Deciphering Realities, Moving Frontiers

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The discoveries in biology about the organisation and function of the living are the basis of numerous technological inventions which open possibilities of direct interferences of humans on the living matter, including programming, transforming and creating living matter. This form of acting on nature differing from what we knew so far has been the focus of numerous debates and artistic creations, building thus a frame where different disciplines contribute to the advance of thoughts regarding the new ability to change life processes that were so far modified only through natural selection. This indicates that the ability of direct interference on living matter raises relevant questions in the fields of biology, philosophy, social sciences and numerous ethical issues. When the artist, manipulating life processes by using various approaches, weaves tight connections with life sciences, these different questions are intertwined and closely related. Theses approaches are tentatively defined as "*the coaching of biomaterials into specific inert shapes or behaviours; the unusual or subversive use of biotech tools and processes; the invention or transformation of living organisms with or without social or environmental integration*".[1] Thus artists are engaged in extraordinary complex creations, facing questions deeply related to the "creative-doing".[2]

Probably, by this new form of acting, are we transiting between our "real" and "fictional" constructions. The moving frontiers become more and more permeable and we are led toward a "creative-doing" linked to the complexity of the contemporary "doing" and "thinking" and whose specificity is closely related to the ability to act on life or living matter.[2] This "creative-doing" affects art, science, ethic, philosophy, etc.

Here, we evoke artistic and scientific practices involved in deciphering the "reality" while creating new worlds or ways to perceive it. This paper intertwines our respective artistic and scientific investigations from the exploration of the work "*In Question*", created by the artist and produced in collaboration with Hervé Guillou in an experimental and critic approach. "*In Question*" is part of the artistic project "*Perception intertwining*", initially developed during the artist residence in the Institute for Structural Biology. A first version of the work was shown at the Rencontres-I, France, 2007. This project started from the exploration of fading frontiers between interiority and exteriority and takes a look on life on the molecular scale. Here, elements from life, like proteins, DNA and cells are both expressive materials and basis for reflections for the creation of four different spaces: "*In Vitro*", "*In Vivo*", "*In Imaginarium*" and "*In Question*" interconnected by biological, cultural, imaginary and poetic information fluxes. In this project, the artist seeks to establish symbolic links starting from biological information, in order to give rise to new areas of questioning on the will to control, modify and create life. This project is inscribed in the complex relation established nowadays between art, biology and the society.

"*In Question*" is a work of cell culture on protein micro-pattern, in which the viewers can monitor at the exhibition place, by real-time videomicroscopy, the interaction of living cells with each other and with the protein pattern designed by the artist. The geometric shapes adopted by cells result from the constraints imposed by the artist and, also, from elements which escape our scientific control and complexity of the action of the living. These shapes amaze us and question our willing to control the living. A dynamic to be grasped by an "in between" biologic-social, natural-artificial, reality-virtuality and "amongst" several symbolic links. We propose here to weave connections between the presence and virtuality of science and the creation of "new possibles" by the artistic and scientific intervention.

For proper proliferation and development, living cells require specific interactions with their environment that trigger a network of metabolic biochemical reactions. The adhesion of cells onto a glass slide can be promoted by the immobilisation of proper extracellular proteins that switch on these metabolic reactions through highly dynamic interactions with cellular proteins. The development of microfabrication techniques allows the patterning of such proteins. Cell spreading on protein films is a process that involves stochastic cell membrane protrusions, transient interaction of receptors, possible stabilisations and reorganisation of the very dynamic cell cytoskeleton taking into account the new balance of forces. Figure 1 (left) shows single spread cells onto non-patterned and patterned substrates observed by fluorescence microscopy. The red colour is a stain for actin protein chosen for its function in shape regulation, addressing the dogma of form/function relation in biology. The green colour reveals the adhesive points that are macromolecular scaffolds. The blue is the trace of the extracellular matrix that was immobilised onto the glass surface. On the non-patterned surface, the cell organisation is complex and seems random whereas the patterning of extracellular proteins into a network of dots induces a simple geometrical self-assembly of the actin cytoskeleton. The observed shapes are images located spatially but also in time. Indeed these systems are in continuous evolution in a dynamic and stochastic sense. The evolution in time is an essential parameter of this living art work. A real living cell spreading onto an artificially patterned network of possible interactions seems to be stabilized, well organized and controlled. Sudden random fluctuations can drive the system into another state that explore new possibilities as it is seen in the bottom image where the cell escapes out of control from the previous shape contained into a square with a missing angle.

On the right part of figure 1, a population of cells was spreading onto a network designed by the artist to explore the possibility of organisation when the interaction between cells mediated by the VE-cadherin protein is crucial. The staining shows actin (green) and tubulin (red). Like actin, tubulin is a polymer organized in a network of dynamic filaments and plays an essential role in the transmission of signals and information within the cell. These information fluxes are similar to other fluxes that are the organizing forces of "out of equilibrium" systems such as living matter.

Figure 2 stresses the dynamic aspects of the organisation process and the question of the control of living system, here constrained by the protein network from the serie "PQ carré?" designed by the artist. The question asked by the artist and the scientist "why a square ?" is mirrored by cells dynamically filling the space. The diversity of shapes adopted by cells critically addresses the ability to control living systems, also questioning the field of possibilities announced by the techno-scientific innovations.

Figure 1: Fluorescence images of fixed cells. (left) single cells on a extracellular protein array. (right) "In Question", Lamelle 21. Regina Trindade, 2005. Detail.

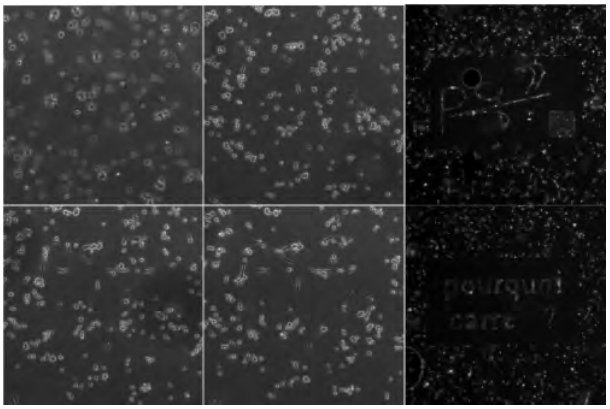

Figure 2: Time lapse images of cells spreading onto the "PQ carré?" serie (greyscale). Staining of the actin cytoskeleton on the "PQ carré?" serie (green).

1 Kac, Eduardo. 2007. "Signs of Life, Bio Art and Beyond." In *The MIT Press*. Cambridge, USA, p. 18.

2 Santos, Laymert Garcia dos. 2003, "Politizar as Novas Tecnologias." In Editora 34. São Paulo, Brazil.