Evolutionary creativity. The inner life and meaning of art

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1. Simple mediations

In art and design making it is possible to identify three main modes. In the first one the artist physically shapes the matter with the body or with parts of the body, or he/she uses some body-based tools, like pencils, brushes, chisels, and so on. This simple mediation happens, for instance, in traditional paintings, in sculpture, in ceramics, in lute manufactoring. A large part of art, maybe the most celebrated in books, manuals, catalogues, exhibitions and events, deals with this making mode, from the prehistoric palaeolitic parietal wall paintings until the XIX and XX Centuries art avant-gardes.

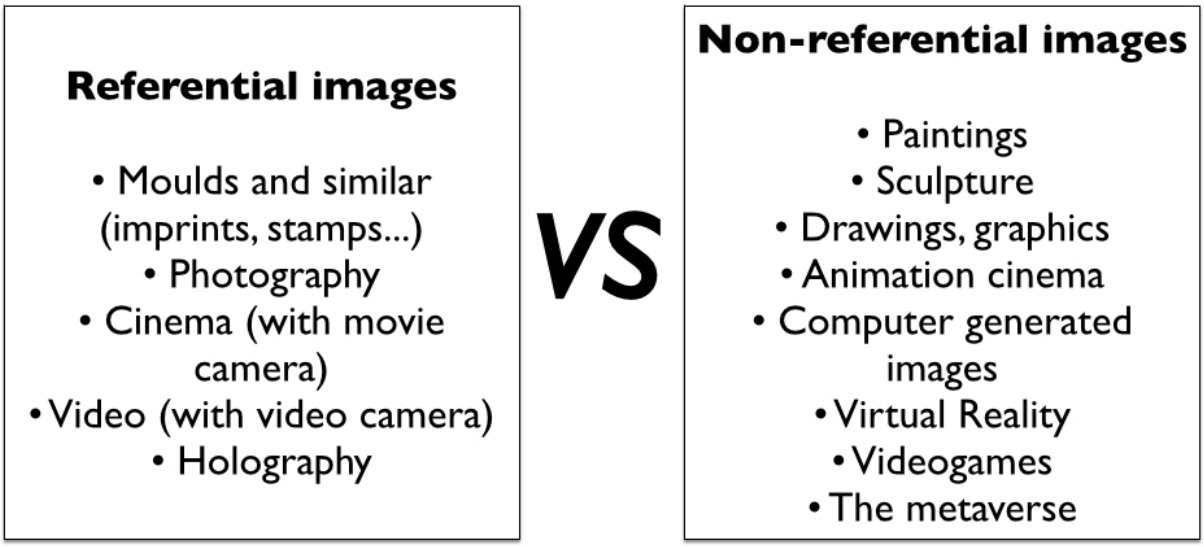
2. The controlled mediation of a device or a machine

In a second art-making mode the artwork is a construct mediated by some device or machine. The final outcome is shaped by a more or less extended and complex automatic process. A device and a machine involve a process that, more or less automatically and repetitively, is strictly driven by starting instructions and conditions. These instructions can remain constant throughout the process, or they can change, being modified during the artwork making, but the device is supposed to strictly and exactly follow them. In fact, the measure of the final result's quality depends on the precision of the device or the machine in following those instructions, in representing the model or repeating the project described by those instructions. The final outcome must be predictable, unique in a serialization or with just a few controlled variations, as close as possible to the starting or evolving model. This mode is typical in the artforms based on techniques and technologies like 2D and 3D printing, photography, cinema, video, computer simulations, numeric controlled devices, and more in general in traditional design and graphic arts, as well as in a large part of technological arts. Just in these days a historical exhibition at MoMA in New York, "Thinking Machines: Art and Design in the Computer Age, 1959–1989", celebrates the creativity mediated by computers [1].

2.1 The example of photography

A perfect example of this mode is photography. Photography is based on a device that, if activated just by pushing a button, generates an automatic image, after the photographer has chosen the viewpoint or arranged the scene, the object(s) and/or

the subject(s) in front of the camera. Photography and cinema from real life (not computer generated) are “referential images” [2, 3].



1. Referential and non-referential images

In this picture the images’ realm is divided in two families, based on *how* the images are obtained and not on *what* they represent: “referential images” and “non-referential images”. In the first category the images can only be obtained *in presence* of the referent (from Latin *res ferens*, which means “that carries the thing”), that is of what is represented [4]. In this category the presence of the subject, of the object or of the phenomenon during the image making process is mandatory: without this *being there*, in front of the camera, there is no image. Recalling Roland Barthes, in front of a photo I can never deny that the represented subject, object or phenomenon *has been there*, for some occurrence, in some time of its existence, in front of the camera [5, 6]. The image is logically and technically built by that co-presence (*being there*) during the image making process: it is the subject/object’s emanation made of the light it has reflected or generated, which has been recorded through a chemical and physical process. On the other hand, in the “non-referential” images that co-presence is simply not mandatory nor relevant during the image making process.

That *being there*, which defines photography and cinema from real life as referential images, also makes them uncanny. No way to escape their cruel as well as luring fascination, they can talk about life and death, as Barthes noted [5]. About life: because classic photography certifies that something *has been* there, in front of the camera, that it once has existed, which is at the core of the social and documentary use of photography. About death: because, sometimes intolerably, photography rise the evidence of a loss, of somebody or something whose light – for some reason, in some instance, in some moment of its life, by will or by chance – was once reflected, caught and recorded onto a two-dimensional chemical support, and at the same time that he/she/it can’t be again anymore in that way, in that situation, or at all. Photography is the contemporary monument. Instead of an expensive but durable single representation made in stone or bronze in order to defy eternity, photography generates a moltitude of cheap and frail pictures, of ephemeral instances, of short-

living emanations, that can anyway survive to the individual's life, against the infinity of time [7].

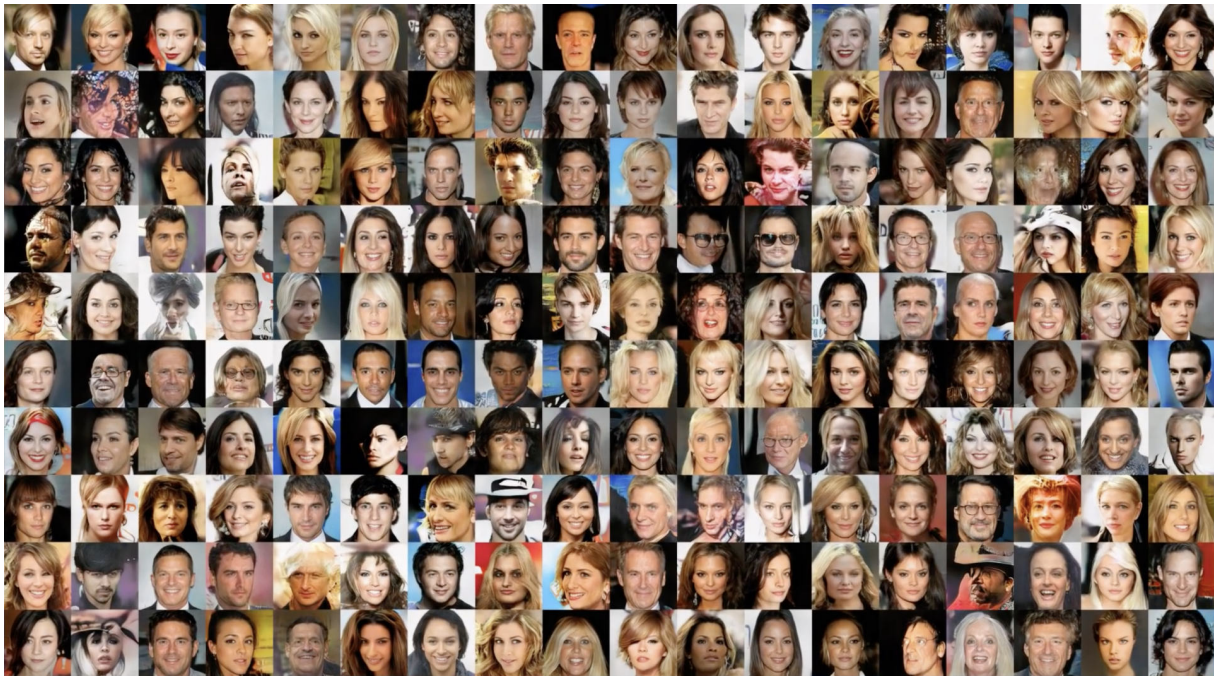
Although in the history of photography there are examples of artists searching for unexpected visual effects, most photographers aim at strictly controlling the final image in its character of an exact representation of reality. In fact, just because of its referential condition, photograpy is socially, bureaucratically and legally considered as a proof.

3. Leaving autonomy to devices and machines

A further step in art making is the use of a machine or a device with a certain degree of autonomy [8, 9]. Instead of a direct or slightly mediated construction process through simple tools, or of a device-mediated controlled process, in this mode an autonomous and possibly open process can take place, limiting or eliminating the human intervention. This process can be eventually influenced by new inputs during its running, generating a dynamically evolving outcome. In creating these artworks the artist and the designer are activators of processes. They set up some general boundary conditions, but during the art generation process some more or less known and expected variables and interactive inputs can make the final outcome – if any – similar to the result of an evolutionary process: like a *work in progress*, using a tipical expression from the art realm. This evolution does not generate a fixed result which is strictly dependent from a rigid starting model; instead it can create a range of outcomes which depend on variables that can be external (like the inputs from the environment and/or from the user) as well as internal (that are inside the process itself). Consequently, the final result is open and it can never be completely predicted, since it depends on variables that escape the artist's control. If the art-generation process is interactive, the relevance of the context becomes primary: people can collaborate in creating the final outcome, even becoming co-authors, and also the environment, where the artwork is located and where the processes take place, can have a great influence, similarly to what happens in the natural processes. In the so called "interactive arts" [10, 11], that have also been called "context arts" [12], the artwork resides in the process itself instead than in the final outcome.

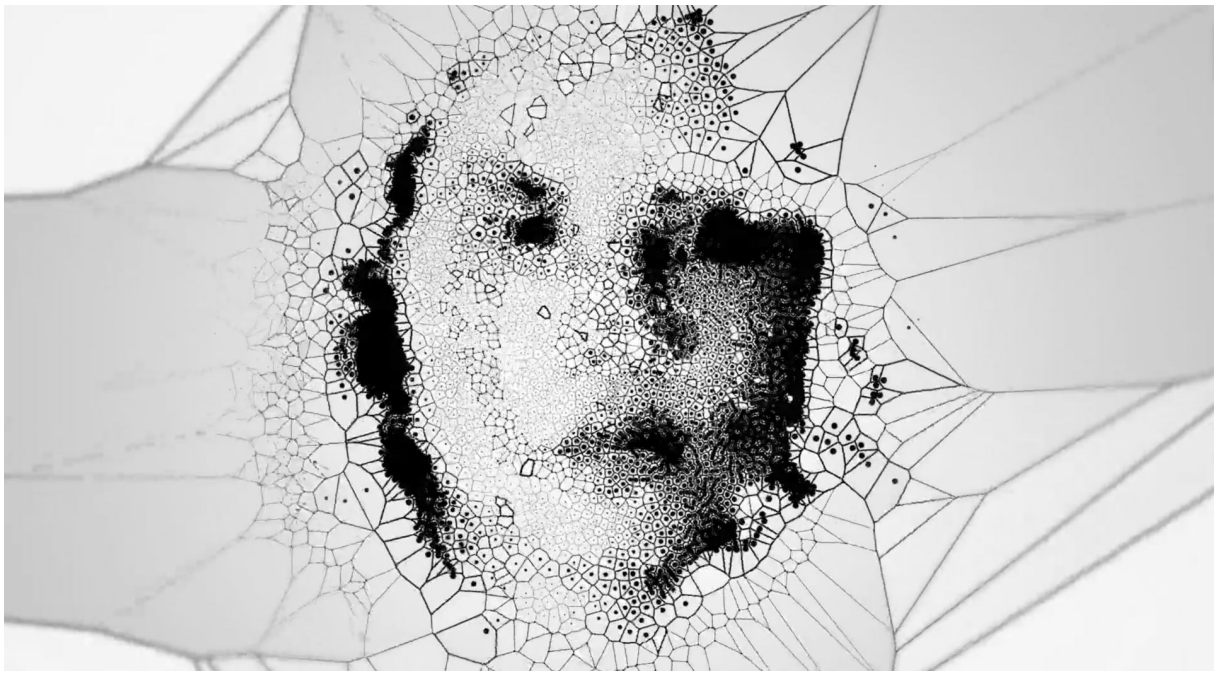
3.1 Two examples: GANs and generative visual aesthetics

Today the generative applications in the digital realm have reached a great standard, for instance in the realm of the human figure's simulation. The pictures generated by Generative Adversarial Networks (GANs), a class of Artificial Intelligence algorithms used in unsupervised machine learning described by Ian Goodfellow and colleagues in 2014 [13], are a good example, like in this example shows [14]. With Generative Adversarial Networks it is possible to get at the same time a wide variation in the outcome and an impressive photorealism, with pictures that look like photographs to human observers [15].



2. Tero Karras, Timo Aila, Samuli Laine, Jaakko Lehtinen, Progressive Growing of GANs for Improved Quality, Stability, and Variation *(still image from the video)*

In the art field the research of the Chinese artist Raven Kwok (Guō, Ruìwén) is based on exploring generative visual aesthetics through computer algorithms and software processes. He builds up systems with customized rules and algorithms to generate and produce the visual outcomes. Actually he codes his artworks mainly using processing, one of the most used programming language used by artists and



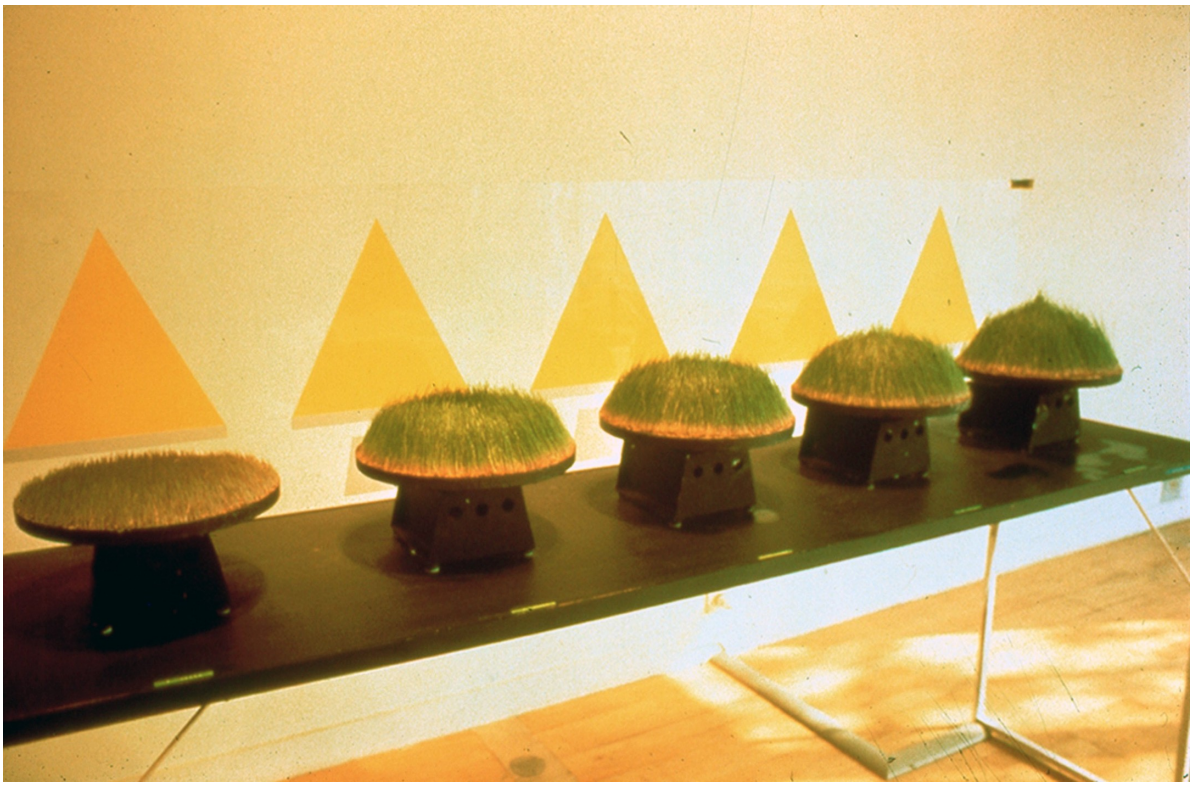
3. Raven Kwok, Skyline, *2015 (still image from the video)*

designers around the world. *Skyline* is a code-based generative music video he has directed and programmed for the track *Skyline* by IA artist Karma Fields. The entire music video consists of multiple stages that are programmed and generated using Processing software [16].

4. Generative art beyond the digital and computers

4.1 Piotr Kowalski, *Dressage d'un cône*, 1967, installation

The generative art mode should not be considered as a research field only related to computers and digital technologies. In the past there have been interesting examples in this direction, for instance a study on Hans Haacke's *Condensation Cube*, an artwork made in 1963 [17]. Here I would try to follow this line, that I think it is theoretically interesting, presenting two examples. The first one is historical: Piotr Kowalski's installation *Dressage d'un cône*, created in 1967 [18, 19, 20].



4. Piotr Kowalski, Dressage d'un cône, *1967*

In this installation seeds are progressively sown on each of the trays under dark bells on flattened wet cotton. They remain in the dark for two days and then they are bathed in a photosynthetic light scattered by ramps of neon lights. The trays are put in rotation by electrical engines which are activated when the seeds germinate and remain in motion until the plants maturity. The centrifugal force, that is stronger moving away from the center of the plateau, forges the cone shape of the plants correcting the force that makes the grass grow vertically. The first sown tray forms a perfect cone after about ten days. The shape of the cone depends on the rotation

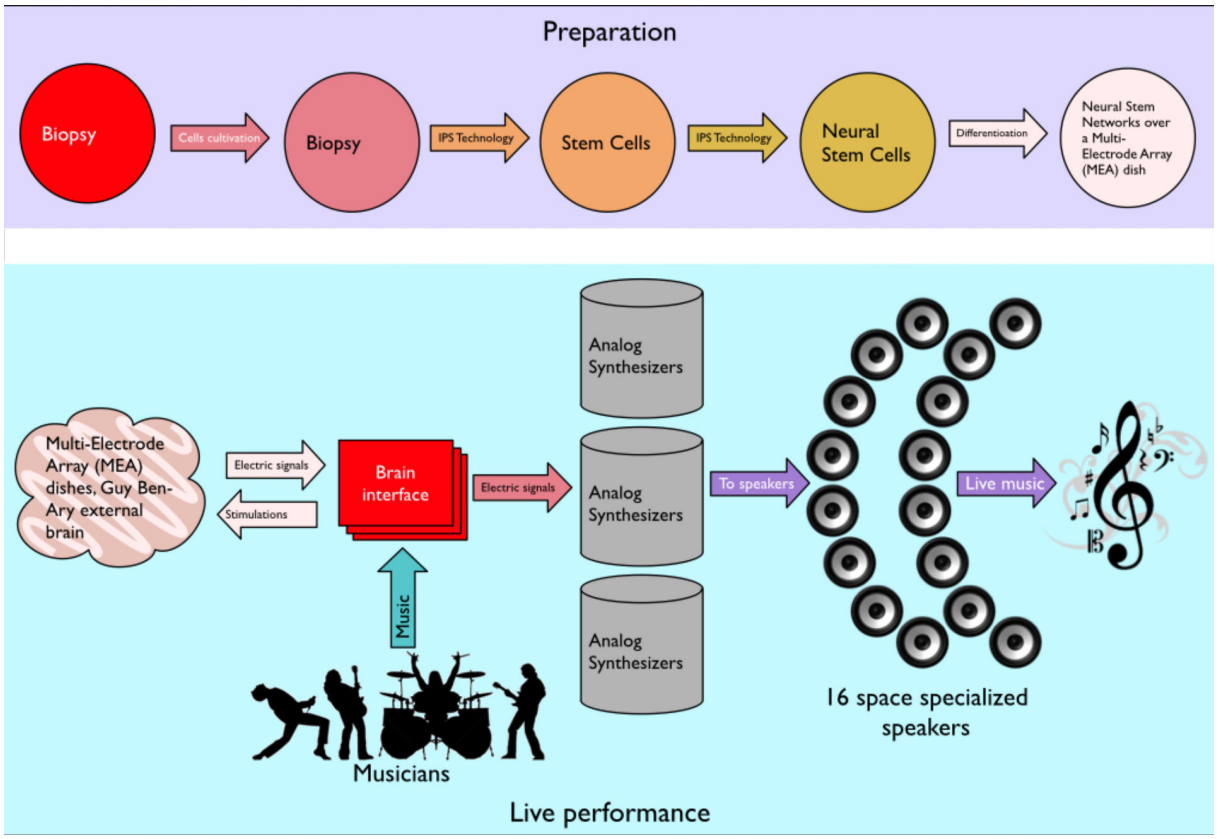
speed and on the growth rate of the plants, which in turn depends on the context (light, water, earth, and so on), and Nature adapts to the external conditions finding a new balance. *Dressage d'un cône* springs out from a combination of nature and culture, from the reciprocal influence between the vital vegetable processes and the motion of a machine. According to Frank Popper, Kowalski transforms a scientific affair – the mutual action of gravitational and centrifugal forces – in a plastic demonstration, revealing the hidden geometries of nature through science and technology [21, 20]. According to Jean-Christophe Bailly, who wrote a book on Kowalski's work, this installation resides at the boundary between the "natural" and the "artificial". Is here that nature becomes artifice, or is artifice that becomes nature? [19].

4.2 Guy Ben-Ary, *CellF*, 2015, installation

The second example is from the bioart realm [22]. In 2015 the artist Guy Ben-Ary created *CellF*, a collaborative project that has involved scientists, engineers, artists and musicians, which has been called the first neural synthesizer [23, 24]. *CellF* is a completely autonomous tool consisting of a biological network of neurons that grow in a Petri capsule and control in real time an apparatus of analog modular synthesizers, built on an *ad hoc* basis, interacting with human musicians and playing with them. According to the artist, choosing to use analog synthesizers depends on the fact that there is a similarity in the way neural networks and analog synthesizers work.

5. Guy Ben-Ary, CellF, *2015. Performance at Ars Electronica 2017*

CellF neural network has been created from the artist's body, making a biopsy from his skin, whose cells were cultivated. Using iPSC (Induced Pluripotent Stem Cell) technology [25], these cells have been transformed into pluripotent cells, which can evolve into different types of body cells. Then the cells have been made to evolve in neural stem cells to create the network of neurons that was grown to reach about 100.000 cells. This is a much smaller number than the 100 billion neurons in the human brain, interconnected by trillions of synapses, which makes this "outer brain" a symbolic brain, also to show the future possibilities of these technologies. These neural networks, however, produce a massive amounts of data, respond to external stimuli, show plastic properties and have a lifespan [23].



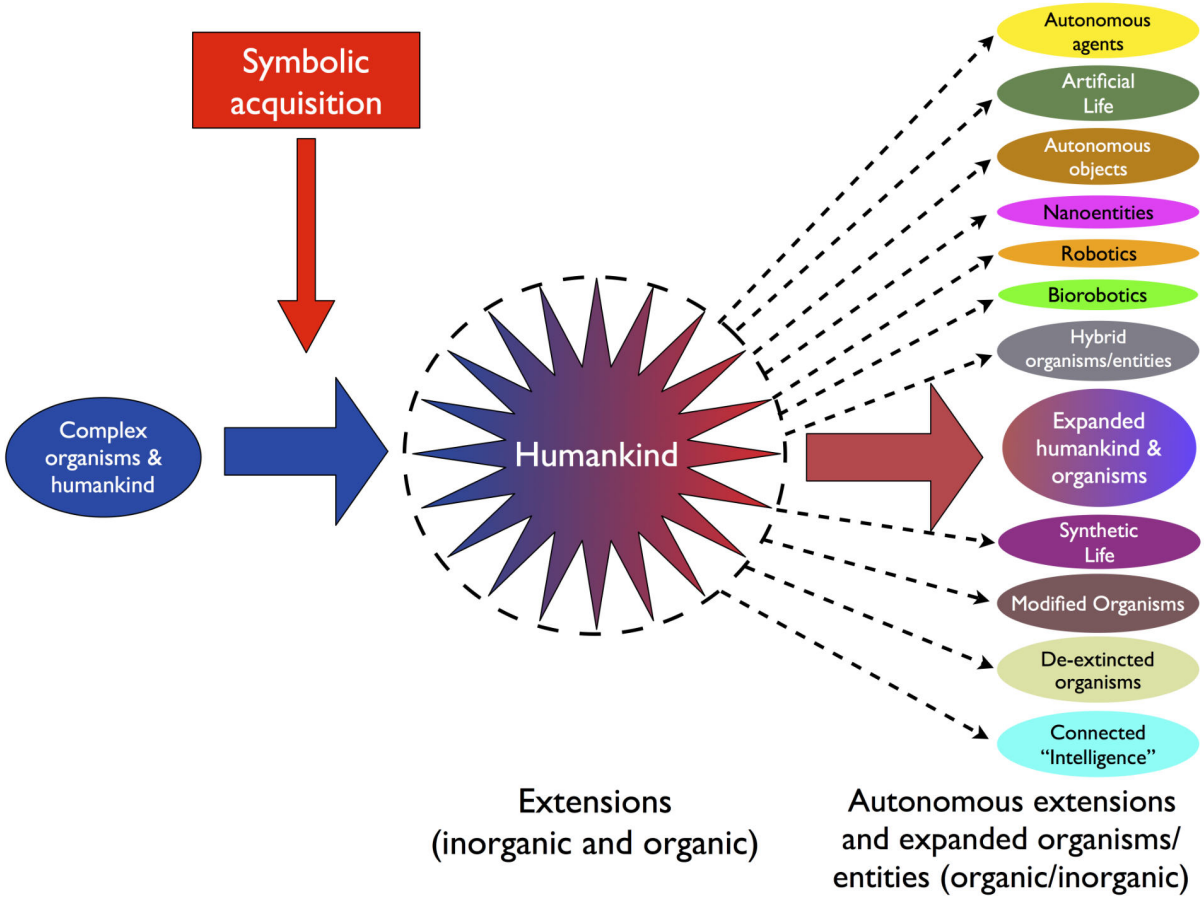
6. Guy Ben-Ary, CellF, *2015 (installation scheme)*

The music created by the human musicians is sent to the neurons as a stimulus, the neurons respond by controlling the analog synthesizers and creating their own music: together they perform live, weighted or improvised tracks, or jam sessions that are not entirely human. The sound is spatialised, reflecting the spatial disposition of the activity within the Petri's capsule, and it is sent to sixteen loudspeakers. Therefore walking in the performance space is a bit like walking in real time in the artist's outer brain. In *CellF*, the musician and the musical instrument become a single entity, a kind of cybernetic musician, a rock star in a Petri capsule that plays post-human music. Ben-Ary declares that *CellF* has been inspired by his narcissistic desire to reincorporate himself and follow one of his adolescent dreams: becoming a rock star. *CellF* is a radical way to reflect on the nature of musical instruments and how music can be produced.

According to Ben-Ary, "*CellF* addresses my 'interest in problematising new bio-technologies and contextualizing them within an artistic framework'. It started with a new materialist question underpinned by the belief that artistic practice can act as a vector for thought: What is the potential for artworks using biological and robotic technologies to evoke responses in regards to shifting perceptions surrounding understandings of 'life' and the materiality of the human body?" [23].

5. The Third Life

With the generative art making mode it is possibile to create outcomes that simulate or emulate the behavior of the living systems and beings, as well as of the natural phenomena. Generative art does not only involves the digital realm, it can also be biological-based, giving birth to organic and hybrid (organic/inorganic) constructs. Step by step these forms are becoming autonomous, and due to the pressure of the anthropic environment they could evolve as living entities, organic, hybrid and inorganic. These forms are not the result of a natural selection, they are selected by the human culture and habitat. The more the anthropic environment expands and develops, the more these forms proliferate, diversifying and evolving.



7. The Third Life

We are going to assist in an extension of the idea of life to a complex panorama with organic, inorganic and mixed life forms. In mirroring nature and life, also the generative art forms and processes are leading to the advent of a “Third Life”, the life that humanity is giving to its artifacts, being the “First Life” the biological life and the “Second Life” the life in the symbolic realm [26, 27].

References

[1] https://goo.gl/mucB8w (last access 10 November 2017).

[2] Pier Luigi Capucci, *Realtà del virtuale. Rappresentazioni tecnologiche, comunicazione, arte*, Bologna, CLUEB, 1993. Second Edition: Ravenna, Noema, 2015, ebook, https://goo.gl/u9eDyP.

[3] Pier Luigi Capucci, “Simulation as a Global Resource”, in *Noema*, 2010, online, http://wp.me/p1P1S6-16 (last access 15 November 2017).

[4] “Referent” in semiotics is “the thing that a symbol (as a word or sign) stands for”. From the *Merriam-Webster* online dictionary, http://mw1.m-w.com/dictionary/referent (last access 25 October 2017).

[5] Roland Barthes, *La chambre claire: note sur la photographie*, Paris, Cahiers du cinéma/Gallimard/Seuil, 1980.

[6] Jean-Marie Schaeffer, *L’image précaire*, Paris, Seuil, 1987.

[7] Pier Luigi Capucci, “Tecnologie del vivente”, in Mario Morcellini, Michele Sorice (eds.), *Futuri immaginari*, Roma, Logica University Press, 1998.

[8] Celestino Soddu, “Generative Art”, online, http://www.generativeart.com (last access 7 November 2017).

[9] Philip Galanter, “What is Generative Art? Complexity Theory as a Context for Art Theory”, online, https://goo.gl/un6S3J (last access 15 November 2017).

[10] Roger F. Malina, “The Beginning of a New Art Form”, in Hannes Leopoldseder (ed.), *Der Prix Ars Electronica*, Linz, Veritas-Verlag, 1990.

[11] Pier Luigi Capucci, *Arte e tecnologie. Comunicazione estetica e tecnoscienze*, Bologna, L’Ortica, 1996. Second Edition: Ravenna, Noema, 2013, ebook, https://goo.gl/PVSE4v.

[12] Peter Weibel, *Kontextkunst – Kunst der 90er Jahre*, Köln, DuMont Verlag, 1994.

[13] Ian Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, Joshua Bengio, “Generative Adversarial Networks”, a*rXiv*, 2014, online, https://goo.gl/gTRCfe (last access 2 November 2017).

[14] https://goo.gl/MqG14k (last access November 9, 2017). There is also an interactive version, https://goo.gl/qjGe75 (last access 9 November 2017).

[15] Tero Karras, Timo Aila, Samuli Laine, Jaakko Lehtinen, “Progressive Growing of GANs for Improved Quality, Stability, and Variation”, *arXiv*, 2017, online, https://goo.gl/42hxAr (last access 3 November 2017).

[16] Information from his personal website, http://ravenkwok.com/reel/ (last access November 11, 2017), and from Technarte website, W.A., “Raven Kwok; the beauty of coding for creating generative visual artworks”, *Technarte*, 2017, online, http://www.technarte.org/?p=3509 (last access 10 November 2017).

[17] Philip Galanter, “Generative Art after Computers”, *GA2012 – XV Generative Art Conference*, 2012, online, https://goo.gl/fN8BLV (last access 3 November 2017).

[18] Catherine Millet, *L’art contemporain en France*, Paris, Flammarion, 1987.

[19] Jean-Christophe Bailly, *Piotr Kowalski*, Paris, Editions Hazan, 1988.

[20] Gianna Maria Gatti, *L’Erbario Tecnologico. La natura vegetale e le nuove tecnologie nell’arte tra secondo e terzo millennio*, Bologna, CLUEB, 2005, p. 42.

[21] Frank Popper, *L’arte cinetica*, Torino, Einaudi, 1970, p. 276.

[22] Among the many publications about bioart: Jens Hauser (ed.), *L’art biotech. Le lieu unique*, Paris, Filigranes Editions, 2003; Eduardo Kac, *Telepresence & Bioa Art. Networking Humans, Rabbits, & Robots*, Ann Arbor, The University of Michigan Press, 2005; Jens Hauser (ed.), A*rt Biotech*, Bologna, CLUEB, 2007; Ivana Mulatero (ed.), *Dalla Land Art alla Bioarte / From Land Art to Bioart*, Turin, Hopefulmonster, 2008 (bilingual, Italian/English); George Gessert, *Green Light. Towards an Art of Evolution*, Cambridge (MA), MIT Press, 2010.

[23] Guy Ben-Ary, “CellF”, in *Guy Ben-Ary personal website*, 2015, online, http://guybenary.com/?p=10 (last access 7 November 2017).

[24] Ryszard W. Kluszczyński (ed.), *Nervoplastica. Guy Ben-Ary. Bio-robotic Art and Its Cultural Context*, Gdańsk, Laznia Center for Contemporary Arts, 2015.

[25] Among the wide scientific literature on this topic: Sibel Yildirim, *Induced Pluripotent Stem Cells*, Berlin, Springer, 2012; Kursad Turksen, Andras Nagy (eds.), *Induced Pluripotent Stem (iPS) Cells. Methods and Protocols*, Berlin, Springer, 2016.

[26] Pier Luigi Capucci, “From life to life. The multiplicity of the living”, in Roy Ascott, Gerald Bast, Wolfgang Fiel, Margarete Jahrmann, Ruth Schnell (eds.), *New Realities: Being Syncretic*, Wien, Springer-Verlag, 2009.

[27] Pier Luigi Capucci, “Declinations of the living: Toward the Third Life”, in Dmitry Bulatov (ed.), *Evolution Haute Couture. Art and Science in the Post-Biological Age*, Kaliningrad, BB NCCA, 2013.