

After The *Tunnel*: on shifting ontology and ethology of the emerging art-subject

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Abstract

During ISEA1995, the *Tunnel Under the Atlantic* presented an artwork that Maurice Benayoun conceived at the time as a manifesto supporting virtuality as a medium. 25 years later, we propose a new understanding of the work and its emergence along with a reconfiguration of the ontological status of contemporary media art. Rather than mere *object*, as defined by normalized code of representation, the artwork can now be characterized as a *subject* with operational sensitivities that allow complex reactive behaviors. Real-Time processing of information has played a major role in this mutation. Virtuality – understood as design of the potentialities of the work – sensors and other input devices keeping the work aware of the existence of its ‘public’ and environment seem to have converted the interactive artwork into a sentient entity, empowered with perceptive functionalities and new cognitive capacities: memory, artificial intelligence, and intentionality. This transductive process leading to the evolution of the original *art-object* into the *art-subject* announces an expansion of what is considered the artwork’s milieu and potentiality. More recent works of Benayoun help us to envision the next steps in this evolution: opening the ontology of art further towards its subjective capacities and possible dynamic implications in society.

Keywords

Virtuality, Virtual Art, art-subject, Tunnel, EEG, transduction, individuation, blockchain

Introduction: The Tunnel

1995, ISEA Montreal. In the lobby of the Museum of Contemporary Art, visitors are digging. They are virtually digging the *Tunnel under the Atlantic*. [1] They are digging into culture, the past culture of France and Canada. 6000 km from Montreal, in the Pompidou Centre, Paris, another two meters in diameter-pipe is plugged in the ground, in the direction of Montreal. The visitors were digging in the opposite way. The Virtual Reality (VR) material to be dug was not the geological strata of the ground underneath the Atlantic Ocean. They were pictures, converted into blocks

of virtual marble. When dug, they revealed veins that were actually fragments of the original image: paintings, maps, drawings, signs. If diggers could talk to each other from both sides of the Atlantic, they could see each other. It took five days before the first visual encounter. We could see the video of the other, at the new end of the freshly dug tunnel. “I can see you! You are dressed in red with a white collar!”



Figure 1. *The Tunnel under the Atlantic*, M. Benayoun, sept 1995. Top: in the Contemporary Art Museum, Montreal, ISEA1995 Bottom: in the Pompidou Center, Paris (© Benayoun M.)

The first dialogue was not a message of the utmost importance transmitted from an emitter to a receiver. This was the time of the beginning of the “phatic era” [2], when the phatic dimension of communications was going to replace proper content. At the dawn of the Web, getting in touch, seeing each other, talking to each other was becoming the core of mediated communication. The history of social media will confirm later what the *Tunnel under the Atlantic* was offering: the experience of emotionally intense communication with no message other than its performativity. The work was drawing the public’s attention

to a significant social change derived from the specificity of the so-called communication highways (Figure 2). [3]

The *Tunnel* was a significant move in the field of VR applied to Art. Many witnesses identified a series of premières in the technological and aesthetic aspects of the project: the first intercontinental virtual environment, the first video in a shared VR, the first spatialized sound, generated music, real-time automatic mixing, virtual director producing a machinima, and first virtual librarian... Even though some of these claims can be debated, we may consider that something was pushed to its extreme boundaries.

All the work, in spite of its multiple layers, is a sentient entity. A new species that exists only in the realm of art. Most of the “organs” of the work responds to their ecosystem. Its relation to the public, the diggers, determines most of its behavior, as well as its appearance. Beyond only acknowledging the existence of the digger, the work interprets one’s actions, one’s interests, intentions, and motivation. Observing the digger’s behavior, the *Tunnel* offers a responsive architecture with bespoke content. It builds another layer of meaning made possible by the “chance meeting” of an author’s driven adaptive environment and its public: the visitor’s experience triggers reactions from the artwork, and these reactions have been intentionally planned by the author. The work becomes the footprint of the visitor’s experience. One can refer to this situation as a form of “dialogue” – not only the dialogue between two people, the artist and the spectator, but the equivalent of our relation to nature, our ecosystem. A complex evolving relation made of trial and errors, building a mutual understanding that allows the artist’s intentions to become visible thanks to the visitor-behavioral questioning. Something with explicit intentions that feeds the audience sense-making.

At a time when VR was closer to simulation, the “visitor” of these worlds used to be like tourists discovering an uncharted territory with a specific culture. The *Tunnel* didn’t want to offer a preconceived, prebuilt architecture. The architecture had to be the footprint of the “experience”; more specifically here the experience of meeting. Each segment of the *Tunnel* kept the shape resulting from the digging process, like the Jurassic mud preserving the trace of the late dinosaur. The path of the digger is converted into an architectural semantic space, at the same time construction and memory. Although the content waiting for revelation inside the marble-like blocks of images is structured around the digger’s behavior.

The *Tunnel* integrates complex forms of agency based on user’s behavior analysis and qualitative structured response. It uses an intrinsic and extrinsic knowledge to build a form of dialogue far from the usual pre-structured content offering. This is achieved through a piece of software created for the *Tunnel* called “le GADEVU,” a cryptic reference to the Quebec expression: “C’est arrangé par le gars des vues” (“it has been arranged by the film maker in

Le Monde

VENREDI 22 SEPTEMBRE 1995

Le creusement du tunnel sous l’Atlantique a commencé au Centre Pompidou

Maurice Benayoun propose une expérience exceptionnelle et ironique entre la France et le Canada

Une aventure unique attend les visiteurs du Centre Georges-Pompidou: participer au percement du tunnel sous... l’Atlantique. Virtuel bien sûr. Commande publique de la délégation des arts plastiques du ministère de la culture à l’artiste multimédia Maurice Benayoun, elle ouvre les portes d’une expérience extraordinaire à travers la matière, les sons et l’image. Le tissu même des images.

LE TUNNEL SOUS L’ATLANTIQUE, événement de télévirtualité de Maurice Benayoun. Centre Georges-Pompidou, Grand Foyer. Tél.: 44-79-12-33. Jusqu’au 24 septembre.

Le premier coup de « pioche » a été donné mardi 19 septembre. À 18 heures à Paris, à midi à Montréal. Fin des travaux: cinq jours plus tard. Grâce au forage acharné de deux équipes, dont vous pouvez faire partie en vous rendant sur les lieux, d’« embauche » (le Centre Pompidou à Paris, le Musée d’art contemporain à Montréal), l’Atlantique sera bientôt vaincu par un tunnel... virtuel.

Qu’est-ce qu’un tunnel? C’est un trou. Une vole percée dans un obstacle sur un parcours. Et le tunnel sous l’Atlantique traverse vraiment une matière résistante qui s’interpose entre les deux bords de cet océan. Quelle est cette matière? Il ne faut pas le révéler tout de suite, car la résidie le coup de génie de Maurice Benayoun, le Lesseps de ce percement. Qu’appelle-t-on virtuel? On appelle virtuel une réalité simulée par ordinateur qui garde certaines propriétés de la réalité. La possibilité, par exemple, d’évoluer différemment en fonction des actions diverses qui s’exercent sur elle, comme un être vivant réagit à son environnement. Qu’est-ce qu’un tunnel virtuel? C’est un tunnel creusé par des ordinateurs dans un ordinateur.

Les promoteurs du tunnel sous la Manche ont dû simuler maintes

fois son forage sur des petits écrans avant de lancer leurs béliers d’acier sous la terre. Le tunnel sous l’Atlantique, lui, est assez différent, puisqu’il n’a pas besoin, une fois simulé, d’être reproduit ailleurs. Une fois simulé, il existe. Pour creuser ce tunnel, Maurice Benayoun, artiste multimédia déjà remarqué pour ses installations « info-métaphysiques » (*Dieu est-il plat?*; *Le Diable est-il courbe?*), a bénéficié d’une commande publique de la délégation des arts plastiques du ministère de la culture. Il a créé un logiciel de forage capable de dévorer quelques kilomètres de « matière atlantique » par jour. Développé par les informaticiens David Nahon et Tristan Lorach, ce logiciel permet d’une part de creuser, d’autre part de coordonner la progression simultanée de deux actions dirigées l’une vers l’autre, enfin de visualiser ces progrès – rendus d’autant plus visibles que l’image du petit écran est projetée sur un grand écran.

Les volontaires qui attendent leur tour d’entrer dans le tunnel peuvent voir ainsi ce qui se passe dans les entrailles de l’Atlantide, et quelle distance il reste encore de part et d’autre à dévorer. Deux personnes seulement à la fois, une en France, une au Canada, sont autorisées à prendre les commandes du percement. Le forage s’installe devant une table sur laquelle se trouve un petit manche devant lui, l’entrée du tunnel est matérialisée par le gigantesque orifice d’un boyau s’enfonçant

dans le sol du musée. Tout ce qu’il entreprend à l’intérieur du tunnel, tout ce qu’il découvre, s’affiche sur la peau de cet orifice. S’il veut aller très vite et tout droit, il ne voit pas grand-chose, ne trouve pas grand-chose à voir. S’il louvoie, le spectacle de la matière traversée peut devenir grandiose. Et tous ceux qui l’entourent en profitent comme lui.

UNE VRAIE CREATON

Par ailleurs, une musique interactive, composée par l’Argentin Martín Malazon sur les ordinateurs de l’IRCAM, guide les progrès des foreurs l’un vers l’autre. « L’autre » est identifié par un thème distant (*Trompette Miles*), qui grandit au fur et à mesure de l’approche. Chaque coup de bouloir se traduit également par un son. Et toutes sortes de bruits musicalisés, spatialisés, manifestent la résistance de la matière pénétrée.

Si, comme acteur ou même comme spectateur, vous envisagez de participer au percement, ne lisez pas plus loin que la fin de ce paragraphe, et gardez-vous la surprise de découvrir vous-même cette matière. Interdisez à quiconque en revient de vous décrire ce qu’il a vu. Laissez-le seulement

vous dire son impression d’avoir, pour une fois, participé à un événement virtuel d’une grande qualité, peut-être la première vraie création digne de ce nom en ce domaine, mettant en jeu participation du public et technologie sophistiquée au service d’une imagination renversante.

Il s’agit en effet d’entrer dans les images. Pas seulement dans ce qu’elles représentent, mais dans leur tissu même. S’y promener, y découvrir des canaux secrets, se lover dans leurs plis, se perdre dans leurs trames, les regarder palper de près, rebondir de l’une à l’autre comme sur une marie courbe infinie. Cinq cents images appartenant au passé commun de la France et du Canada tissent une immense tapisserie de Bayeux numérique: des caravelles, des canotiers, des batailles, des arbres, Trois-Rivières, etc. Cinq cents images tassées, embolées, épaisses, denses. Elles se forment pas un couloir qu’il suffit de longer. Elles dorment, tels des minéraux, dans une matière virtuelle. Elles ne forment pas un couloir qu’il suffit de longer.

C’est simple. Il fallait y penser ou plutôt cesser d’y penser et se mettre à le faire. *Benayoun tunnelum fecit*. Les autoroutes de la communication, cette métaphore inflationniste, passe-patout, sont enfin dotées d’un tunnel... ironique, et qui conduit quelque part.

Jean-Paul Fargier

Figure 2. Article in the French national newspaper: “The digging of Tunnel under the Atlantic just started in the Pompidou Center”

order to get a positive outcome”) – the “guy” in charge of organizing the content in order to provide more specific content to each *Tunnel’s* visitor. This neural-network approach would later evolve to become a more ambitious research project, the “eGonomy” maieutic engine: a technology to find the picture you look for without asking for it, and without even knowing that it exists. Maieutic here comes as a reference to Plato/Socrates’ method that also refers to “Gnothi Seauton”, “know thyself”. [4]

The continuous transformation of the *Tunnel*, following the traces left by the previous diggers, reflects an ontogenetic process of the work whereby it comes into being. The art continuously evolves from the processual nature of its generative capacities. The generative capacities of the *Tunnel* derive from the sophistication of its real-time data processes and the intentional behaviors, by which it can be situated along a trajectory of processual paths in complex experiences in art and other symbolic fields – contingent with our technological evolution and advancing from real-time technologies. These contribute to some fundamental changes in the art, eventually leading to what we

characterize as a significant art-ontological shift. What evolves is not only the specific environment of the experience, shared between audience-participants in Montreal and Paris in 1995. The *Tunnel* also reveals an involvement in art's ontological status in the world related to advancements in sensitivity.

With the *Tunnel* as an example, we wish to propose an ontological shift in art – one which we describe in a transductive perspective from the art-object to the art-subject. This shift, as we elaborate on its stages and implications for art in this paper, seems to be partially triggered by the introduction of sentience as the artwork feature. Today we may wonder, if the work starts feeling, it may start thinking. [5]

Considering the novelty and the apparent complexity of some key features of the *Tunnel*, we suggest the starting of a new taxonomy of media art practices. The real-time construction of the tunnel and the general virtualization of its continuous actualization lead us to reconceive the way we analyze and describe similar art endeavors. The transductive perspective, which we develop from the theory of Gilbert Simondon, spurs a way of thinking about technological art as processual and contingent with its associated milieu, publics, and society. This approach rejects the art's imposing of form as well as its categorization by genre or technical specifications. It involves an alteration in how we think about art and how we understand its modes of existence and modes of implication in the world.

Real-Time, Virtuality, and the art-ontological shift

During the past decades, scholars have been trying to put words on the evolution that affected contemporary society in general and art practice in particular. The desire was to identify a linear process that would have funneled the apparently chaotic stream of art experiments and innovative artifacts in relation to media technologies. Historians have identified mutations going from figuration to abstraction, from static to dynamic, from reality to the virtual. Paul Milgram's linear model of the reality-virtual continuum [6], as well as others based on a continuity between the physical and the virtual, doesn't apply to the systemic mutations that involve a large range of parameters, even if some of them, like the digital, come at once with different masks.

This chapter tries to identify the major factors of the digital shift in art making. It may propose a new analytic understanding of contemporary art practices that goes beyond the specificity of related technologies.

Real-Time

We'll start with the notion of "real-time" and its avatars and the role real-time has played in the evolution of the arts from the 19th to the 21st Centuries, starting even before the actual use of the terms. Nobody used the expression "real-time"

when performers in theaters and concert-rooms were producing a spectacle that the public could enjoy, immediately. In fact, the "live" performance is so close to the experience of real life that it doesn't challenge the question of Time. The observer just sees the similarity with real life. It is commonly admitted that the expression real-time (now often spelled "realtime") came from the computer simulation engineering field when the output is produced at the time the spectator can see it without noticeable delay.

Understanding the importance of live/real-time, the first question to wonder about could be: How is the spectacle or the artwork produced at the time it is experienced by the public? (Figure 3)

Process: If we list the processual paths that allow real-time experience, we can observe that the duality presentation/representation helps us to understand where the break in history happened. Live performance vs cinema. Physical presence of the actor vs recorded image.

Nature: We can categorize the transmission of visual information according to the different technologies employed: Natural (light waves through atmosphere), Optical (deviation of the light wave through a reflective, diffractive or refractive device), Chemical (Cellulose acetate, silver salts), Electronic (analog electric signal), and Digital.

Signal: The signal is either continuous, sequential (cinema stills, 24/sec), linear (frame and fields of video signal), discrete (bits, digits, and pixels).

Recording: On the other hand, the mirror requires the physical presence while presenting an image. Cinema is recorded and is therefore not "real-time," but television was a real-time form of representation (in the 1930s) before being recorded at the end of the 1950s. Waiting for the electronic analog recording (Ampex), we used to shoot the TV screen or the video monitor with a film camera – usually 16mm.

This categorization reveals two facts: An attempt to find in the representation this very property of the physical

Figure 3. "real-time" medias

	"real-time" medias				
	The live-action path	The Optical path	The Cinema path	The radio-television path	The generative path
Applications	Theatre, performance, concert	Mirror	Cinema, animation	radio, Television	VR, AR, real-time graphics
Source	Spectacle	Physical world	Physical world	Physical world	Algorithm
Process	Presentation	Reflection	Capture	Capture	Generation
Nature	Natural	Optical	Chemical	Electronic	Digital
Signal	Visual (light sound) Continuous	Visual Continuous	Sequential	Linear	Discrete
Recording	Textual graphic, Human Memory	Human Memory	Audio-visual	no/yes	no/yes

world, which is its ability to be experienced through real-time perception of its phenomena. Representation (e.g. image, artificial sounds) converges with the presentation of the physical world in offering the visitor an immediate experience.

Real-time processing, which has become possible with digital production of the artwork, allows additional features, like: generativity, interaction, virtuality, and immersion, which were previously impossible in the realm of image production.

Virtuality

If the real-time treatment of signals had a strong impact on the evolution of information and communication, the one that could include all the others was to make possible the intrusion of *virtuality* in the realm of representation. With digital technology, along with how computers introduced new forms of interactivity in the realm of artmaking, virtuality became a component and sometimes medium of art.

Tunnel under the Atlantic is an artwork steeped in virtuality. Although it linked Paris and Montreal in a Virtual Reality experience, the *Tunnel* is however not an object of Virtual Art. It avoids any reductive categorization of ‘Virtual Art’ determined by categories or representations of technological instrumentalization. The artwork can rather be characterized by its generative and dialogical capacities that result from a collaboration between the intentionality of the artist and the intuitions and choices in the visitor’s behavior. Rather than an image quality or space, the *Tunnel* explores virtuality as a process. Architecture, music, content, navigation, dialogue, database, narrative sequencing, were literally virtualized. They lost their status of pre-defined or predetermined components of the work to become an infinite combination of potentialities. Far from the concept of ‘composition,’ while, for example, observing a painting, the world resulting from the incidental design is thus the consequence of presence, action, and reaction. The process takes over the result, providing unlimited variation on the author’s intentions.

Far from trying to be “demonstrative,” the *Tunnel* nevertheless demonstrates a processual notion of virtuality – not “virtuality” as abstract and external to the public experiencing it – but as consubstantial to the existence of the artwork. We can initially grasp this account of virtuality with reference to the French philosopher Henri Bergson (who is “re-actualized” in the work of Gilles Deleuze), writing in the late nineteenth and early twentieth centuries. For Bergson, the virtual realm is not an abstract, imaginary “third dimension.” The virtual is a realm of reality that acts on the present and leads to actualization. [7] While the actual real relates to what has been historically actualized, what we know as the past, the virtual is made up of all those forces surrounding the present, which await actualization in the confluence of historical time. Like the endless possibilities of digging out the images converted into virtual blocks in

the *Tunnel*, the virtual is something which *could* coalesce historically in the present moment in endless possible combinations, but which has not yet been actualized (or conceived as possible). Virtuality is a movement from which we emerge from our own duration, a term Bergson uses to describe a mode of being in the world in an active, processual manner. It is in the realm of the virtual that we invent what becomes actualized.

In the Bergsonian legacy, virtuality is a process, not a space. The understanding of virtuality in terms of a process, rather than a substance or representation surrounding you, can be elaborated further with Gilbert Simondon’s conception of *transduction*. For Simondon, transduction concerns a rupture that reconfigures the structure of both the being and its milieu. [8] It is a process in which we evolve with potentialities of our environment, in which potentialities of our environment affect our state of becoming. It is about transformation rather than explanation, denoting both a structural change and an amplification process. It concerns a process, or an action, coming out of an energetic field related to communication and transmission. It announces an environment that is codependent with the individual – a heterogeneous composition in ongoing and highly complex processes of individuation with and within a milieu (and technological environment).

We see in the example of the *Tunnel* how individual perception participates in and constantly restructures the relation between the artwork and its milieu. The experience with the *Tunnel* is the outcome of a dialectical dialogue and negotiation between the audience’s unpredictable subjectivity (i.e. “the diggers”) – designed by nature and by culture, and the recently acquired perceptual sensitivities of the artwork – designed by the artist. The *Tunnel* therefore exists as an ontogenetic process whereby it comes into being with its environment and living beings within it. It behaves like a living artwork, facilitating multiple and ongoing processes of transformation within its own genesis and contingently with its associated milieu (society).

The sensory complex of the environment does not only contain elements of an external world but also elements of the artwork’s public, which also feed into the process of individuation. The transductive process happens from individuations of human perceptual and affective components, and human internal milieus such as psychic life, feelings, imagination, perception, and memory. These perceptual capacities modulate relations between the perceivers (the art-“diggers”) and their milieu, and between the artwork and the world. Processes of individuation of living things are sensorially and temporally variable. The domain of art structures itself through individuations, through the transductive transformation.

In the experience of the work of art, virtuality is not a category or a mode of representation but a behavioral dimension that triggers a capacity in the environment enacted in a collaboration between the artwork (the intention

of the artist) and the artwork’s public. In the experience of the *Tunnel*, as the artwork components are reduced at the level of infinite potentialities, the outcome becomes the footprint of the visitor’s experience. Endowed with awareness, the artwork acknowledges the presence and the singularity of its visitor. It responds to the behavioral perception of the public. It converts the situation into experience, and the work becomes responsive. Or, we could say that it perceives its public. As a transducer, it conveys expectations more than messages.

The Virtual Paradigm

If we follow and merge literature on the subject, the impact of virtuality in art could be described as a set of three different features: (Figure 4)

- *Potentiality* (not yet actualized)
- *Immateriality* (resulting from the digitization of the physical or from the modelization of ideas)
- *Interactivity* (real-time+virtuality make interaction with human and environment possible)

A fourth feature should be considered as an extension of the 19th Century painted panorama, but affected by a significant move: the possibility to adapt the perspective in real-time according to the visitor displacements:

- *Immersion*: graded from exteriority of the public to full proprioceptive immersion, sensory-immersion

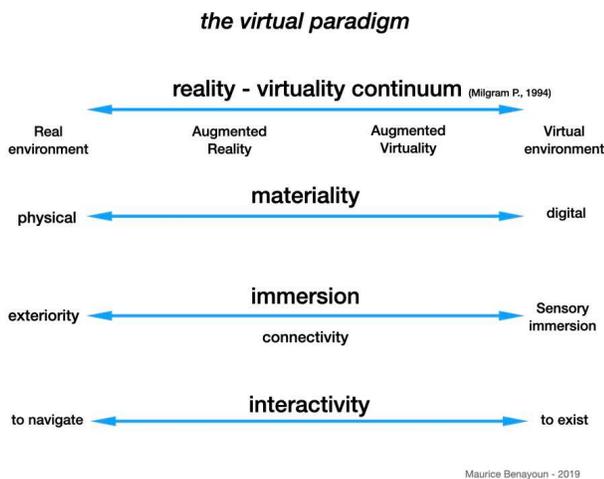


Figure 4. The virtual paradigm

Immersion. “To navigate in” or “to exist for”

With immersive forms of creation, the artwork develops primitive forms of perception of their public. The objective is to provide a visually/auditory responsive form of experience allowing immersion, being surrounded by the work, and being able to move in a predefined virtual environment. The interaction is limited to the tracking and observing of the visitor. This level of presence doesn’t affect the representation, the virtual environment. The viewpoint

and the perspective in VR are constantly and dynamically adjusted to the visitors’ behaviors, but the architecture, colors, figurations and behaviors of living beings don’t change. It can be a virtual ride, a virtual reality experience, a panoramic movie. As we’ll see later, VR artworks like Jeffrey Shaw’s *Legible City* in 1988 [9], or Char Davies’ *Osmose* [10] in 1995, belong to this category.

Among early VR artworks are David Em’s navigable virtual worlds in the 1970s, Jeffrey Shaw’s *Legible City* [9] and *Virtual Museum* [11], and Char Davies’ immersive and interactive VR environment installation *Osmose* (1995) realized as a space for exploring perceptual interplay between self and world, and navigated via one’s breath and balance; and *Ephémère* following in 1998. [12] Works like *Very Nervous System* by David Rokeby, in 1982-1991 [13], *Intersection* by Don Ritter in 1993 [14], *Interactive Plants Growing* and *e-Volve* by Laurent Mignonneau and Christa Sommerer [15], like the *Tunnel under the Atlantic* (1995) mentioned above, constitute but a few of the first attempts to capture inputs from the visitor in order to trigger a minimalistic or significant response from the work.

While *Osmose* was proposing a virtual visit of a pre-existing/pre-design environment, the physiological behavior of its visitors (“immersant” in Davies’ terms) was taken into account not by having an impact on its environment but by moving the virtual camera according to the breathing, head rotation, and body tilting. The system was aware of the visitor’s intentional navigation but the space to visit and its virtual life was not affected by the visitor’s presence. This limited awareness of the system is extended during the last period of the experience, when the visitor navigates in the middle of the artwork code, executed according to the visitor’s actions. At this stage, everything in the field of view is directly affected by the audience. [16]

Osmose makes an aesthetically stimulating and a quite literal example of a virtually immersive experience. At the same time, in the same venue, Montreal Museum of Contemporary Art, during ISEA1995, the *Tunnel under the Atlantic* proposed an environment aware of its public and directly affected by its presence and action. Architecture, sound, content, everything was the result of the digging and the meeting.

Even if the *Tunnel* was responsive and aware of its visitor, it was still a reactive piece of art limited to its exhibition space. The “digger” had to intentionally act inside the virtual substratum. The apparent complexity of the *Tunnel*’s sensory-system would have led – if we compare to natural life – to a life-form similar to the one of the earthworm. Feeling its environment, avoiding the obstacle, absorbing food/information, repelling unused material that later becomes useful to other species. No apparent consciousness, no production of diversified content.

The Art Ontological Shift

How sentience brings life to the arts

The digital shift in 1995

The artwork sensory-motor system is no longer limited to capture the visitor position and action. Based on the property of the living, the artwork can perceive and often combine multiple information of the audience and their environment.

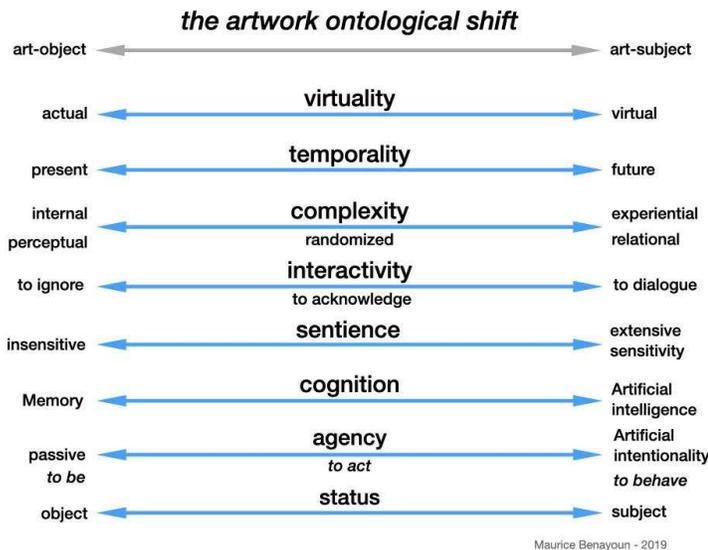


Figure 5. The artwork ontological shift.

These data are analyzed, interpreted and used to determine the artwork behavior in response to the public intrusion. The behavior of the work becomes more complex but is still limited to their location and field of action. Artworks becoming sentient systems have been emerging at the time of information technologies. The *Cybernetic Tower* by Nicolas Schöffer [17] in the early 1960s constitutes an excellent example of an artwork responding to Nature. Calder's *Mobiles* in the early 1930's could epitomize the unplugged version of the work. It is only later that the works started to react to people with the intention to institute a more complex cognitive relation.

What happens when the artist starts considering real-time and virtuality as effective mutations of the medium? (Figure 5)

Virtuality, the capacity of the work to have a future, not to be a frozen composition reaching completion when all elements are at the predetermined place in the masterpiece. The constant evolution of the sensible, resulting from the evolution of time, context and external inputs including visitors' behaviors is a dynamic form of actualization that becomes the outcome and the actualization of experience.

Temporality is now more than ever a dimension of space, allowing exploration, discoveries, serendipity and accident/incident.

The lack of **complexity**, absent from the early computer-generated artworks, was often "simulated" by the basic application of randomized generation or distortion of the original material. Now complexity may come from the constant unpredictability of the visitor's behavior. The living is the more significant factor of complexity that preserves a high level of resonance for the user.

The most primitive version of **interactivity** is the one we experience in navigating into panoramic videos limited to a basic control of the point of view, a vectoral freedom that we have when attached to a leash. The next step is when the virtual environment acknowledges our presence. *We exist* for the world we visit. Then, the state of the art of interaction is when the artwork is able to reach a level of intensity in terms of interaction close to dialogue. Dialogue is not about words. Benayoun used to say that the most intense forms of dialogue are to make love and to make war (Prix Ars Electronica awards ceremony, Sept. 1998).

The sentience singularity

Virtuality in a self-generative process allows the creation of an effect of diversity, and complexity, but it doesn't affect the visitor's experience beyond a potential retinal excitement. This may be explained by the fact that the spectator doesn't perceive the intelligence behind the screen.

Now, the artwork has become able to feel more than the mere intentional actions from the spectator with a mouse or a keyboard. It can perceive multiple events, feel sensations made of sound, light, image, smell, and even collect environmental and contextual data. When the French philosopher Condillac in the 18th century defined *sensualism*, he suggested that just giving the sense of smell to a sculpture would activate a capacity of memory and adding other senses would awake its cognitive functions like consciousness and intelligence. [18] Empowered with senses, perceiving its environment, the passive sculpture starts feeling and thinking.

Even though nowadays Condillac's speculations sound more than debatable, we can observe the evidence of the impact of sensory perception on the cognitive functions of 21st-Century-artworks, dotting them with a semblance of consciousness and intelligence. When perception of external stimuli can be memorized, feeding an inner database, we have the matter to apply functionalities of what we call *machine learning* and **artificial intelligence**. To perceive the environment is the best way to determine action. Agency becomes a property of the artwork that may passively accept inputs, act by reflex, or behave according to **artificial intentionality**, empowering it with a potential behavior *by design*, corresponding to the artist's intention.

Toward the Art-Subject

It is now possible to understand how, beyond the technological performances, this evolution leads to an

artwork that may change in real time and evolve according to internal and external inputs and perceptions. It has become able to virtually mutate and behave. This behavior is not the result of a randomized process simulating complexity. It has been designed by the author.

This artificial intentionality totally changes the ontology of the artwork. It is not any longer a static object expressing the ultimate state of perfection, of talent, and craftsmanship expected until the end of the 19th Century to fulfill the definition of “masterpiece.” It is closer to a living being, endowed with perception abilities, learning capacity, cognitive competencies, with intentional behavior. This doesn’t define a natural living being that we would observe as an entomologist strutting a new insect species.

*Artworks have become complex
intelligent entities striving to talk to us.
Art-objects have mutated into art-subjects.*

And now, 25 years after the *Tunnel*

How the art-subject changed the art practice?

From the *Brain Factory* to *Value of Values*

20 years after the *Tunnel under the Atlantic*, together with artist/architect Dr. Tobias Klein, Benayoun started working on another level of sentience leading to an increased autonomy of the artwork. The *Brain Factory* [19] asks its public, converted into “Brain Workers,” to give shape to “human abstractions.” The interaction leaves little space for intentionality. Equipped with an EEG (ElectroEncephalography) head band, the public reacts to a generated, evolving form displayed on a screen. (Figure 6)



Figure 6. Brain Factory, Benayoun, M., Klein, T., Brain Worker neuro-designing an abstraction. Microwave Festival, Hong Kong Dec 2018. © Benayoun

The Neuro-Design Station [20] (Brain2Shape) interprets the brainwaves coming from the Brain Worker as positive or negative reactions. Human abstractions are comparable to living beings evolving in the human mind. Reacting to the

dynamic generated shapes, the Brain Worker acts like a *mental ecosystem* assessing the viability of a new species: tri-dimensional abstractions referring to a written concept. Dynamic shapes striving to represent FREEDOM, POWER, or SPACE, survive in the mental ecosystem by continuously evolving. The quality of dialogue between Human and Machine (BCI) is not a form of control (cyber) and the public is not invited to “design” – what would have required knowledge, skills, and craftsmanship. On the contrary, the brain worker is “assessing” the living form, like nature assesses new lifeforms. In the *Brain Factory*, the outcomes of the process are then reified [21], “thingified.” The 3D-printed form becomes a physical artwork. We could consider that the assessment process is a form of dynamic curatorship.

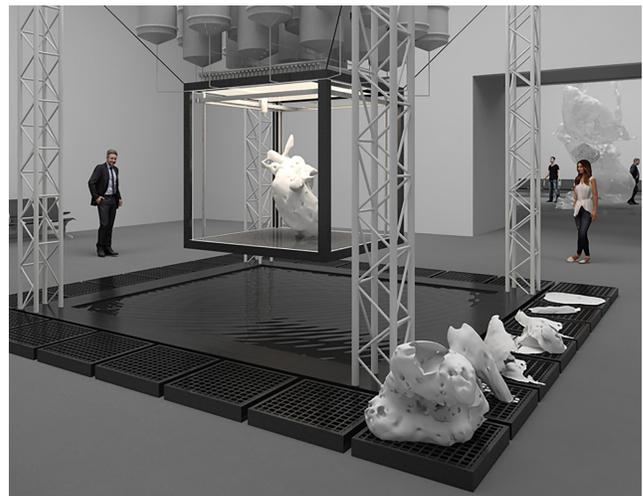


Figure 7. *The Big Reificator*, project from the *Brain Factory*, CGI representation of the reification process. picture © Tobias Klein



Figure 8. Value of Values, Benayoun, M., Mendoza, N., Klein, T., Brain Workers neuro-designing abstractions, and phone wallet. ISEA2019. Gwangju, Korea © Benayoun

In 2019, thanks to the additional contribution of Dr. Nicolas Mendoza [22], the *Brain Factory* project was extended with the *Value of Values* project. [23] (Figure 8-9)

Instead of giving shape to ‘human abstractions,’ *Value of Values* focuses on ‘Human Values.’ Like human abstractions, human values reside in the human brain, their natural ecosystem. At the end of a similar neuro-design process, the Brain Worker takes away the 3D model, an abstraction that has become a token on the Blockchain: a VoV (for *Value of Values*). (Figure 7) Giving shape to ideas,

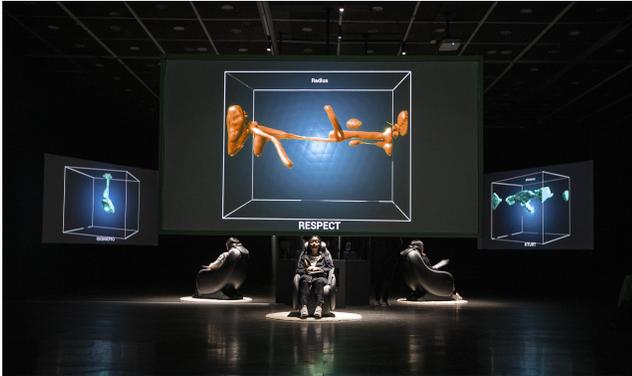


Figure 9. *Value of Values*, Benayoun, M., Mendoza, N., Klein, T., Brain Workers neuro-designing abstractions. Value of Values, Benayoun, M., Mendoza, N., Klein, T., Digital Art Festival, MoCA, Taipei, Taiwan © Benayoun

the spectator-Brain Worker becomes an “artist.” By assessing the evolution of the shape according to a topic, s/he becomes a “curator.” Getting the resulting artwork/token, s/he becomes a “collector.” Brain workers can then trade their VoVs on the market, they become “art dealers.”

Bartering the human values like giving MONEY to get PEACE and LOVE becomes in real time *Transactional Poetry*. Poetry is automatically generated out of the transaction. Something like “I gave all my MONEY to get PEACE and LOVE. Deal!”. Then, finance makes sense. Generated *Transactional Poetry* is displayed in real-time on the project’s website and in the exhibition’s spaces. [24]

Monitoring the trading of values helps to understand the relative value of human values. Their ranking is different according to the people, the cities, the countries, and the continent. The artwork reflects on the human hierarchy of values for the individual and their communities. This may affect our perception of cultures and incites some people to leverage on their image or the image of their social group.

Ethology of the Art-Subject

The *Brain Factory* and *Value of Values* radically reflect the impact of these changes by introducing the living into the arte-fact: *the fact of the art*, a human-made entity with complex behaviors.

Adapting itself to the context, absorbing, treating, and expressing the result of the metabolization of its environment, the *Tunnel* was at a primitive stage of the evolution toward the art-subject. It announced the coming of

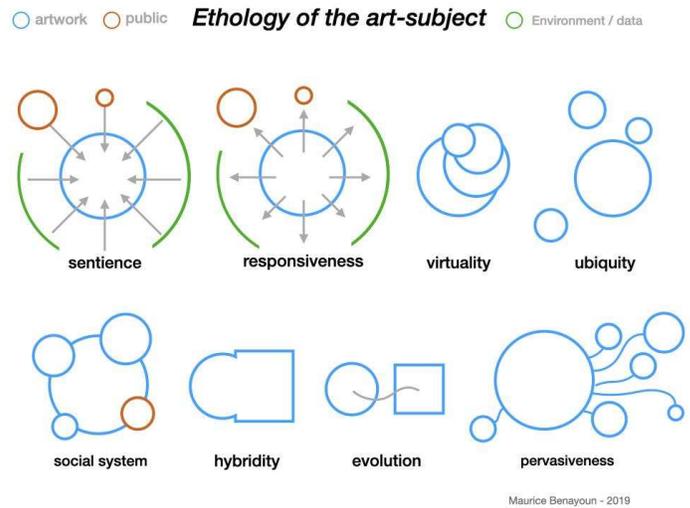


Figure 10. Ethology of the art-subject.

more advanced and empowered artworks. 25 years later, art live-forms have evolved from the original artwork as the “art-object” to the “art-subject” and with this evolvement become able to elaborate complex forms of interactions with its public. We call art-subject vs. art-object the complex sentient system that makes an artwork a cognitive being able to act, react, and communicate with its public.

The concept Figures above illustrate a move away from the status of the object and towards the capacity of the artwork as a complex machinery. The environment is composed by networks of humans and non-humans, spacings and distances, timings and temporal configurations, interweaving of closed contexts and widely distributed milieus, and imaginings related to deep-anchored and multi-leveled memories and projections of future events.

As the artwork’s behavior has become artificially intelligent, it processes information in a more autonomous manner, suggesting a level of complexity that, if not competing with human intelligence, makes the work look like a higher form of a living being. The system has been empowered and can now enter another level of dialogue with the public. All included in the process, the highly sentient artwork – that now integrates sound and physical biofeedback – has become an acceptable interlocutor for its audience: a real “subject.”

We have seen how the “art-object” has become an “art-subject.” If its autonomy doesn’t make it an individual, meaning free from human control or human intentions, it is able to develop higher forms of induction, affecting the former spectator and the physical world around it. The art-subject cannot be represented, and it does not represent. It is never fixed but ‘living.’ The art-subject presents an open system.

Now, if we try to observe this new “subject” like the aforementioned entomologist would do, we should pay

attention to its ethology: how to characterize, classify, and analyze its behavior. In the process of observing the ethology of an art-subject, we first understand that it perceives people around it, but also all elements that constitute its environment and even data through the network, like a world scale nervous system that would provide information about the whole World and beyond.

We begin at the top-left corner (Figure 10):

The extensive capacity of *sentience* is “intentionally” filtered by the limits of the technologies and/or by the will and expectation of the artist that may decide how this information will be “mapped,” converted in order to generate appropriate, significant, and meaningful *response*.

Perception determines emotions that lead to action accorded to a pre-coded set of artificial intentions.

The diversity and the accuracy of the response depends on the level of *virtuality* that the art-subject can afford as we may say about robotic devices that they have degrees of freedom.

Works like *Value of Values* may exist only if they are present in different venues simultaneously or sequentially. *Ubiquity* may become a feature that networked artworks experience systematically. At the time of the digital, there is no specific location required for an artwork.

The different functions of an artwork may have their own specific behavior, they collaborate to create a *society* of what engineers call “agents.” They accomplish their mission as designed for. The *Tunnel* and *VoV* are conceived as *social systems* with agents playing their role at the same level as the visitor/interactor assuming also different functions and statuses that evolve during the whole experience of the work. In *VoV*, the Spectator becomes an Artist, a Curator, a Collector, an Art Dealer, a Trader. S/he is confronted with an artwork that is, at the same time: a Brain-Reader, a Shape-Generator, a Music Composer, a Printer, a Sculptor, a Reader, an Interpreter, a Scientist, a Poet... Each of these characters is a separate entity that learns how to understand the others and contribute to the unity of the whole.

Art-subjects are not necessarily only made of silicon and human flesh, they may integrate elements of what Roy Ascott calls “wetware,” physical objects or pieces of architecture, financial or medical data. *Hybridity* has become a keyword to express the vanishing of disciplinary, material, social, or economic borders.

The work doesn’t have a stable state that could be considered completed. During a single presentation / activation, or from one exhibition to another, everything in the work may have evolved. From the hardware, the material elements, to all software components, the same artwork is always a new instance of the original one. This *evolution* can be compared to the one of the painters starting again from scratch the same pattern or the same painting. The art-subject is its own evolution like living beings are never the same when we meet them again and again.

Beyond escaping to conventional venues, crossing the borders known to separate materiality from digital

immateriality, the living from the mineral, politics from poetry, finance from emotion, artworks can be everywhere, they contaminate all sectors of human activities making sense with this absolute *pervasiveness*: an endless potential of semantic, aesthetic and poetic connectivity.

After the *Brain Factory*, *Value of Values* provides a significant example of an art-subject becoming a complex ecosystem affecting different fields of human activities, from image, sound and poetry, to finance and sociology, neurosciences, and philosophy. Highly networked and dematerialized, it pervades the social and the economy in ways that were not developed before. It interrogates playfully the fields of knowledge economy, fintech, the artworld, and the art market. As such, it should be understood as an attempt of simultaneously addressing aesthetics, politics, and institutional critique. With the *Brain Factory* and *Value of Values* series of works, we aim to illustrate how the artwork is ready to pervade a wide range of human activities and, in doing so, hopefully to increase the level of global awareness.

Transduction and pervasion

As we perceive the mutation of the art-subject to the art-object, many contextual factors have an impact on the nature of the work: who is contributing and how large is the art-subject’s public; how high is the level of the art-subject’s affect; and where is the art-subject’s field of operation located? (Figure 11)

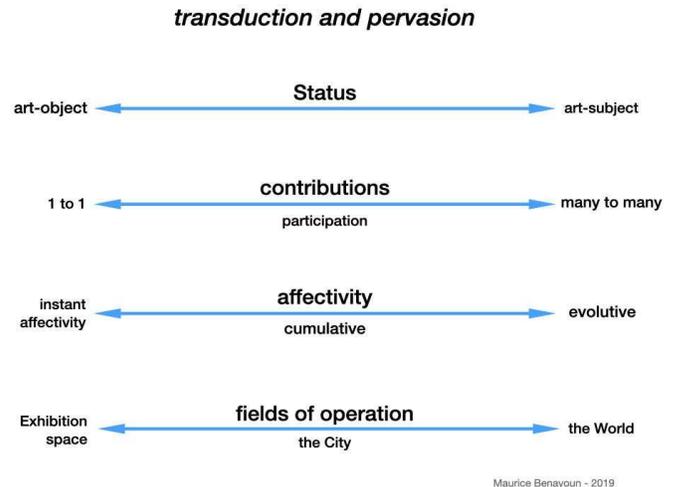


Figure 11. Transduction and pervasion.

Contributions: If the work interacts with living beings, is it a one to one interaction? Does it collect data from the successive interactions to express a significant evolution? If many people can interact simultaneously, should we expect multiple outcomes or a collective impact on a single outcome? Is the art-subject made of multiple entities, each of them addressing a different public?

Affectivity: A sensitive, sensible artwork probably experiences new forms of affectivity. How is the artwork affected by the interaction? Immediate impact/reaction? Cumulative impact with delayed reaction? Slow evolution resulting from the diversity and complexity of interaction along the lifespan of the artwork?

Field of operation: Like a fight, a war, or a love party, the artwork expresses its intentions on carefully selected venues. Is it practicing its art: inside a White Cube, at the City scale (e.g. Urban Media Art) [25], at the World level, affecting all fields, layers of society, no matter the geographic, disciplinary, linguistic or political borders?

Conclusion

The potential of technologies and their infiltration in the fabric of our daily life made possible the evolution of art-forms becoming more sentient, more autonomous, and more pervasive, contaminating wide fields of human activities. As the artwork's behavior has become artificially intelligent it processes information in a more autonomous manner, suggesting a level of complexity that, if not competing with human intelligence, makes the work look like a higher form of living being. We propose in this paper an ontological shift in art, from the "art-object" to the "art-subject." If its autonomy doesn't make it an individual, meaning free from human control or human intentions, it is able to develop higher forms of induction, affecting its publics and the physical world around it.

Art penetrates layers of our informational ecosystem, from overflowing the frame of the art world to infiltrating urban media. The ontogenesis of the artwork is not contained in the space or domain of 'art' but exceeds its own context. The transductive process of the artwork is not isolated to a microcosmos of the gallery space or domain of art but participates in contingent and continuous processes of individuation and transduction. The art-subject is a subject in the world. If the artwork was ever *just* an object-itinerary to an emotional place of imagination and perspective on complexities of what it means to be human in the world, the art-subject has – because of its generative capacities – become a living entity, political by its intentionality, that cannot exist without leaving traces and participating in reconfiguring the technological world. In doing so, *artworks expand our understanding of their ecosystem* (the gallery, the physical world, the hybrid sphere, the intra-temporal public domain) by increasing the level of perceptive awareness (also called sentience) through transductive processes of individuation.

In the transductive process, art becomes a living entity with specific behaviors. It initiates an exchange or a dialogue with the public that in real-time generates its fleeting appearance. Art becomes a context for the exploration and questioning of our (technological) present

and communicative existence. And here the intentionality of the work becomes important. Intentionality cues and determines the transductive process. The domain of the art is structured around mechanisms trying to find a solution to a problem, and the criticality lies in the intentionality of the artist.

We propose the art-ontological shift not as a finished process of transformation from one state to another but to illustrate how the domain of art is continuously changing. The ontological shift from art-object to art-subject is not a temporary conclusion either but rather an opening of a chapter that destabilizes epistemological and conceptual architectures of art's discourse, especially as these have concretized with the consolidation of the modern art-object. In this perspective, concepts emerging with the digital, such as "virtuality" in art, as pioneered with the *Tunnel* and other artworks, concern more than just an adaptation of aesthetic material into a new medium (so-called Virtual Art). Further exploration into the processual elements of virtuality, as we have attempted in this paper, offers a new model for thinking about human existence and becoming in sentient environments in our current technological age.

With the ontological nature of the art-subject, the boundaries between where technology begins and the human ends are blurred. This is a fact of our existence in the world today. And this demands a reconfiguration of the art's public – the individual, the art audience, 'user,' spectator, or "expectator" – who is waiting for the artist's intention to be revealed while visiting the work. The art's public becomes in and through relations with the world as mediated through the artwork's experience. Here conditions of perception, representation, conceptualization, judgment, meaning – and *value* – of the art-subject are not detached from the contexts and technological milieus in which they are located. Technological environments are constitutive for the human genesis. It influences temporal dimensions of the experience that in the case of the artwork affect immediate responses in the participating audiences, such as patience or impatience, expectation, and anticipation. The transductive process extends to formations of intentions and actions from memories and anticipations, conceptions and complexities of technological invention and innovation. This perspective invites for further investigation into technogenetic and transformative experiences with art, especially with regards to the cultural-societal impact of such experience. [26]

This has to do with how the art exists and participates in the ongoing technological transformation of the world. Further investigations will allow us to elaborate on the idea of artworks becoming comparable to a society of agents, simulating or even emulating active aesthetic and social models while providing prototypes for observing and understanding contemporary mutations of society, as well as the transduction of its new hybrid material/digital fabric.

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Authors Biographies

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Maurice Benayoun (aka MoBen) is a French pioneer, contemporary new-media artist, and theorist based in Paris and Hong Kong. Often conceptual, MoBen’s work proposes a critical investigation of the mutations in the contemporary society induced by the emerging or recently adopted technologies. For the last 40 years, MoBen developed a wide range of practices including art installations, interactive media, urban media art, and conceptual projects. MoBen’s work received close to 30 international awards including the Ars Electronica Golden Nica. Benayoun, gave close to 400 lectures around the world. He taught at Paris1 Pantheon Sorbonne University, Paris 8, and the French National School of Arts (ENSBA). He is presently Professor at the School of Creative Media, City University, Hong Kong.

Dr. Tanya Ravn Ag

Tanya Ravn Ag, Ph.D., is a curator and scholar focused on perceptual experience, memory, temporality, and technogenesis in relation to media art and media aesthetic phenomena in the urban domain. Her curatorial engagements with urban, media-based art include the Screen City Biennial 2017 in Stavanger, the SP Urban Digital Festival in São Paulo in 2013 and 2014, and Nordic Outbreak presented in New York City and across the Nordic region by the Streaming Museum in 2013-2014. She is the editor of *Digital Dynamics in Nordic Contemporary Art* (Intellect, 2019) and co-editor of *What Urban Media Art Can Do – Why, When, Where, and How?* (av edition, 2016). In 2017 she co-founded the globally networked Urban Media Art Academy. From spring 2020 she continues her scholarly work at Institute of Arts and Cultural Studies, University of Copenhagen, on art, temporality and technogenesis. This research follows a two-year visiting fellowship at School of Creative Media, City University of Hong Kong, where she researched media art and other phenomena in perspective of philosophies, neurological theory, psychologies, and media aesthetic dimensions of digitally expanded reality.