Brain and the aesthetical mind[1]

Giuseppe Vitiello

The brain constructs within itself an understanding of its surround which constitutes its own world. The collective neuronal dynamics appears to be finalized to the continuous attempt to reach the equilibrium of the subject with its environment. In the dissipative quantum model of brain[2, 3, 4, 5]*, the mathematical formalism describes this by* doubling *the brain degrees of freedom, so that fluxes ingoing in the brain are outgoing from the environment (called* the Double*), and vice-versa. This is obtained by inverting the time direction (*the arrow of time*) for the environment, namely exchanging 'in' with 'out': the Double is the time-reversed image of the brain system. It is like having a 'mirror in time' in which the self reflects in its Double image.*

The goal pursued by the brain activity is thus the most harmonious 'to-be-in-the-world', which defines the *aesthetical experience*, characterized by the 'pleasure' of the perception.[6] In this sense, the aesthetical dimension is a characterizing feature of the neuronal activity, in strict relationship with the cognitive dimension.

We are embedded in the intricate net of perceptions, trades and reciprocal actions and reactions within our environment. In the dissipative model, such a highly dynamic life of the brain is described in terms of transitions between different dynamical regimes (*phase transitions*), and thus as *far from the equilibrium* processes, approaching to and departing from stationary points where variations of free energy are vanishing. The act of *consciousness* is postulated to reside in such a restless dialog of the self with its Double;[7] it belongs to the bridge which connects, does not separate them. It lives in the present since the present stays on the surface of the mirror in time in which the self reflects in its Double. Consciousness is thus an act of sudden knowledge, an intuitive one, not susceptible to be divided into rational steps, non-computational, non-separable from our body.[8] Our to-be-in-the-world manifests itself as a constraint to 'listen' to it through our perceptions[9] and as a constant self-referential emotional experience flowing through our body;[10, 11] in a continuous recomposition between subjectiveness and objectiveness. The relations between the self and its surround constitute then the *meanings* of the flows of information exchanged between them.

In the dissipative model, memory states are states of minimum energy. They behave as 'dynamical attractors'. The brain state at a given time is described by the collection of such memory states, namely as the *attractor landscape*. Going from memory to memory is described by trajectories in such a landscape. They are chaotic trajectories,[12] sensible to tiny fluctuations in the initial conditions. An important role is thus played by noise and weak perturbations, which explains the observed relevance of small stimuli to the brain functioning. One observes[13, 14] that the same weak stimulus in different contextual conditions may lead to different brain reactions or answers. The brain activity is triggered, not controlled by weak stimuli. Any new stimulus, by inducing the breakdown of the symmetry of the dynamics,[15] produces the recording of a new memory; it originates the formation of a new attractor in the landscape of attractors. The new information is submitted to a process of *abstraction*, by eliminating unessential details, and of *generalization*, by recognition of the category to which the stimulus belongs. The inclusion of the new attractor never results in a pure *addition* to the pre-existing set of attractors; rather it produces the *rearrangement* of the whole attractor landscape, so to

'situate' the new memory in the 'context' of pre-existing memories. The new 'information' becomes thus *meaningful: memory is not memory of information, but memory of meanings.*[16] The rearrangement of the attractor landscape is made possible by the maintenance of the cortex in a state of *criticality*, a readiness from expectancy to realization and back again, repeatedly in tracking changes in the environment. This constitutes the *learning* process through which the flux of information becomes *knowledge*. The *vision of the world* is thus generated and creates *expectations* which drive the brain in the *intentional* search of situations considered satisfactorily on the basis of previous experiences. This in turn determines our *actions*, which at once also provide a *test* for our expectations, thus making our knowledge *reliable*. In this way, the dissipative quantum model describes the *action-perception cycle* of neuroscience, or the *intentional arc* in the Merleau-Ponty's *Phenomenology of perception* (1945).

In order for the action to be successfully carried on in the environment, hypotheses need to be formulated on the basis of 'past' perceptual experiences. Their formulation needs to 'recall' from the past (remembrances) scenarios 'similar' to the ones in which to operate in the future and which need to be pre-figured, i.e. *imagined*, in the past with respect to their actualization. This is realized by the Double, which by its own characteristics operates by time-reversal. Mind and mental activity thus operates "*along parallel time lines, one corresponding to reconstructing the past in remembering, the other forecasting environmental trends by extrapolation into the future in predicting.*"[17] The time-reversed copies of amplitude modulated (AM) neuronal patterns observed in laboratory are constructions of the Double, used by it to formulate hypotheses and predictions. "*The Double is mind, yet it is completely entangled with brain matter that is shaped in the original AM pattern.*"[18] Brain and mind do not constitute a dual-aspect of some entity, they are one single undividable system.

Each rearrangement of the attractor landscape provides a new vision of the world, so that the functioning of the brain has the dimension of the *surprise*, of the *astonishment...*[19] "*and suddenly, all at once, the veil is torn away, I have understood, I have* seen;"[20] and of the *Now*, the magic dimension of the present, the time that stops his course in the photographer "surprise":…"*when at the precise instant an image suddenly stands out and the eye stops*" forcing "*the time to stop his course.*"[21] It is through such features that the brain functioning is characterized by the *aesthetical experience*, flavoured by the 'emotion' of the perception, the *pleasure of exploring*, the satisfying accomplishment, although never definitive, of our *trade and play* with our Double.[22, 23]

The *aesthetical dimension* thus describes the entire texture of our perceptual experiences, it enters the construction of knowledge, establishing a link with Spinoza's "*intuitive science,*"[24] determines itself in the *aesthetical judgment* which involves always *solely* the first person,[25] and it is never matter of discussion, rather, opposing often to previously consolidated views, it carries the flavor of being *eversive*.

Even the *act of thinking*, usually synonymous of 'rationality,' of 'logical consequential necessity' in its chain of steps, acquires a new perspective in the model: 'to think' appears much better grounded on the *erratic walk* described by chaotic trajectories in the attractor space; perhaps, as in the tragedy *Oedipus at Colonus* by Sophocles, one can finally come to *see*, to *know* only after wandering. The missing of strict consequential necessity in the acts of consciousness gives us the 'privilege' of being able to 'make mistakes', namely to follow unexplored paths, eluding conformity and homologation, thus opening the possibility to 'invention' and 'novelties', contrarily to mechanical machines which by definition are 'broken' if their functioning deviates from a sequence of strictly planned steps.[26] Thus, *errare e pensare* (to err and to think) get along much better than one may suspect. Maybe, pensare is errare.

The aesthetical experience also implies the 'active responses' of the self to the world and vice-versa, which in turn imply responsibility and thus they become moral, ethical responses through which the self and its Double become

part of a larger social dialog. An interpersonal, collective level of consciousness thus arises; a *social brain* emerges, a larger stage where a common 'culture' is originated. Cultural atmospheres are then the manifestations of long range correlations among mutually dependent individuals, each other bounded (entangled), each one simply non-existing without 'the others.' A higher level of knowledge, structured levels of meanings in a shared common view of the world are thus obtained; new cultural trends, whose novelty may even acquire a *revolutionary* character, or simply new 'fashions', may swap over large assemblies of people, that then become a *community*. In such a frame, aesthetical experience unavoidably implies disclosure, *language*, to *manifest* 'signs,' including artistic *communication*, which typically does not carry information, but meanings, with the additional essential aspect of 'vagueness,' crucial to leave open the doors to dynamical formation of further meanings.

Remarkably, the coherent structure of the brain background state is observed to have fractal properties conform to power-law distributions.[27, 28, 29] These facts, the observation that fractal structures occur in a large number of natural phenomena and systems and the discovery[30] that fractal self-similar structures are isomorph to coherent states in quantum field theory suggest that the dynamical law of coherence acts at a fundamental level as a *law of form* ruling *morphogenetic processes*. We are then lead to conclude that the *appearance of forms* through coherence becomes the *formation of meanings*. Nature is then not a collection of multi-coded *isolated* systems, rather it is unified by the dynamics of coherence which thus becomes a *dynamic paradigm* ruling natural phenomena. In this sense, coherence is by itself the primordial origin of codes, which then appear to be expressions of meanings, not of pure information.[31] This view seems to be confirmed by the PCR (polymerase chain reaction) processes commonly used in biology[32, 33] and by recent experiments[34, 35] on the electromagnetic properties of aqueous solutions of DNA of viruses and bacteria. The possibility to duplicate through PCR the DNA (the genetic code) is due to the fractal self-similar property of the electromagnetic signal emitted by the DNA aqueous solutions. That signal appears to be the carrier of the coherence (meaning) of which the DNA code is expression. Perhaps, modifications in the signal coherence (as in the squeezed coherent states[36]) may play an important role in the dynamical origin of epigenetic modifications. They might reveal the appearance of *new meanings* associated to deformed coherent signals. DNA appears in conclusion to be the *vehicle* through which coherence and its dynamical deformations propagates in living matter.

[1] For an extended version of this paper see G. Vitiello, "The aesthetic experience as a characteristic feature of brain dynamics, Aisthesis", *Pratiche, linguaggi e saperi dell'estetico* 8(1), 2015, 71-89. http://www.fupress.net/index.php/aisthesis/article/view/16207

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Zaven Paré, *Danger Will Robinson*,
Huile sur toile, 150 x 200 cm (2016).

Friendly Robots (des robots compagnons)

Zaven Paré[1]

*Dans l'espace interstellaire de la physique relativiste, l'homme isolé, perdu parmi des milliards d'étoiles et de planètes, a transformé la sienne pour y vivre et y prospérer. L'Anthropocène s'apparente à maints égards à une robinsonnade. Contrairement à l'*Utopie *de Thomas More (*Utopia*,1516) décrivant la Nature comme cadre idyllique, le Robinson de Daniel de Defoe arrache sa survie à une nature inamicale et clairsemée. Dans cette économie, Robinson est seul jusqu'à l'arrivée de Vendredi. Aujourd'hui, le monde technologique annonce le robot tel un nouveau Vendredi, futur compagnon nommé friendly robot.*

Danger, Will Robinson !

Créé à l'image du robot Robby du film *Forbidden Planet* (Fred M. Wilcox,1956), celui de la série télévisée *Lost in Space* (Irwin Allen, 1965) est déjà une sorte de Vendredi. Postulat d'une altérité de science-fiction, affecté d'un tronc cylindrique et rotatif, de bras terminés par des pinces mécaniques rouges à rayons laser, il a une tête en bulle de verre abritant une antenne mobile, et un panneau de contrôle avec un voyant lumineux synchronisé avec le timbre de sa voix est placé dans son torse ; par une petite porte coulissante translucide, on accède à ses bandes perforées. Ses jambes, solidaires l'une de l'autre, offrent une certaine mobilité avec l'apport de chenilles. Équipé d'un ordinateur apte à effectuer des calculs complexes et à déduire de nombreux faits, il est pourvu de connaissances approfondies sur de nombreux sujets, comme piloter un vaisseau spatial, et de divers capteurs afin de détecter différents phénomènes et d'éventuels dangers : « *Danger, Will Robinson !* » dit-il souvent[2].

Par principe, les robots humanoïdes des films d'anticipation exerçant des missions d'« utilité générale » sont des « robots environnementaux

Manutention de Geminoid HI-1, Advanced Telecommunication Research International Institute (ATR), Kyoto, 2009. Photo Zaven Paré.

non théorisant ». Le robot de la série est un M-3/modèle B9 nommé « *G.U.N.T.E.R.* » pour *General Utility Non-Theorizing Environmental Robot*. Sigle qui définit déjà ce que l'on appelle de nos jours les robots sociaux : *G.U.* se réfère à la notion de majordome universel et *N.T.E.R.* pose l'axiome d'une machine capable de prendre des décisions en conformité avec les lois de la robotique. Privé de la capacité de théoriser, *G.U.N.T.E.R.*, d'une conscience limitée (celle d'un ordinateur ou même celle d'un « esclave »), n'est pas seul dans la catégorie des robots domestiques à capacités décisionnelles. Il y a aussi la Rosie des séries d'animation *Jetson* de Hanna-Barbera (1962), et *Doraemon*, le chat-robot venu du futur, du manga de Fujiko Fujio, 1969.

Les représentations idéalisées de « servitude volontaire » commencent à jouer un rôle important dans l'inconscient collectif après guerre. Aujourd'hui, la diversité des tâches techniques incombant aux robots nécessite autant d'appareils spécialisés qu'il existe de groupes d'usagers et de personnes ayant besoin d'assistance spécifique. La complexité du projet de réalisation de *majordomes universels* tels que décrits dans les récits de science-fiction reste sans doute, heureusement ou malheureusement, une utopie[3]. Quel serait alors, hormis la constitution de plateformes com-