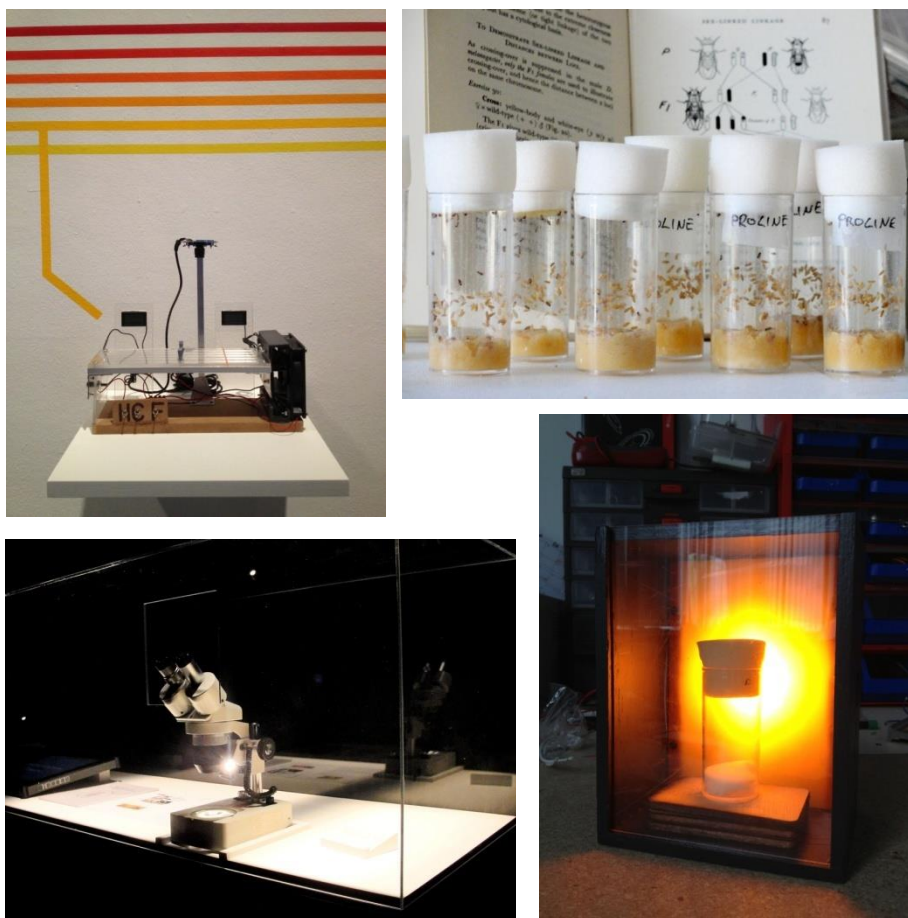
(Detail Figure 6) Andy Gracie, Deep Data (2009-2016), ©Andy Gracie
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(Detail Figure 6) Andy Gracie, Deep Data (2009-2016), ©Andy Gracie
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(Figure 7) Andy Gracie, *Drosophila Titanus*, 2011, © Andy Gracie hostprods



(Details Figure 7) Andy Gracie, *Drosophila Titanus*, 2011, © Andy Gracie hostprods