

## **Title (8 – 15 words)**

Conclusions of Experimento#2: the uncertainty and the metaphor like points of confluence between artistic and scientific research.

## **Abstract (200 – 250 words)**

Experimento#2 was a working group that gathered artists and scientists which took place under the overall framework of Grid\_Spinoza ([www.gridspinoza.net](http://www.gridspinoza.net)) which is a project promoted by the Research and art production center Hangar and the Barcelona Biomedical Research Park. This project explores the processes, methodologies and dynamics of artistic and scientific research, paying attention to spaces of confluence and ways of transferring knowledge from one field to the other.

During the projects' first year of life, interviews to scientists and artists were carried out in order to understand and compare how they research and to gather a deeper knowledge on the research methodologies they deploy. One of the aspects they share in common is the use of two concepts that are constitutive of both fields: uncertainty and metaphor. We designed Experimento#2 as a space in which researchers from these fields could share ideas and work thoroughly on these two aspects. Along the session the concept of research was discussed and put under scrutiny.

The activity was a closed-door meeting, conceived more as a work group rather than a public event. This session was designed by the members of the research team of Grid\_Spinoza. Artists, cultural producers and scientific researchers (from Barcelona Biomedical Research Park) were invited to discuss and share their ideas with us.

Summary of the conclusions:

### **1. Metaphor as a generator of knowledge**

Metaphors are inherent to the act of thinking: when somebody thinks, he or she is making comparisons between their surroundings and their acquired knowledge, so thinking is mediated by metaphors. This naturalization turns the metaphor into a common mechanism, used in both academic research but also in common exchanges of ideas. One example posed by a scientist during the session, was the use of the metaphor "jam session" in order to explain, illustrate and help to understand the DNA sequence.

### **2. Uncertainty and complexity**

Uncertainty seems to be something alien and incompatible with the goals of scientific research. People expect from scientific thought forms of certainty, hypotheses to corroborate reality and to make it more understandable. By doing so, providing higher instances of truth.

During Experimento#2 this statement was constantly challenged. It was pointed out that even if the actual trends in scientific research are trying to approach instances of truth using probability in their procedures, science can illuminate some doubts and contribute to the creation of new theoretical frameworks that can help to the understanding of our environment and certainty. Furthermore, the hope to achieve the ultimate truth, the one that can describe every aspect of the reality is finally discarded as reachable goal.

More than an anomaly, uncertainty is a starting point and a central element to trigger research. Researching from uncertainty implies that ultimately there aren't definite tools to verify completely a theory. Therefore every theory and hypothesis should be challenged; we can not expect a global paradigm or statement that can grasp complexity to exist.

### **Keywords (6 – 8 keywords) -**

uncertainty, metaphor, research, art, science, processes, methodologies, complexity

### **Introduction (500 – 1000 words)**

Experimento#2 was a working group that gathered artists and scientists which took place under the overall framework of Grid\_Spinoza ([www.gridspinoza.net](http://www.gridspinoza.net)) which is a project promoted by the Research and art production center Hangar and the Barcelona Biomedical Research Park.

Grid Spinoza explores the processes, methodologies and dynamics of artistic and scientific research, paying attention to spaces of confluence and ways of transferring knowledge from one field to the other. The project is based on an online platform ([www.gridspinoza.net](http://www.gridspinoza.net)) that contains an open archive of articles and audiovisual interviews with artist and scientists.

During the projects' first year of life, interviews with scientists and artists were carried out in order to understand and compare how they research and to gather a deeper knowledge on the research methodologies they deploy. One of the aspects they share in common is the use of two concepts that are constitutive of both fields: the use of the metaphor as a generator of knowledge and uncertainty as one of the driving force for research.

Experimento#2 was designed by the members of the research team of Grid\_Spinoza as a space in which researchers from the Art and the Science fields could share ideas and work thoroughly on these two aspects. The activity was a closed-door meeting among artists, cultural producers and scientific researchers from the Barcelona Biomedical Research Park, conceived more as a workgroup than a public event.

To begin with we went through a document with some of the ideas collected from the interviews with artists and scientists carried out during the first year of life of the project. After that, the debate started with the participation of an invited moderator. Along the session different points of view of uncertainty and metaphor as points of confluence between artistic and scientific research were discussed and put under scrutiny while other aspects related to research processes and methodologies were also discussed.

This paper collects some of the conclusions of Experimento#2 together with some other points of view and opinions about the same topics taken from the articles and the audiovisual interviews of the online archive of the project.

### **Background / Conceptual framework (1000 – 2000 words)**

During the second half of the 20th century a series of theories that brought about a change in the way to conceive Science as a pure, objective and exact system were developed. As

a result of the development of the theories of chaos, the quantum theory and the new theories of evolution, the fundamental laws of the positivist model were questioned bringing uncertainty as a new methodology for Science.

For understanding this change of paradigm we often use the metaphor of a machine in comparison to an organic system. For the positivism, the universe is a clockwork, formed by parts that interact according to eternal and immutable laws. However for the new Science the reality adjusts more to the idea of an organic and complex system characterised by being self-organised, changeable and uncertain.

It is in the field of the physics and to be more specific in the field of quantum physics where we can find the origine of the discussion that will wobble the pillars of the traditional Science making become useless big part of the knowledge and formulations of the traditional physics. The German physicist Werner Heisenberg formulated in 1927 the "principle of uncertainty" that affirms that the more precisely the position of some particle is determined, the less precisely its momentum can be known, and vice versa.

One of the consequences of the superseding of the traditional scientific model - which it has largely conditioned our vision of reality like something that can be objective through methods and technics of universal scope - is the consideration of crossing disciplines models as ideal frameworks for the generation of knowledge.

According to this, in the 60s the gap between Humanities and Science begins to be considered as an important obstacle for the resolution of the big world-wide problems. A milestone in this debate was the conference "The Two Cultures and the Scientific Revolution" given by C. P. Snow in 1959 in which the author talked about the big separation existing between the actual "two cultures". Since then numerous authors have pleaded for the two disciplines to become closer. The always controversial Edgar Morin, in his work "The method" and in his collection of articles "Science with Consciousness" (1984) defends that Humanities mostly don't know about the physical and biological aspects of the human phenomena, in the same way that Natural Science research sometimes seems not to consider the fact that scientific research processes belong to a specific culture, society and moment of History. This lack of connections becomes an obstacle to understand the complexity of the world. Morin takes over an interesting idea by Popper about the supposed objectivity and rigour of the scientific theories. According with the author the scientific theories are not fruit of an individual effort, but a social construction result of criticism and countercriticism among scientists originated as much as a result of the collaboration among them as their rivalry. Morin explains that the new spirit of Science, initiated by Bohr, consists in making the explanation progress and not eliminating uncertainty and contradiction, but "recognising them". That is to make the knowledge progress showing the zone of darkness implied in any kind of knowledge.

Another interesting reference article is "Once upon a time the hedgehog and the fox" by the biologist and palaeontologist S.J Gould. In his article Gould talks about "the common aim of the human knowledge, achieved through the union of the natural and creative knowledge, two different truths which however are not in opposite".

John Brockman talks about this space of convergence in his work "The third culture. Further the scientific revolution" (Brockman, 1996). During the seventies, Brockman collaborated with Robert Rauschenberg, Claes Oldenburg and Andy Warhol and in 1981

he founded the Reality Club for organising meetings among artists, scientists, politicians and businessmen. More recently he also founded the Edge Foundation which website is devoted to promote the third culture.

Since 2005, Edge launches an annual question for all its members and publishes the answers in a book. In the 2012, the answers of 151 thinkers to the question “which scientific concept would make us smarter?” have been published. (<http://edge.org/annual-question/what-scientific-concept-would-improve-everybodys-cognitive-toolkit>). Surprisingly, the most repeated concept in the answers of the thinkers is related with the importance of uncertainty as an essential element to understand Science and life. It is not possible to include here the 151 answers. But, for example, the physicist Carlos Rovelli talks about uncertainty and the importance of being able to recognise that we make mistakes at the same time that he affirms that Science should always keep the door to doubt opened.

The project Grid Spinoza is developed under the philosophy above which considers that the dialogue between Art and Science is a very fertile context for the production of knowledge. As it is in Experimento#2 where artists and scientist dialogued about different points of view regarding to metaphors and uncertainty as a crossing tool for research in Arts and Science.

### **Methodology (500 – 1000 words)**

The “Experimentos” of Grid Spinoza are workgroups where artists, scientists and members of the team of Grid Spinoza share, exchange and look for points of confluence among different conceptual approaches and research methodologies. The content of these sessions is given by the conclusions and the fields of interest that the project Grid Spinoza generates along its development. In this sense these sessions are also a framework where, direct or indirectly, the own methodologies of the project and its advances are reviewed collectively at the same time that new directions and lines of work are opened.

The “Experimentos” of Grid Spinoza usually have the format of a work session and have the characteristic of gathering artists and scientists from very different disciplines and research fields. The methodology used in the “Experimentos” is based on a previous review of documents and audiovisual interviews from the online archive of the project as well as other documentation provided by the participants in each “Experimento”. After that the group defines the questions that are going to be the starting point for the discussion. The methodologies used during the development of the session go from reading and viewing new documentation to visualising concepts by means of in-situ collaborative conceptual maps. The conclusions of these sessions are always open and materialise under different formats (texts, videos, conceptual maps, ...) and made available to the community with its inclusion in the open online archive of the project.

The open online archive is an essential tool for the project Grid Spinoza. The archive has been developed in Drupal and it is nourished with articles and audiovisual interviews with scientists and artists. The contents are searchable and linked by keywords (tags) what allows to navigate through the articles, posts, videos, texts and other contents specifically developed for the project.

The open online archive is the tool that better represents the conceptual framework of the project based on the concept of Grid Computing. The concept Grid Computing refers to a distributed system where different nodes develop similar tasks adding resources for reaching results in a larger scale.

## **Findings (1000 – 1500 words)**

### **1. Metaphor as a generator of knowledge**

From the interviews with artists and scientists about their research processes carried out during the first phase of the project Grid Spinoza we could see how both (artists and scientists) use the metaphor as a methodologic tool for the development of their research projects. The metaphor is used as much as a tool for the generation of hypothesis (poetic function) as well as a discursive tool for understanding and explaining the reality by making connections between known and unknown concepts (epistemological function).

Considering this, we put the following questions on the table for its discussion during Experimento#2:

How do Art and Science approach the use of metaphors?

Can metaphor (and its poetic and epistemological functions) be considered as a strategy for understanding complex systems?

How important the metaphor is during the development of a research process? Can it be used for formulating the hypothesis and explaining it at the same time?

More than finding answers for these questions, during Experimento #2 we saw how the use of metaphors by artists and scientists questions itself the existing stereotypes around the generation of knowledge in Arts and Science. These stereotypes are based on the idea that scientists are discoverers of truth and artists are only creators of fictions. In this dichotomy there is an opposition between those who look for becoming closer to reality (the scientific objectivity) and those whose move away of it (the artistic subjectivity). However, as Raquel Renno also confirms later in her article "The truth is inside here: relations and tensions between Art and Science" written by commission of the project Grid Spinoza, the division between subject and object, or between objectivity and subjectivity, is not a direct opposition, but they are different strategies of narrativity. One of the strategies (the artistic) gives more importance to the subject, and the other one (the scientist) to the object. The reality then would not exist either in the subject nor the object, but in the relation between both (Flusser 2010:s/n) and the object and the subject would be part of a systematic process of acquisition of knowledge, either artistic or scientific.

After considering this, during Experimento#2 we began to discuss about open research processes in both scientific field (where they are less frequent) and artistic field. Then it is when we started to consider this field as the new field of exploration for the project Grid Spinoza. Although the open research processes had already been a crossing theme during the first year of life of Grid Spinoza, it is after Experimento#2 that it becomes the main object of investigation for the project, extending the topic to the knowledge transfer communities and paying special attention to those that exist outside the academic or the institutional context.

Here some quotes of reference extracted from interviews with artists and scientists and the discussion during Experimento#2:

“When someone is thinking is continuously comparing what is around him with what he already knows, the act of knowing itself is mediated by metaphors”.

Miguel Beato, scientist.

'The process of understanding, formulating a project, many times finishes when you are explaining it to somebody because it is then when, somehow, you have to order your ideas, you have to make it comprehensible and many times it happens that when you make the effort of explaining it...When you explain it it is when you realise: “Hey, it seems I'm right, aren't I?” Also you must consider that the creativity process is an entirely dynamic process and Science is creativity. '

Mara Dierssen, scientific.

“(…) 'Eureka' is something that happens in all fields. I think that the artistic 'eureka' probably happens ten minutes before the presentation (of the project), while the scientific eureka's need a little more of time because of the need of presenting exactly what you have thought, what has occurred...But I think that the “eureka” is something that everybody knows and recognises. It happens all of a sudden, when someone asks you to think an idea, a new project... It is something that can't be forced... Maybe you need to spend seven days thinking of it and nothing happens. But one day, taking the bus, an idea comes up and that is. This is how it works, very fast. (...) I think that the artistic education should be, overall, to learn how to recognise “eureka's”.”

Dora García, artist.

“(…) I'm interested in a methodology that works behind the image (of the power), that works in the background, showing its structures. (...) For me the artistic practice is a pure research process and I'm interested in showing it this way.(...) What I found interesting is that (...) the process itself it is shown as a process.”

Daniel García Andújar, artist.

## **2. Uncertainty and complexity**

Uncertainty seems to be something alien and incompatible with the goals of scientific research. People expect from scientific thought forms of certainty, hypotheses to corroborate reality and to make it more understandable. By doing so, providing higher instances of truth.

However, among the scientists and the artists interviewed during the first year of life of the project Grid Spinoza it was frequent to hear references to uncertain as a value, as an occasion for surprises and also as a motivation for doing research. Terms like chance, fluctuation, disorder, improvisation which previously were used for disqualifying a fact, today are an essential part of the scientific vocabulary.

In this sense during the session Experimento#2 we discussed about how the new methodological dynamics that are now essential in the scientific research processes, they mainly consist in causing perturbation even if they start from premises based on certainties. The aim would be to act in an unexpected way for breaking new roads, for collecting new data that can help to the better understanding of the complex systems. Then even if Science can illuminate some doubts and contribute to the creation of new

theoretical frameworks that can help to the understanding of our environment and certainty, the hope to achieve the ultimate truth, the one that can describe every aspect of the reality, would be finally discarded as reachable goal.

To do research from uncertainty would mean to assume that it does not exist the mechanism to entirely corroborate that a theory is entirely true. Then we should assume that every theory and every hypothesis can be called into question, as well as it does not exist a unique way or paradigm that can apprehend complexity.

Here some quotes of reference extracted from interviews with artists and scientists and the discussion during Experimento#2:

“We have changed from hypothesis driven research to non-hypothesis driven research”  
Miguel Beato, scientist.

'Science must be something changeable, modifiable, adaptable, because you need to adapt yourself, you do not know what you are going to find next, this is the beautiful thing about Science: it is a challenge.'  
Mara Dierssen, scientist.

“I usually say that I first do something and afterwards I try to understand what I have done. (...) That is why there is a first stage in my process that it is not under control: I try something, I create something that I keep working on later. So this first stage is not very lineal either very defined. It usually happens that the framework that I previously set goes towards unexpected directions. I would say that there are some surprises on the way”.  
Mireia Sallarés, artist.

'It happens that you prepare a perfect experimental plan and already the first experiment doesn't work. Then you have to be flexible and not to remain stuck in your initial idea and say “Well, it doesn't go into this direction, let's change then.” In that sense I think that financial programmes (for research) are extremely strict.  
Mara Dierssen, scientist.

'One of the things that I have to say to the actors, which is something that is very difficult to understand for an actor, it is that it doesn't exist the idea of doing it well or doing it badly. It simply consists in observing the situation and trying to adapt yourself in the best way. To adapt means that you don't have to have preconceptions: you don't have to think about the public going back home happy, or the public knowing what they are go to see, you don't have to think about what people expect from you.”  
Dora García, artist.

“It is scientists' moral duty to question everything.”  
Miquel Porta, scientist.

'I think that what is left are only certain moments. You have been there, you have been able to record or perceive certain moments, and that is what you show to the public. There are very significant situations that you would never thought they would be so. They are completely unexpected.”  
Dora García, artist.

## Discussion / Implications (1000 – 1500 words)

After the results of Experimento#2 where metaphor and uncertainty were considered crossing methodologies in artistic and scientific research, we found interesting to approach the scientific method again according to some questions that can we be also used for reflecting on artistic research methodologies.

1. The scientific method is based on observation, since its aim is to explain observable phenomena. For doing so there is a series of common stages to all scientific research. These are: observation, formulation of a hypothesis, experimentation of the hypotheses, demonstration or refutation, formulation of a thesis, and scientific community validation through peer review and publications of articles in specialised magazines.

- Can we applied this sequence of stages to artistic research? If not, what other stages or common phases can we identify in artistic research?

2. The scientific knowledge is generated in community. The peer review and the science publications are methodologies aim at sharing, spreading and questioning this knowledge.

- Which methodologies generated in the artistic context are aim at spreading, translating, communicating and validating the knowledge generated by artistic researches?

3. One of the fundamental principles of the scientific method is the principle of falsifiability. The scientific knowledge looks for true hypotheses, but at the same time an hypothesis is only true until proven otherwise. Therefore the scientific knowledge does not advance confirming new laws, but ruling out the laws that contradict the experience. Part of the scientist work consists in reviewing and questioning the work of their mates.

- What is the role of the peer review and the peer to peer methodologies in the artistic community? Can we consider both as methodologies for research validation at the same level?

- Should exist forums or spaces for the artistic researches to been reviewed and shared with other researchers?

4. Another of the principles of the scientific method is reproducibility, that is that an experiment has to be able to be repeated in any place and by any person. This principle is based on the communication of the results obtained. For this the source code of the experiment needs to be opened and accessible for other scientists.

- Can we consider the principle of reproductibility for designing methodologies for artistic research processes?