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We are the Avatars of Ourselves

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Abstract

In human "Cognition", the so-called voluntary action is the reaction carried against a stimulus perturbing the psychophysical equilibrium of the mind; the aim of the reaction is either gaining the equilibrium quo-ante by stimulus removal or setting a new equilibrium. The questions are: "Who is in charge of the action-decision mechanism that opposes the stimulus perturbation and how does the mind manage the situation?"

"The Bignetti Model" (TBM) is the cognitive model that gives the answers. According to TBM, the mind is a tabula-rasa; whose cognitive mechanism is managed by the physiological dual-state of the mind: "Conscious Mind" (CM) (or explicit mind) and "Unconscious Mind" (UM) (or implicit mind"). UM has the computational task of ageing; if the stimulus is already known, UM might find the correct reaction paradigm already memorized in Long-Term-Memory, otherwise, it will find it by a trials-&-errors strategy. CM falsely believes to be responsible for UM's actions thus self-assigning a reward or a punishment. These incentives will function as a sort of "Conditional Learning" to upgrade Long-Term-Memory for future needs. It is noteworthy that CM may comply this trick only when the UM's action has been already made, i.e. with a few milliseconds delay.

TBM can be inferred from a series of functional aspects of the mind: 1) The mind is functioning as a dual state: UM and CM; 2) The binomial Ego-free will is an illusion of CM; 3) The mind is probabilistic-deterministic computational machinery; 4) Inner or outer stimuli may perturb the psychophysical equilibrium of the mind; 5) The mind is a "tabula rasa" with a trials-&-errors strategy that obeys to the cause-effect law. The paradox is that, even if these functional aspects of the mind underly an efficient cognition, humanity is suffering from an evident social and cultural degradation. During the toddler's age, the illusion of the binomial Ego-Free Willis installed by CM in the mind for an autopoietic finalty: "self-protecting from perturbing stimuli". Consequently, cognitive processes are certainly Self-oriented but not necessarily wise; the emotive, egoistic nature of this illusion is fundamental for cognitive mechanisms but sometimes prompts people towards false ideals and distorted life perspectives.

In conclusion, CM believes to have controlled real life when it becomes aware a-posteriori of UM's actions, i.e. with hundreds of milliseconds delay. Then, the individuals consciously live their lives as in a pre-recorded broadcast; the analogy of CM with the Avatar moving in a virtual game is striking.

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Abbreviations

AP: Action Potential, C: Consciousness, CA: Cathexis, C-E: Cause and Effect law, CM: Conscious mind, Ego-FW: Free will-possessing Ego, FW: Free Will, I: Imitation, LTM: Long-Term memory, P: Priming Effect, PD: Probabilistic-determinism, PI: Personal Identity, RT: Reaction Time, SA: The Sense of agency, SR: The Sense of Responsibility, STM: Short-Term Memory, TBM: The Bignetti Model, TR: Tabula Rasa, UM: Unconscious mind, 1PP: 1st-person perspective, 3PP: 3rd-person perspective

Introduction

Generally speaking, the re-establishment of the equilibrium of a chemical system in response to a perturbing, external stimulus is a classic example of how Le Chatelier's principles work: "In response to a change in concentration, temperature, volume, or pressure, a system is looking for a new equilibrium that may partly counteract the applied change". In various ways, researchers have reinterpreted and simplified this principle [1]; the basic idea is that the equilibrium may change either by physically modifying the relative rate constants of the single reactions involved in the equilibrium or by artificially adding or subtracting some of the chemicals.

The tendency of the mind to react against a perturbing stimulus either removing it, thus regaining the equilibrium quo-ante or setting a new equilibrium, just recalls the behaviour of chemical systems. However, the analogy of human behaviour with a chemical system is not completely pertinent. Chemical reactions follow a well-defined mechanism, in a way that can be defined "deterministic"; conversely, according to people's beliefs, the "so-called voluntary" reactions are decided by a Soul-inhabited Self or by an independent Ego that might intervene with the freedom of the will (FW). According to the folk definition of "so-called voluntary" action, this kind of action should not be mismatched with genetically pre-programmed ones (e.g. lacrimation in response to the irritation of a foreign body or salivation when chewing food, gastric secretion when smelling a tempting food, etc.). Most people believe that the binomial Ego-FW might overcome the restrictions of any natural law or principle; on the contrary, this review will report the evidence that Ego-FW is an illusion. The paradox is that, on the one hand, the logic and physiological mechanisms of consciousness are founded on this false belief; on the other hand, this illusion cannot be unveiled, since it plays a crucial role in all the cognitive aspects of people's life.

The paradox is well described in "the Bignetti Model" (TBM) [2-17] a human cognitive model that we have refined in many years of study (Figure 1) (Appendix). TBM is based on a probabilistic learning process

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sharing a strong analogy with other post-adaptive learning theories like Bayes' theory of conditional probability or Darwinian learning theory [2,4,6,14,18,19].

Recently, we have challenged TBM's reliability by carrying out a press-no-press psychological test with some university students [2,17]. Each test was made of 48 trials. Salt or sweet foods images were randomly and shortly projected onto a computer screen, at each trial. The students had to press a key as fast as possible, only in response to the sweet food image; the difficulty was raised by progressively increasing the number of food images introduced per test. The results were analysed by plotting all the reaction times as a function of the trial number. Each data set per subject gave a hyperbolic trend; typically, the curves we have obtained looked like Ebbinghaus' learning curves [20]. It is interestingly to note the student were not paid for their participation; though, they were happy to participate (indeed, they carried out very few mistakes in the test). The reason why we did not pay the students contrarily to what the majority of colleagues do in these kinds of experiments, was that we thought an external reward might have altered the agent's motivations.

The data of the test demonstrated that, at the first trials, LTM archive were void of information about the images projected onto the computer screen; so, UM opted in favour of a trials-&-Errors (T-E) behaviour. However, from trial to trial, the subjects accumulated experience; so, their reaction times became faster and faster. When the food images in each test were increased, the image recognition became progressivelly more and more difficult; so, subjects exhibited progressively lower reaction times and the learning curve became progressively flatter. However, the increase of complexity did not increase subject's mistakes (below 5%), thus demonstrating the adaptability and the resilience of the cognitive function upon different test conditions. The data were analysed using a computational method that was conceived as the best one in very different natural systems such as the study of the enzyme kinetics using "Michaelis and Menten" steady state conditions and Bayes' theorem applied to mental information processing [2]. The efficiency and reliability of these systems stand on a statistical computation that can be applied as a metaphoric background in the context of cognitive psychology. In other words, cognitive processes do not need a "driver of the car" or a Soul-inhabited Self possessing FW; in accordance with TBM, for an efficient cognitive system it is sufficient to install a computational system in the mind that may give rise to the Ego-FW illusion [9-12].

The rising question is whether CM's mechanism of learning might have something to share with the effect of motivations and rewarding of associative learning in animals. To answer, a reference to the old issue of "Cathexis" (CA) can be done. Long ago in some behavioural studies, Tolman demonstrated that voluntary action performance is determined by the incentive value of the outcome of the action

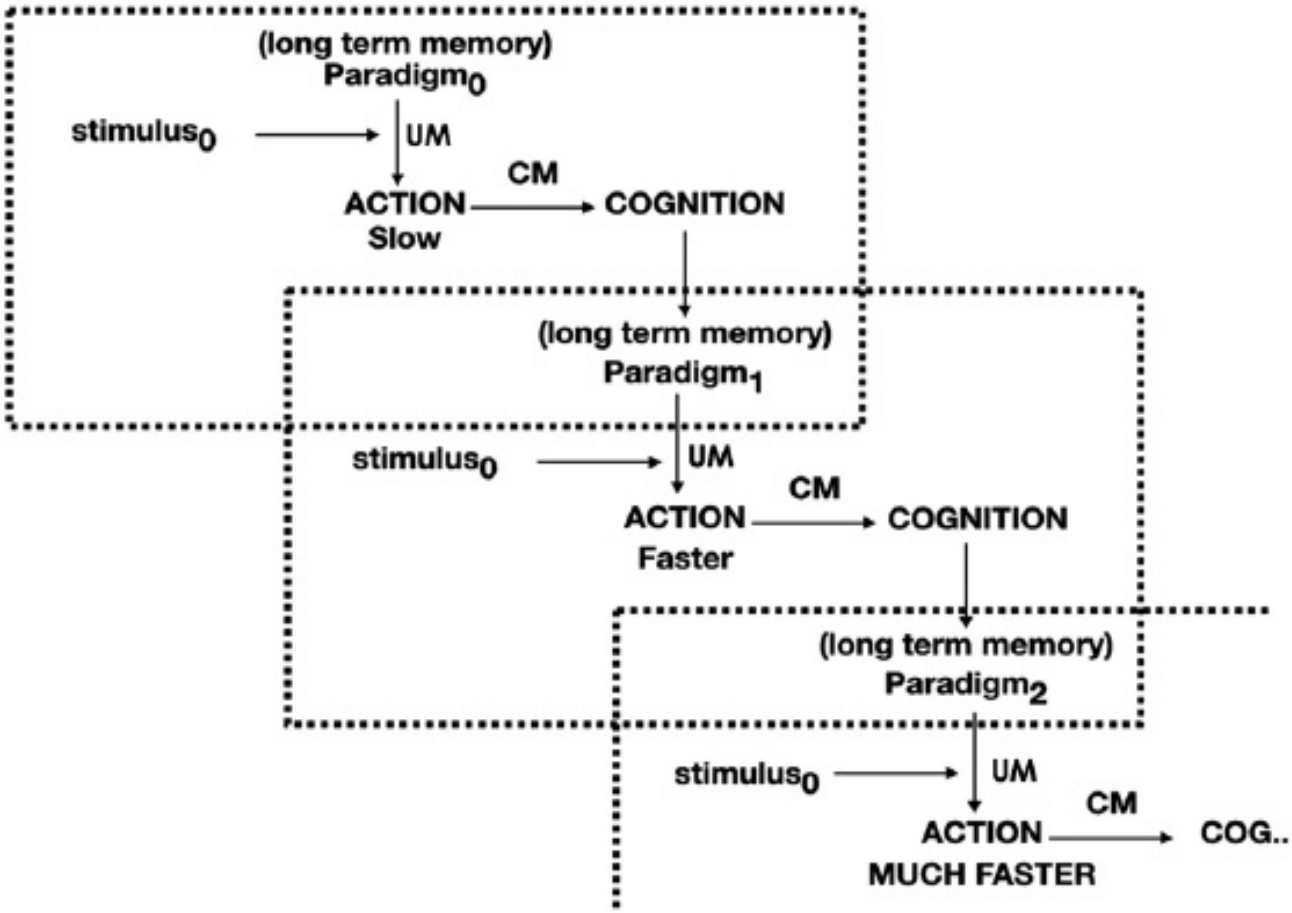

Figure 1: The Bignetti Model (TBM). UM reacts to a stimulus by choosing in LTM archives the most adequate paradigm within those used in the past. Then, CM receives the feed-back information of the action outcomes; among them, CM can extrapolate useful indications to update LTM. By repeating this protocol several times, the memorized paradigms become more and more efficient so the reaction outcomes progressively ameliorate (the success probability increases and the required time shorten).

itself [21-22]. In his theory, he introduced the concept of CA which argued that both animals and humans cannot predict the degree of the success of their actions unless they have already acquired a CA of what could occur in response to their actions; i.e., they cannot fully predict the intrinsic value of their actions unless they have already tried them. Unlike Pavlovian instrumental learning, Tolman's "CA" theory establishes that an unconditioned stimulus cannot automatically trigger a successful response. Thus, the representation of a meaningful incentive value is instantiated in the motivational system as a post-adaptive mechanism. The publication of the "CA" theory anticipated Dickinson's work and offered him an extraordinary tool for the interpretation of some experiments performed in rats, where the rats failed to drink sweet drinks when feeling thirsty for the first time due to sudden water deprivation [23-25]. Each motivational system may be fuelled by a specific incentive value. An ample variety of behavioural studies have taken advantage of the appetitive behaviour of animals and humans. According to Dickinson and Balleine [26,27], behaviour can be learned via two main motivational mechanisms: by the successful outcome of goal-directed instrumental action, or by the classic conditioning stimuli of aversive or appetitive reinforcement according to the composition of the food. Every time we act, we have the opportunity to test the relative efficacy of our incentives; thus, we may not only deduce something new about the stimuli, but we may also evaluate the adequacy of our motivational system. In other words, the cognitive processes and motivational systems appear to be linked because depending on the outcome of an action, we learn how to finely tune our motivational system for the future [4]. In this regard, it is an interesting consideration that FW constitutes a real psychological need of the conscious agent, to the extent that the two things are inextricably linked. so, we may deduce that cognition is a post-adaptive mechanism. Along with the coordinates of knowledge improvement, action will favour cognition and vice versa. This is a type of feed forward process. The role of CA as incentive motivation can manifest when the subject has made at least the first attempts employing T&E. However, after this initial experience, by which kind of computational skill the subject might be helped to go successfully to the end of the test? As we'll see next, the "Priming Effect" (P) might be envisaged as the computational skill that will correctly bring the subject to the end of the pathway.

Years ago, by studying neural networks, Dolan O. Hebb [28] proposed a new way of intraneural connections without the intervention of synapses: "When an axon of cell A is near enough to excite cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased". This statement paved the way, on the one hand, for further studies on the mechanisms of synaptic plasticity and the possible link with memory formation [29] and, from the other one, for a mechanistic interpretation of P whose psychological mechanism says that the exposure to one stimulus influences a response to a subsequent stimulus, without conscious guidance or intention [30-31]. In Psychology, there are many examples of P: semantic, perceptual, conceptual, repetition, masked, associative, responsive etc. In our society, P has found a major application in marketing and advertisings. In cognitive processes, according to TBM, CA has been envisaged as the embodied, incentive motivation that will push ahead of the subject at any trial, but P might play the role of indicating UM the right paradigm to choose at any trial, on the basis of preceding experience. Then, C, I and P might cooperate in cognition thus underlying a successful cognitive experience.

Part A –TBMWAS Inferred from Scientific Evidences

The mind is functioning as a dual-state: unconscious and conscious mind

Recent reviews reported that the mind emerges from the brain as a "dual state of the mind", i.e. with two functional states: the unconscious mind (UM) or implicit mind and the conscious mind (CM) or explicit mind [16]. An interesting table in the review of Baars and Cage [32] summarizes the different functions located in UM's and CM's domains, respectively (for instance, LTM and Short-Term-Memory (STM) belong to UM and CM, respectively etc.). Then, CM and UM exhibit different functional processes. CM can manage thoughts, music and images; moreover, it hosts the short-term-memory archive. While, UM can communicate either with CM at the intellectual centre and with the sensory and the motive structures at the periphery; moreover, UM hosts the LTM archive. It should be noted that the distinction between CM's state and UM's state is neurobiological and has nothing to share with Psychoanalysis.

To exploit their functions, CM and UM adopt two different languages: the mother's tongue inner speech (that is learnt since birth in a familiar environment), and the biophysical-biochemical language that is genetically inherited, respectively. Though belonging to two different functional domains, CM and UM cooperate, in cognitive processes. CM and UM reciprocally communicate by cross-translating their languages; the mysterious mechanism of cross-communication has been indicated by the author as the hint of "The hard question of consciousness" [13].

As a neurobiological example, the mechanism of fear conditioning could be noticeable. Fear conditioning that was exhaustively studied in the Amygdala [33,34], is a specific form of associative learning that required the interplay between conscious and unconscious nervous mechanisms. The perception of a fear stimulus is first intercepted by Thalamic nuclei; the subsequent defensive reaction of the Amygdala occurred in two ways: the longer route mediated in between by the cortex or the shorter route involving only a direct Thalamus-Amygdala communication. In the longer route, the intermediate role of the cortex added a more detailed cognitive conceptualization of the signal, thus delaying the overall process; while, in the shorter one, the unimodal route provided a fast automatic response to repetitive alert signals that did not require a further conceptualization.

To better understand the asynchronous but cooperative activities of CM and UM in cognitive behaviour, Bignetti [15,16] reported an example of real-life in which several interventions of UM and CM alternate, respectively (Figure 2). In short, when we feel the need to communicate a message to somebody else, this means that we unconsciously deliver the information from UM to CM; so, the translation mechanism makes the biophysical-biochemical signal (stimulus) a phrase comprehensible to CM, by using "inner speech" (note that thoughts, music and images can be elaborated within the CM's domain); then, the phrase is delivered to vocal organs by translating the CM's message into a series of electrophysiological UM's language. Then, we can vocalize the message and send it to the mobile's microphones. To this aim, the information assumes different physical energy sources (air vibrations, electronic etc.). Now, the physical energy of the message had nothing to do either with UM's or with CM's languages; so, how can we know that the message has been correctly sent? Of course, our ears capture the message and translate the vibrational energy of air into UM's language and this is sent back

to our CM. Here, the information is made again comprehensible, being translated again into syllables, words, thoughts etc…As one can notice, UM and CM are different states of the mind thus working with different functions, though they cooperate for the same cognitive purpose. The further interesting conclusion we can draw, is also that the information is highly conserved along the chain of signal translations that occurred from UM and CM and vice-versa (in other terms, the information is highly preserved even at long distances thus indicating that the mind is obeying to the Cause-Effect law, see below).

According to Bignetti [15,16], "The dual state of the mind" is the early dualism of the mind that gives origin to the second dualism, "The double-perspective of the mind", from which, in turn, emerges the third one, "The Cartesian-like dualism". Since their intrinsic functions evolve from mostly physiological to mostly psychological, they necessarily exhibit different impacts on "Cognitive processes". The second dualism emerges from the thinking domain of CM and manifests two opposed ways of thinking modalities: "The first-person-perspective" (1PP) and "The third-person-perspective" (3PP). Then, CM's processes may be distinguished either in subjective, emotional and self-referential, typical of a 1st-person perspective (1PP), or in the objective, rational and scientific, typical of the 3rd-person perspective (3PP). Neither 1PP nor 3PP can give an absolute, objective definition of "consciousness".

The binomial ego-free will is an illusion of CM

The kind of FW to which people always refer is: "the particular sort of capacity to choose the rational course of action from among various alternatives "the power to make your own decisions about what to do, without being controlled by God, fate or circumstances, that will lead to a successful effect. This is a folk FW definition that fully corresponds to the psychic motivation conveyed by an agent to justify the decision of a "so-called voluntary" action. Any further philosophic or sociologic FW definition adds nothing of concrete and is acceptable to the agent's motivations. Any intellectual elucubration on FW may be fascinating for the soft sciences, but it will not match the folk definition beloved by an agent.

Since antiquity, the philosophical issue of free-will (FW) has generated hard discordances. The antithetic term of freedom is determinism; actually, one term mutually implicates the other. The C-E law (or causation) has been usually considered an obvious consequence of a deterministic view of nature. People have a peculiar idea of FW. People believe in C-E law since they conceive the action-decision mechanism as obviously conditioned by the cause (the stimulus) to get a successful effect. So, nobody should escape the false "choice" of an action-paradigm that, by experience, is well known to be the most correct and proper reaction to do. Paradoxically, the "choice" is strongly conditioned; though, in people's minds, it looks like a decision based on FW. That's why the debate between freedom and determinism (or causation) is still lively.

According to Mills [35], the conundrum about the question of agency could be tentatively solved by considering FW a "conditional FW" or by assuming a "psychic determinism", i.e. by introducing "an unconscious agent for determining the material expression of conscious choice and action". In economic choice theory, reward shows its utility in compelling the action-decision mechanism. According to Schulz [36], utility is the formal mathematical characterization of subjective value and a prime decision variable, since it can incorporate various influences, including risk, delay, effort, and social interaction. The neuronal reward signals are guiding behaviour while constraining the free will to act. Since, the C-E law draws the "so-called voluntary" action whose rational motivations are to remove the stimulus and re-gain the equilibrium quo-ante, or to set a new equilibrium, Mill's "psychic determinism" (according to which the freedom of unconscious internal forces may operate on causality and intentionality outside of human CM) is an absurd hypothesis. Under the recent pieces of evidence of a dual-state of the mind, Mill's perspective is quite confusing: "How might Soul-inhabited Self be responsible for choices and actions under CM's will, though these

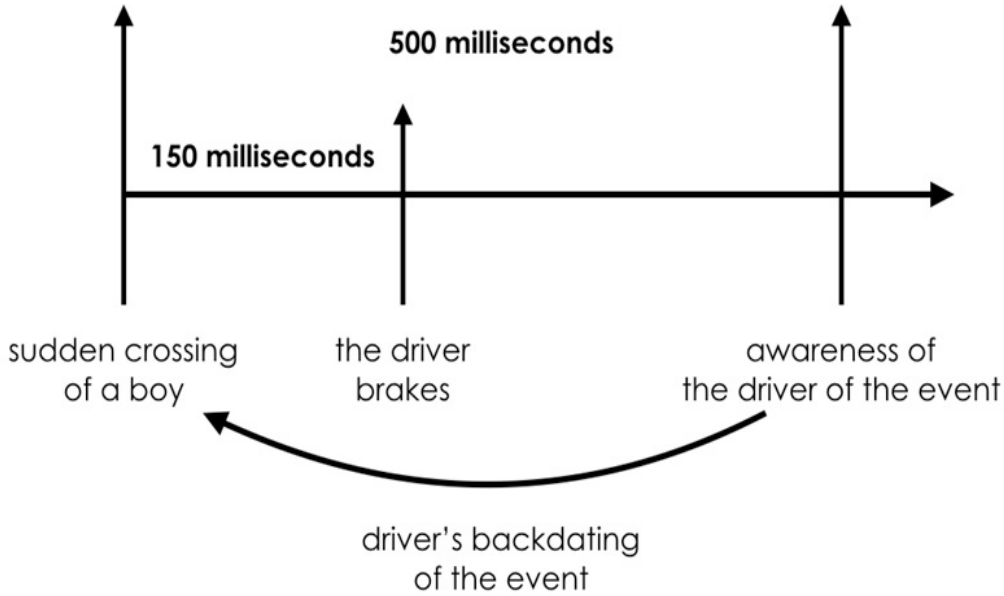

Figure 2: A distract boy suddenly crosses the street (time 0) but the driver brakes immediately (in 150 milliseconds). Since time 0, the driver takes 500 milliseconds to become aware of the entire event. The driver might bet to have consciously seen the crossing boy 500 milliseconds ahead (backdating).

activities are located in UM?" With a euphemism, Mills shuffles the deck by concluding that freedom and determinism are the same!

Some scientists mistake the freedom of the will leading to voluntary decisions, with a spontaneous activity of the mind. However, for other scientists, action decision making cannot occur at random; rather, it is motivated to obtain a fruitful experience. Amelioration of cognitive processes moves from a fruitful experience to a more fruitful one and so on. So, it seems reasonable that an agent might exercise the right of deciding based on the freedom of the will. This should lead a scientist to avoid attributing FW of spontaneity unless FW might be more deeply investigated inside according to Lavazza's proposal [37]. According to him, FW might be conceptualized, operationalized and, then, measured. Factors to be measured could be the external cues and other factors, including those that might be called "will" and "reasons", in crossing the critical threshold of the spontaneous activity of the brain. He says: "*This may also allow one to create a quantitative index, albeit still quite rudimentary, of the degree of freedom of each subject. This freedom would be specifically defined and therefore may not perfectly coincide with the intuitive concept of free will. Starting from these functional indicators, which psychology has well clarified, one could then move on to investigate the precise neural correlates for a different and (possibly) more fundamental level of explanation in terms of brain processes that enable the executive functions*".

A different way of approaching the question of FW has been proposed by physics, considering the potential impact of Quantum Physics in real life. Based on the success of this branch of research, some scientists have seen a possible dependence of the sub-microscopic events of psychic processes, on the "Indeterminacy law" [38]. If this dependence were true, the mind might not be able to predict the future, thus opening the door to FW existence [39,40]. The discussion on this issue was also investigated in our recent works [12,15]. The apparent paradox is that "the real" might hide a sub-microscopic word with quantal properties, though appearing to the mind as a macroscopic word that obeys classic physical-chemical laws. In other words, the ensemble of sub-microscopic events that underlie the biophysical-biochemical word of the brain, surely "obeys" the "indeterminacy law". However, the psychic domain of the mind is unaware of this hidden mechanism, since every minimal detail of the real world that can be seen and measured by our mind ("entanglement"), is determined by a macroscopic mean of a large number of microscopic events, varying in space and time; this result appears statistically stable and predictable, i.e. it is probabilistically determined and easily interpretable by people [41]. This hypothesis holds for the stimulus (cause) and the reaction's outcome (effect). Upon repetitive stimulation, our reactions will become more and more efficient, that's why TBM gambles on the efficiency of the C-E law [12]. This inference leads also to conclude that the indeterminacy which quantum scientists are talking of, is irrelevant from the TBM point of view: the mind is conditioned to work in a macroscopic dimension. When a stimulus is striking our mind, the objective nature (if any) of the stimulus is subjectively interpreted by the mind, i.e. it is transduced into a piece of neurobiological information that is semantically compatible with PI content.

In this debate, a shred of clear-cut experimental evidence could be counter-posed by neurosciences [4,16]; a famous example has been given by Libet [42,43] who studied the dynamics of voluntary action by EEG. He discovered that the "intent to act" (the conscious activity of the mind) is hundreds of milliseconds later than the "early readiness potential" (the unconscious activity of the mind). Then, he discussed which impact might have this evidence on everyday life. He proposed that the agent might undergo an unconscious backdating; so that, he might assume the fictitious responsibility of the action-decision mechanism (see Figure 2). Libet was hesitant whether FW did exist or not; maybe, the circumstances or the context of something else, convinced him to find a compromise, i.e. during the intermediate time to perform the action, the agent might have the time to refuse it bygrasping a free "won't". His idea is anyhow unsustainable since the "won't" would be a secondary reaction that will take further time. So, a chain of "won't" of "won't" of "won't" and so forth… might be triggered with a deadlock of the mind.

The alternative solution to Libet's proposal comes from TBM [9]. According to TBM, the witnessing activity of CM becomes aware of the action only in the right moment of the performance, when feedback sensory perceptions of the action attracted the attention of CM; in other words when UM's action-decision mechanism and performance have already occurred. Due to hundreds of milliseconds delay, individuals always live a pre-recorded life. 1PP cannot describe the cognitive processes (i.e. Action and Cognition) in a self-detached way. This might occur only when the cognitive moment has been concluded; only then, 3PP (i.e. the other way of thinking of CM based on the objective, rational and self-detached perspective, typical of a scientific analysis of daily life events), can be engaged. 1PP sustains cognitive process by believing in FW, thus considering the agent responsible for the "so-called voluntary" action; while, 3PP may intervene after the cognitive processes, by unveiling 1PP's lies and tricks in cognition.

The question that arises is why does 1PP grasp so tightly the idea of possessing FW, though believing that the C-E principle is correctly driving our decisions? The folk idea of possessing FW will never steer an action but will function as a necessary basis for the arousal of cognitive processes. Then, questions still unsolved are: "Which is the psychological origin of a so strong belief in the binomial Ego-FW and how does it rise?" it might be interesting to overview two independent interviews that were made to know how the subjects considered their actions in comparison with others' actions (here, for sake of simplicity we may call group A and group B, respectively) [44,45]. In particular, group A was asked whether their actions appeared as determined by the freedom of the will. As statistically expected, the answers were mostly "yes". Then they were asked how they considered B's actions, in their eyes. In most cases, A tend to refuse the intervention of Ego-FW in B's actions, adducing several conditioning reasons like destiny, personal or natural overwhelming forces etc…

The authors of these experiments could not give a psychological explanation of the divergent result. To the solution of this ambiguity, we might contribute by saying that people have a folk idea of the meaning of FW which does not coincide with any sophisticated philosophic principle or conceptualization. Any effort the philosopher of the mind might do to explain the existence of FW through a complex-mysterious meaning is useless. Any voluntary action is egocentric, self-referential; so, the origin of the belief in FW must be simply looked at in the self-defence mechanism of PI maturation. Then, a possible explanation may come again from going back to the early stages of an individual's life, the toddler's age, i.e. the same age we have attributed to PI maturation. Toddler's age is characterized by the most fruitful phase of social and affective interactions with the environment. This phase is known as crucial for children's growth since it is characterized by the greatest development of cognitive, social and emotional stages in humans' life [46,47]. An emotional outburst, usually associated with

children of that age, in emotional distress, is known as a tantrum. In most cases, the tantrum is associated with frustration, anger or other emotions that children do not know how to deal with. However, the tantrum is one of the most common forms of problematic behaviour in young children but tend to decrease in frequency and intensity as the child grows older. The toddlers' critical age, interests us mainly for two milestones: 1) the first one is the awareness of a Self; at about the age of 1-2 years old, a child will begin to recognize herself/himself in a mirror as a separate physical being; the presence of her/his PI with thoughts and actions are early perceived; 2) The second behaviour we would like to consider is the toddlers' phase of "Bossy" with parents and caregivers; orders them around and the phase of "No", i.e. the refusal to withstand their commands and rules; this phase reveals a dare to dictate their own will upon the others' one (https://www.motherforlife.com/baby/13-36-months/psychology/1392-the-no-stage.thtml;http://www.parkchildcare.ie/how-to-deal-with-the-no-phase.html).

As it regards the second issue, we have proposed a further interpretation of the "No!" that a toddler says to the parents during Tantrum: this behavior underlies the arousal of the Sense of FW. In the tantrum, the toddler lives a fundamental step of his PI maturation, not only the bodily mechanism of self-recognition but also the idea that, through FW, he may decide his/her daily-life behaviour, instead of the parents; in fact, with the "No!" the toddler confronts them (actually their freedom of the will) to borrow the same will. The "No!" embodies a psychological fight during which the toddler tests the possibility of having the same freedom of the will of the parents, i.e. an unconditional will. If the repetitive "No!" will achieve some kind of result, then, sooner or later, the individual will acquires FW, i.e. a psychological instrument that, according to TBM, will enrich the Ego sense of an extra-cognitive power.

In summary, the crucial question is: "how is it possible that complex and sophisticated psychic functions such as human behaviour and cognition, were managed by two physiological states of the mind, i.e. UM and CM, without the extra-force of a Soul-inhabited self (or without a "the driver of the car" as Dennett would say [48,49]. To reply to this question, a reliable cognitive model should indicate the presence of a computational machine in the mind (i.e. in UM and CM) that might manage the psychic situations on a statistical basis. In this regard, TBM seems to fulfil the demands. In TBM, the C-E law seems to work as the intrinsic psychological motivation that moves an agent against a perturbing stimulus; on this basis, a computational, statistical machine might well elaborate the action-decision mechanism occurring in UM. The same kind of mechanism can be envisaged to justify the cognitive processes (i.e. learn and memory) occurring in CM; these processes cannot be elaborated by an independent Ego (Self or Soul-inhabited Self), since he is only a virtual presence in CM. Then, to escape from this deadlock situation, the computational statistical machine of the mind intervenes by creating the virtual Ego-FW, i.e. the illusion of it; using this tricky mechanism, the binomial Ego-FW will be able, as an extra-force, to manage CM's activity [7-9].

The mind is a probabilistic-deterministic computational machinery

The single elements (subcellular structures) that constitute the system will comply with a collective predictable behaviour according to the "probabilistic-deterministic" (PD) mechanism. In practice, to better understanding what PD is, one might observe the Galton's machine as a physical model [5,16]. Many balls released on top (the cause), will randomly bounce on pins when falling. The probability to predict the end position of each ball, taken as a unique representative of the overall system, is very scarce; conversely, the end of all the balls, collectively taken, will exhibit true global effect with a "normal" distribution, i.e. a mathematically pre-determined effect. In other words, a complex system might exhibit a deterministic C-E relationship, by integrating into space and time the behaviour of a large number of its randomly-moving constituents. Some other representative examples of PD are [5]: 1) The microscopic collision of ideal gas behaviour and the macroscopic behaviour described by Boyle's law; 2) The microscopic productive enzyme-substrate collisions in enzymatic catalysis and Michaelis-&-Menten's enzyme-kinetic equation in steady-state conditions [2,17]. The macroscopic behaviours of gas and enzyme catalysis can be interpolated as a mean, by mathematical equations; however, these equations hide a large number of unpredictable microscopic events. In conclusion, the true "Cause" and the real "Effect" become evident only by carrying out a reductionist approach, thus going from the macroscopic level down to the microscopic one [5].

For those who want to reconcile with reductionism, the PD behaviour is underlying the functioning of the cellular and sub-cellular elements in the brain [5,50]; striking examples are exhibited by voltage-sensitive Na+-channels, synaptic excitatory and inhibitory vesicles of synapses; synaptic vesicles of the end-plate junction, the visual cells in the visual area of the brain, etc… As an example overall, the activity in neuronal membranes of the voltage-sensitive Na+-channels can be reported. These channels are integral membrane proteins that may assume several conformational states only one of which is the "Open State" (permeable to Na+ ions); the "probability" of being in the "Open State" when the train of Action-Potentials (AP) come close is very low; in fact, the response of any single channel is unpredictable, i.e. random. However, if we analyse the collective response of all the channels in that membrane patch that is invested by AP, gives a mean response that deterministically permits AP travelling across. To this regard, a first important inference can be drawn: "the membrane patch can be excited only by the arrival of specific AP; by itself, it will never produce random AP".

Another interesting inference can be drawn by observing that the frequency of AP might be finally tuned by inhibitory or excitatory synapses coming from neurons of other brain areas [50]. These synapses might respectively reduce or enhance the probability of having the Na+-channels in their "Open State". As a consequence, the patch might play a filtering effect on AP, thus enhancing or reducing the "frequency" of AP travelling across. In this regard, it's known that AP frequency precisely corresponds to a piece of given information, so, the frequency modulation of AP due to the computational output of other brain areas will finely tune the information content.

In summary, the brain exhibits PD at the microscopic level; this behaviour is compatible with Hodgkin & Axley formalism at the macroscopic level. This conclusion is striking since it suggests the concrete hypothesis that the mind may emerge from the brain. PD mechanism seems to offer the tools to manage the stimulus in an adequate, concrete, coherent and punctual way, compatibly with the C-E law.

Inner or outer stimuli may perturb the psycho-physical equilibrium of the mind

First of all, let's define what we intend with "psycho-physical equilibrium of the mind" (a); then, we'll approach the issues either

regarding the semantic nature of a perturbing stimulus and the cognitive impact it might carry on the mind (b):

1. The inner equilibrium of the mind, in the absence of external stimuli, corresponds to a physiological and biochemical state of a low resting activity that looks like a single, never-ending thought [20], lacking any emotional turbulence. This basal work spends most of its time instantiating patterns of activity that are in between identifiable mental states. Area of basin attractors in the resting brain seem to be located everywhere, just are waiting for the biophysical-biochemical signal of a perturbing stimulus; when this signal goes nearby, the attractors "go wide" self-attracting and then spreading it to other basins, thus "playing" like a bouncing ball in a pinball machine [13,14]. Some authors [51] have demonstrated that when the activity of the resting state is somehow high, the brain would lead to low levels of stimulus-induced activity after the onset of the stimulus; while low pre-stimulus activity entailed high stimulus-induced activity. In other terms, the relationship between pre-stimulus and stimulus-induced activity levels was characterized by a reciprocal relationship. Then, the pattern of rest-stimulus interaction is non-additive. We may tentatively explain this behaviour under a cognitive perspective, by considering that such a mechanism could favour a more efficient response to outer stimuli; a stimulus might receive a better (more global) attention when the inner state is highly receptive, not distracted by other perturbing signals, i.e. in a very relaxed, "meditative" ground.
2. As it regards the semantic content of a stimulus, let's assume now that we have never seen before, i.e. that, at present, it is unknown to our mind according to the hypothesis of the Tabula-Rasa. So that, for the first time, the impact on our behaviour might be unpredictable. In this regard, we might say (just to resume the hyperbole of the pinball machine) that the player who is not accustomed to a pinball, is timorous to shake the machine too vigorously; so, without his physical shaking, the ball will get out of play very fast with a low score. The opportunity to repeat this experience several times gives the individual mind the way to learn how to react properly against the stimulus (please note we are talking of "aware, voluntary actions", not of the genetically pre-programmed ones). So, in conclusion, first reactions against a stimulus might be casual; then the target will be tuned by repeating the cognitive experience. Then, after a learning process, the stimulus will be finally identified, and the correct paradigm to react to it will be memorized; so, the player's reactions will become fast and automatic.

The essence of this reasoning is that the human mind behaves like a thermodynamic system; once perturbed by a stimulus, the mind activates appropriate cognitive processes to regain a ground unperturbed equilibrium. As far as it regards us, "motivations" that move cognitive processes are analogous to those predicted by Le Chatellier's principle for chemical systems. Though belonging to different systems, both the mind and the chemical system point to an equilibrium with the lowest Gibbs' free energy ($\Delta G^\circ \rightarrow 0$). The main difference between the two is that the mind should never reach a $\Delta G^\circ = 0$, otherwise it will die. The evidence is that a quiet mind shows a yet minimal electrophysiological background; this continuous activity is an endothermic process that, though low energy consuming, must be coupled to a minimal though sufficiently exothermic, biochemical metabolism. The arrival of a stimulus would excite the mind, thus causing a rapid unbalance between the endo- and exothermic processes; the unbalance might be even more evident, if the stimulus is unknown, thus making its recognition an energetically more difficult task.

The mind is a "tabula-rasa" with a trials-&-errors strategy that obeys to the cause-effect law

The modern contribution to the idea of the mind as a T-R goes back mostly to the empiricist John Locke [53]. In Locke's philosophy, the (human) mind at birth is a "blank slate", without rules for processing data, and that data is added and rules for processing are formed solely by one's sensory experiences. Tabula rasa meant that the mind of the individual was born blank, and it also emphasized the freedom of individuals to author their soul. Since Locke, different scientific disciplines have critically analysed T-R as a possible feature of the mind.

In Psychoanalysis, Freud depicted personality traits as being formed by family dynamics (see Oedipus complex). Freud's theories imply that humans lack free will, but also that genetic influences on human personality are minimal. In Freudian psychoanalysis, one is largely determined by one's upbringing.

Other psychologists together with some neurobiologists proposed that the mind is pre-programmed computational machinery. Initially, the entire cerebral cortex is programmed and organized to process sensory input, control motor actions, regulate emotion, and respond reflexively to learn and refine the ability of the organism. For example, psychologist Pinker [54] showed that, in contrast to written language, the brain is "programmed" to pick up spoken language spontaneously. Important evidence against the T-R model of the mind comes from behavioural genetics. Critically, multivariate studies show that the distinct faculties of the mind, such as memory and reason, fractionate along genetic boundaries. Cultural universals such as emotion and the relative resilience of psychological adaptation to accidental biological changes, also support basic biological mechanisms in the mind.

In Social sciences a different hypothesis was done; for instance, twin studies of social pre-writing behaviour have resulted in important evidence against the T-R model of the mind. Researchers concluded that people born with a genetic wiring to be social [55]. To some extent, newborns most likely have genetically inherited their identity with that specific social behaviour.

Moreover, in artificial intelligence (AI), T-R refers to the development of autonomous agents with a mechanism to reason and plan toward their goal, but no "built-in" knowledgebase of their environment. Thus, they truly are blank-slate agents. Though, we may argue that, even if the data-set is empty, there is a built-in bias in the reasoning and planning mechanisms (in computer's language we might call it the specific "soft-ware" that must obey the limits posed by the hardware). Either intentionally or unintentionally placed there by the human designer, it thus negates the true spirit of T-R. A synthetic (programming) language parser could be considered a special case of T-R; it is designed to accept any of a possibly infinite set of source language programs, within a single programming language, and to output, either a good parse of the program or a good machine language translation of the program, Both situations may lead to a success or a failure, and nothing else. A successful example of the application of the T-R concept in AI was the superhuman performance that algorithm AlphaZero achieved in various board games. The paradigm introduced was the use of self-play and T-R reinforcement learning.

For the sake of knowledge, we should specify that "Reinforcement learning" (RL) is an area of machine learning concerned with how intelligent agents ought to take actions in an environment to maximize the notion of cumulative reward (see Figure 3, taken from wiki).

The crucial question now is whether T-R is a winning concept also in Cognition. To this aim, the author has deeply investigated this issue in the past. The obvious conclusion was that humans inherit from the parents the genetic predispositions to sensory input perceiving, motor actions controlling, affective or rational thinking, language phonemes managing etc… However, this conclusion did not mean that this inheritance should include also all the knowledge and the operational skill that are archived in LTM; it simply meant that the epigenetic forces might cultivate the interactions with the surrounding life, in a pre-fertilized ground and with specific (although limited) cognitive instruments, both offered by the genetic inheritance. Experience after experience, along with the lifespan, the cognitive processes of learning and memorizing will fillup the lemmas of the LTM archive. Moreover, the old studies on classical and operant conditioning have already demonstrated that the reward-punishment binomial affects belong to the epigenetic instruments that motivate cognitive processes in a feed-forward mechanism [10,55]. LTM upgrading seems to be a never-ending story of our life and is made of tiny steps of amelioration one after the other. Long ago, Ebbinghaus [20] has shown that learning of a sequence of symbols is a process that gives an upright branch of the hyperbolic curve as a function of time; on the other end, when stimulation is finished, the oblivion curve shows asymmetrically reverse shape. Ebbinghaus' experimental session of memory up- or down-loading lasts only minutes; then, can it represent the learning and the oblivion processes of the individual mind, during an entire life?

The rooting of PI and self-awareness in the individual who is growing up is an interesting case. One should note that people find it difficult to remember all the experiences and the efforts that they have metabolized from the first days of life to adulthood. In particular, the toddler's age (i.e. the first three years of life) (https://medical-dictionary.thefreedictionary.com/toddler) is the most crucial to this purpose [12], since the individual can learn a lot of things like walking, using spoons, eating by himself, inner speech, using toilette, etc.; yet, it is mostly concealed to the adult's CM. Ata toddler's age, The development of PI (in the sense of bodily recognition) can be provided by several mechanisms, e.g. the self-identification in a mirror (the mirror-test was amply described by using chimpanzees by Gallup [56]). About the definition of PI, there are a huge amount of philosophical hypotheses (https://iep.utm.edu/person-i/); however, the most accepted definition is the folk-reductionist one, which draws special attention to the "bodily-persistence" (especially seen at the mirror) and the "bodily-distinction" from others. An adult takes for grant that this kind of PI is persisting through time. When getting old,

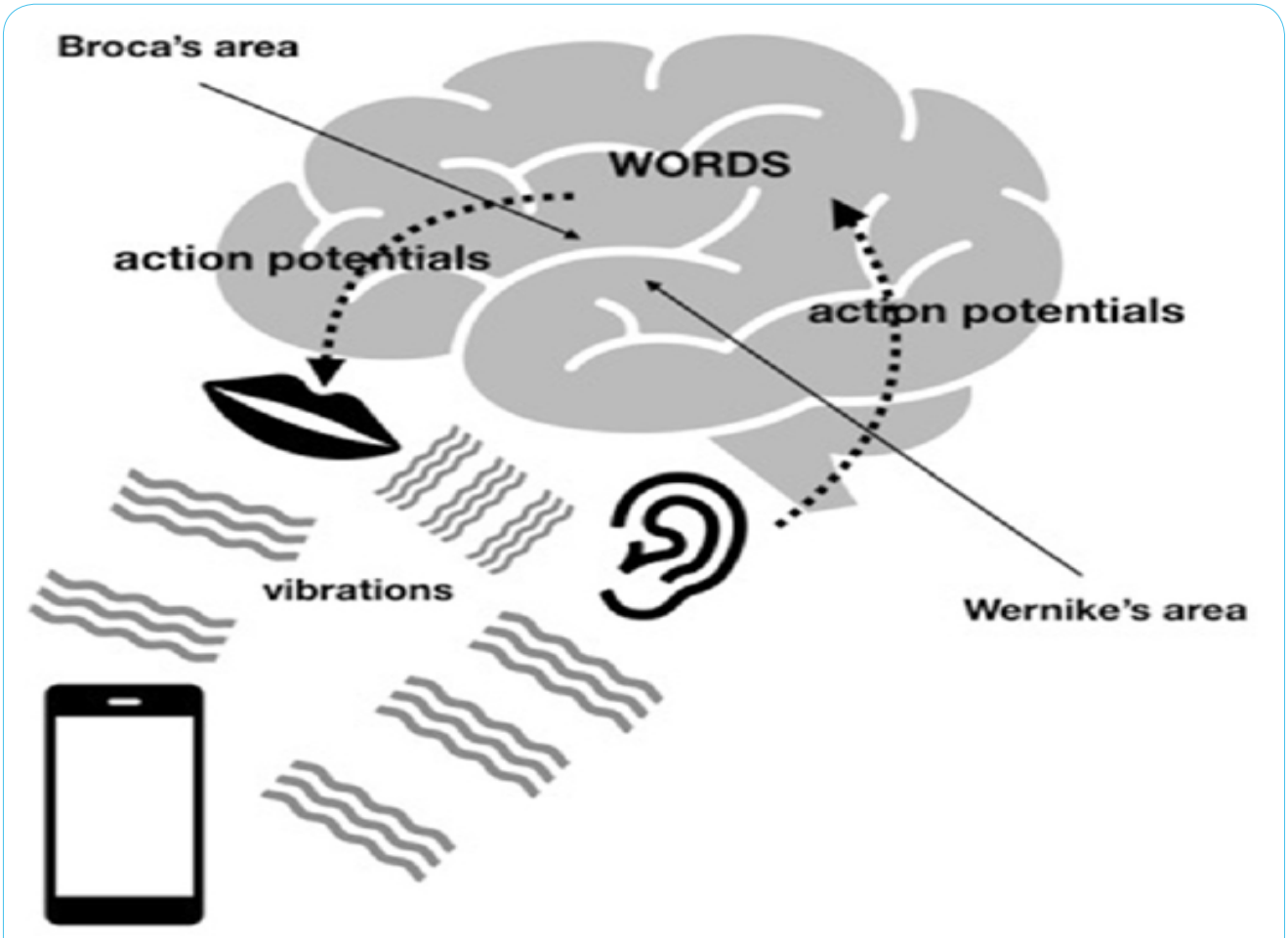

Figure 3: UM and CM cooperates and dialogue to each other in order to interact with body and world. UM utilizes a biophysical-biochemical language, while CM utilizes a mother's tongue language made of words. The dialogue between UM and CM is occurring by means of a reciprocal translation of one language into the other. In this example, it is schematized the circuit of different signals that are implicated in a conversation with a mobile.

oblivion has cancelled the affective contours of the past experiences becoming rare and all different; but it could not cancel the repetitive (quasi-)identical stimulus of bodily appearance, day after day. The steadiness of PI through different situations crystallizes; so, the idea that PI might be the core of self-consciousness rises in LTM. Though, PI is only a box where an individual can introduce all the daily life experiences that directly impact on feelings and character; so, when PI's "content" is established, the individual will forget very soon the features of the box, thus adapting the behaviour to the uploaded rational and affective features of the character. As seen above, the toddler's age is the priming step of PI growth. We are convinced that self-identification and self-distinction from the others are PI's features that necessarily precede further mechanisms, like the "embodied simulation" that should share social identification, empathy, and "we-ness, thus grounding the meaning of actions, intentions, feelings, and emotions with others [55,57]. To this regard, we should mention a work that empathy can be learnt.

From a psychological point of view, the individual trusts in his PI and would not call in discussion his bodily persistence. However, he might challenge his conviction by looking at very old pictures or videos when looks younger; at a first glance, he is used to making a comparison of his present image with the older one, at times getting embarrassed at the bodily discontinuity. The interesting thing is that bodily persistence (either in a static position or a move) is a primary criterion of self-recognition operating through different animal taxa. As an example, dogs offer an interesting opportunity of observing the dynamics of personality arousal. A marvellous self-recognition test can be made with puppy dogs either at the mirror or at the TV. Some training at the mirror will be necessary before the puppy will be indifferent to his reflexed image, at the opposite of which the animal will become interested in the images of other animals on the TV screen. The funny thing is that he will look for these animals behind the TV screen or out in the garden, yelping and growling too (personal observations).

It has been demonstrated that Self-recognition at the mirror can be carried out by primates, birds and also, exceedingly interesting, by fish [58]. The "mirror self-recognition" test with the cleaner wrasse Labroides Dimidiatus, has demonstrated that: "1) social reactions towards the reflection, 2) repeated idiosyncratic behaviours towards the mirror and 3) frequent observation of their reflection. When subsequently provided with a coloured tag in a modified mark test, fishes attempt to remove the mark by scraping their body in the presence of a mirror…" The marks of the test seem to demonstrate that fishes possess self-consciousness; however, the authors themselves seem to exhibit some doubts since such a conclusion might upset the general agreement on the distinctive quality of human "intelligence" and "consciousness" concerning other species and taxa. The old idea of the supremacy of men on nature seems to reduce in a sort of preconception. Yet the notion of human consciousness is an unresolved issue for which Chalmers [59-61] coined the sentence: "the hard problem of consciousness". Several authors suggested solving the question by investigating the functional properties of consciousness, also called "Neuronal Correlations to Consciousness" (NCCs). In this regard, Chalmers [61] proposed: "Once we know which systems are NCCs, we can investigate the mechanisms by which they work, and how they produce various characteristic functional effects. Just as isolating the DNA basis of the gene helped explain many of the functional phenomena of life, isolating NCC systems may help explain many functional phenomena associated with consciousness". However, despite the striking progress in neurosciences and of the different models proposed so far, the basic questions on the nature, origin, and functionality of human consciousness are still a mystery [3,5-6,10,11,13,15,16].

In the scientific literature, it's easy to find that "operational definitions" are erroneously substituted for "scientific definitions". The definition of what can be explained, predicted or measured requires the use of "scientific" (or "absolute") terms; it cannot be satisfied by "operational" (or "relative") terms. What is stigmatized by Hibberd, [62] should discourage anyone from giving an absolute, objective, scientific definition of Consciousness based on the study of NCCs. Said that asking the conscious mind to give a scientific definition of itself is also paradoxical, as asking an eye to watch itself; the conflict of interest in these cases would be unsurmountable [13].

Going back to the main issue, we may briefly present the old philosophical paradox of Buridan's ass; it refers to a hypothetical situation wherein an ass is placed precisely midway between 2stacks of hay and the decision where to eat first is difficult. The number of hypotheses done in the scientific literature was unbelievable! Three possible hypotheses seem to be most adequate to analyse the context "FW vs Determinism":

1. **The great defect of Hard Determinism:** "I'm hungry but nobody told me which stack to choose first?" The ass will not decide and will die of hunger;
2. **The great defect of true indeterminism:** "I'm really hungry?" The ass will show an un-coherent behaviour and die as well!;
3. **The great advantage of a probabilistic-deterministic system:** "Probably I'm hungry!" Stochastic events (random choice) will help the ass to approach either of the 2 stacks and start grazing. In conclusion, the 3rd option would correspond to the most resilient and adaptive cognitive system since the ass will not starve. Moreover, we presume that once the first sack is finished, the ambiguity has been resolved and, due to the ass's hungry, the ass will probably start again with the second one.

Evidently, this is a metaphor but the interesting question is: "What does it happen in the mind of the ass? Is the ass's behaviour determined by a sort statistical computation?"To answer, we should finally consider the Trials-&-Errors (T-E) strategy (a) and the Cause-Effect law (C-E) (b) as two aspects of the mind that necessarily accompany the T-R theory:

1. The concept of T-R applies not only to the mind at birth but also to the adult mind that is perturbed by an unknown stimulus. In both cases, the mind does not know which paradigm should be used to react against the unknown stimuli. The mind will initially react to a given stimulus at random, with a low probability of success; the more the individual will repeat that experience, the better he will tune the reaction paradigm. When the learning process will be maximal (thus reaching the highest efficiency),any further reaction will be automatic; so, the scheme of reaction has become deterministic, in the sense that the intellect intervention will not be any more necessary (see Figure 4) [15]. It should be noted that the macroscopic cognitive reaction of the mind towards a single, unknown perturbing stimulus is probabilistic; while, the final response after repetitive reactions to the same stimulus become deterministic; this, in a way, reflects the PD mechanism of molecular or sub-microscopic components of the brain (see the issue on: "The probabilistic-deterministic

computational mechanism of the mind" above and, in particular, the mechanism of computational control of the mind behaviour).

2. "A general definition of the Cause-Effect law (also referred to as causation) predicts that is influence by which one event, process, state or object (a cause) contributes to the production of another event, process, state or object (an effect) where the cause is partly responsible for the effect, and the effect is partly dependent on the cause. In general, a process has many causes, which are also said to be causal factors for it, and all lie in its past. An effect can in turn be a cause of, or causal factor for, many other effects, which all lie in its future. Some writers have held that causality is metaphysically before notions of time and space.

A computational system working on the basis of a statistical mechanism (like our PD-based mind), should employ pre-existing data or experimental data to infer causality by regression methods. Causal relationships may be understood as a transfer of force; if X causes Y, then X must transmit a force (or causal power) to Y which results in the effect. Causal relationships suggest change over time; cause and effect are temporally related, and the cause precedes the outcome. In other terms, our mind should have accumulated enough experience to correlate with a good approximation, the effect (or reaction outcome) to a pre-existing cause (or stimulus); moreover, the mind should experimentally verify that the reverse possibility, i.e. that the effect may have the energy enough to cause the cause, is impossible. The unidirectionality of the information travel in the mind is essential for its stability over time and space.

Concluding, our mind exhibits a basic T-R feature; to be cognitively efficient, the computational activity of the mind must necessarily stand on both T-E and C-E. So, going back to the ass's metaphor, we may predict the ass will survive thanks to the third hypothesis above made. To give a scientific demonstration of it, Smith simulated the ass's paradox carrying out experiments with laboratory rats. Choosing between two equally attractive goals is difficult; the typical response to "approach-approach" decisions is initial ambivalence. Though the decision becomes more decisive as the individual [randomly] moves towards one choice and away from another [63].

Part B – We Live in a Virtual Game: Ego-FW is Our Avatar

Gazzaniga argued that "*personal responsibility is real*" because it is the product of social rules established by people and "is not to be found in the brain, any more than traffic can be understood by knowing about everything inside a car"[64]. The accountability of ethical behaviour stands on binomials, such as to cause and effect, action and consequence, etc., which belong to a universal architectural principle similar to other systems of information-processing (like the Internet). Accountability of moral rules in social life provides the automatic brain with a self-protecting servo-mechanism, which may put a veto on decisions that may otherwise conflict with social rules. Although FW is an illusion, we are still responsible for our actions, and brain determinism has no relevance to personal responsibility in real life. To add weight to his arguments, Gazzaniga claims that scientific advances in the study of brain mechanisms do not undermine the foundations of the action decision mechanism underlying moral responsibility; so it is time to get over the idea of FW and move on [65].

Obviously, we do not agree with him. Since people may think that FW is a myth, the law presumes "the moral competence' of an individual in order to judge him. TBM explains how people falsely believe that they grow up freely and autonomously. Since FW illusion

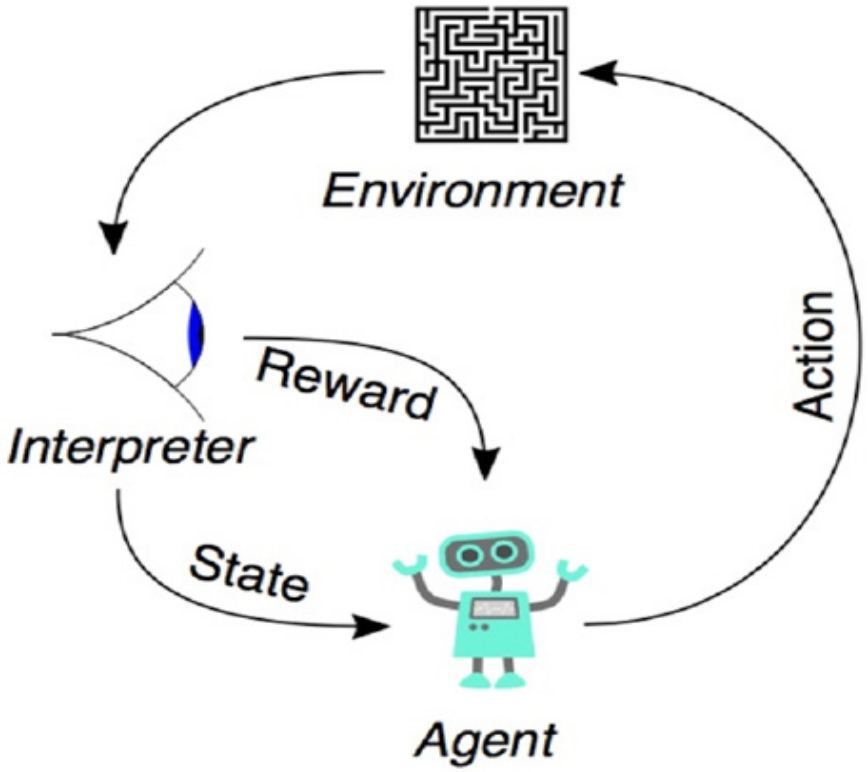

Figure 4: The typical framing of a Reinforcement Learning (RL) scenario: an agent takes actions in an environment, which is interpreted into a reward and a representation of the state, which are fed back into the agent (taken from Wikipedia).

is a sort of unconscious error, the agent is unable to enter into a 'scientific' discussion about it. This belief in FW exists prior to another cognitive process that attempts to disprove it, and thus, TBM will be unable to change the opinion of any agent. However, because laws are acceptable only if their 'meaning' is understood, we can argue that 'education and scholarship' will remain the root of civilization. Thus, formal education together with familiar and social environments are essential for the imprinting of these moral values.

It is absolutely true that a crime is the result of a primitive, barbaric mind; this evidence shed light on a childhood usually spent within sufferance, brutalities, stories of violence, and intolerance, i.e. all negative environmental situations that cause the criminal mind to evolve towards an aberrant PI (e.g. lack of empathy, violent narcissism, etc..). Paradoxically, this is the context in which the Ego-FW illusion might be even strengthen in young individuals. Said that, according to TBM, a criminal is not really responsible for his crimes, as anybody else is not responsible for his own "so-called voluntary action"; though, we must accept the evidence that a criminal is really dangerous for him and for others. So, a rational conclusion would be to confine him in a safe structure; obviously, not a barbaric prison with punitive intentions (as it is frequently seen) but a decent structure, devoted to giving this human being the opportunity of recovering an equilibrated Personal Identity, as far as possible [9].

The huge amount of bestialities that human society has self-inflicted in the name of justice, is unbelievable; however, this is the way we live! The final question we should pose is "why should we defend the idea of a PI controlled by an Ego-FW if this illusion leads us to commit such bestialities? The answer is that it's not our fault. In our brain cells, we have a genetically pre-programmed mechanism that since our birth, installs the illusion of the binomial Ego-FW. This program either gives rise and controls the thinking CM's domain. That's the way by which the conscious mind emerges from the brain committed to cognitive purposes. Moreover, it is noticeable that the cognitive mechanism is neither good nor bad; it is a computational mechanism that has generally evolved to self-protect.

In this regard, Maturana and Varela wrote that autopoiesis is necessary and sufficient to characterize the presence of life and that living as a process, is a process of cognition [66-67]. So, we may infer that when the binomial Ego-FW is steadily Self-oriented, cognitive mechanisms exhibit egocentric, Self-defensive thoughts. If we accept the idea that Ego-FW is the product of a genetic program, *a-priori* instantiated in the human mind, then, no doubts that human behaviour is autopoietic. In conclusion, we might say that life in humans is the necessary and sufficient condition to trigger cognition (that of Ego-FW) and that cognition as a process is an autopoietic process. The statement has been questioned by some authors. Bitbol and Luisi [68]

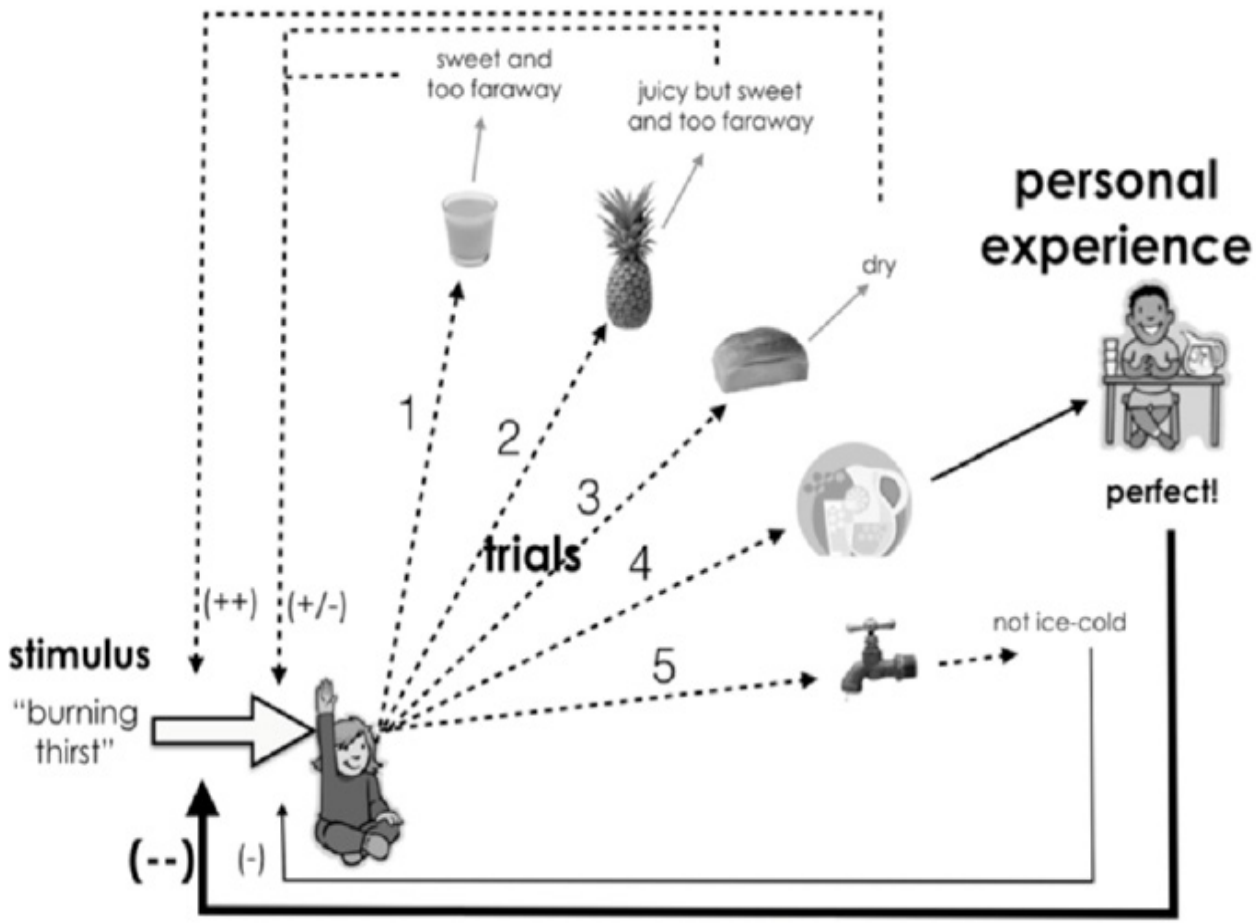

Figure 5: Tabula-Rasa, Trial-&-errors and Cause-Effect law. When a stimulus is perturbing the psycho-phisical equilibrium of the mind, the mind reacts either to remove it or to set a new equilibrium. In this example, thirst is considered an unknown stimulus, then the way to eliminate the perturbation is discovered by adopting a trial-&-error paradigm and by evaluating the efficacy of stimulus removal by trusting on the cause-effect law. Drinking ice-cold water will finally erase the up-hill origin of the thirst.

introduced the example of an autopoietic system that is not necessarily cognitive [69]. It was proposed that, besides the example that a system is living when autopoiesis and cognition coexist, there could be also the case of a cognitive though non-autopoietic system, thus not alive (see for example robots) 81. We may contribute to this discussion by saying that cognition is determinant for autopoiesis and thus for a living (when the binomial Ego-FW of each individual has attained the maximal stage of mental and emotional development possible, its cognitive mechanism is maximally efficient. When the binomial Ego-FW is steadily Self-oriented, cognitive mechanisms exhibit egocentric, Self-defensive thoughts. If we accept the idea that Ego-FW is the product of a genetic program, *a-priori* instantiated in human mind, then, no doubts that the human behaviour is autopoietic [15].

An interesting paper by Bertrand et al. [70] determines how the empathy-related phenomena may affect prosocial behavior and intergroup relations. According to the authors, empathy should enable us to learn from others' pain and to know when to offer support. In summary, the authors say that virtual reality (VR) appears to allow individuals to step into "someone else's shoes" through a perceptual illusion called embodiment, or the body ownership illusion. To this regard, as we have already explained, Ego-FW is installed with a Self-oriented finality in the toddler's mind, well before the mechanisms of "embodied simulations" [55]. So, empathy should not be confused with altruism.

In this space-time frame, people perceive the sense of embodiment in Ego-FW as a virtual-game player may perceive towards his Avatar (Fig. 5). Obviously, people are not aware of dressing a false Avatar by which they give rise to cognitive processes; moreover, people don't even want to listen to a scientist who is revealing that cognitive mechanisms stand on a gigantic illusion! People consciously refuse this idea. Yet, entering the labyrinth of the mind, we can conclude that people's opinion is absolutely right: they must think so! and that is why TBM is successful; FW illusion and not FW is required by the 1PP of the agency 11.

A substantial literature deals with the impact that psychological embodiment in the Avatar, determine on the sense of reality, location and freedom of the will. The stringent analogy between biological and virtual realities can be particularly seen when the virtual player utilizes the "oculus rift". In this context, the player perceives two main feelings: strong embodiment and immersive [71-72], that are characterized by:

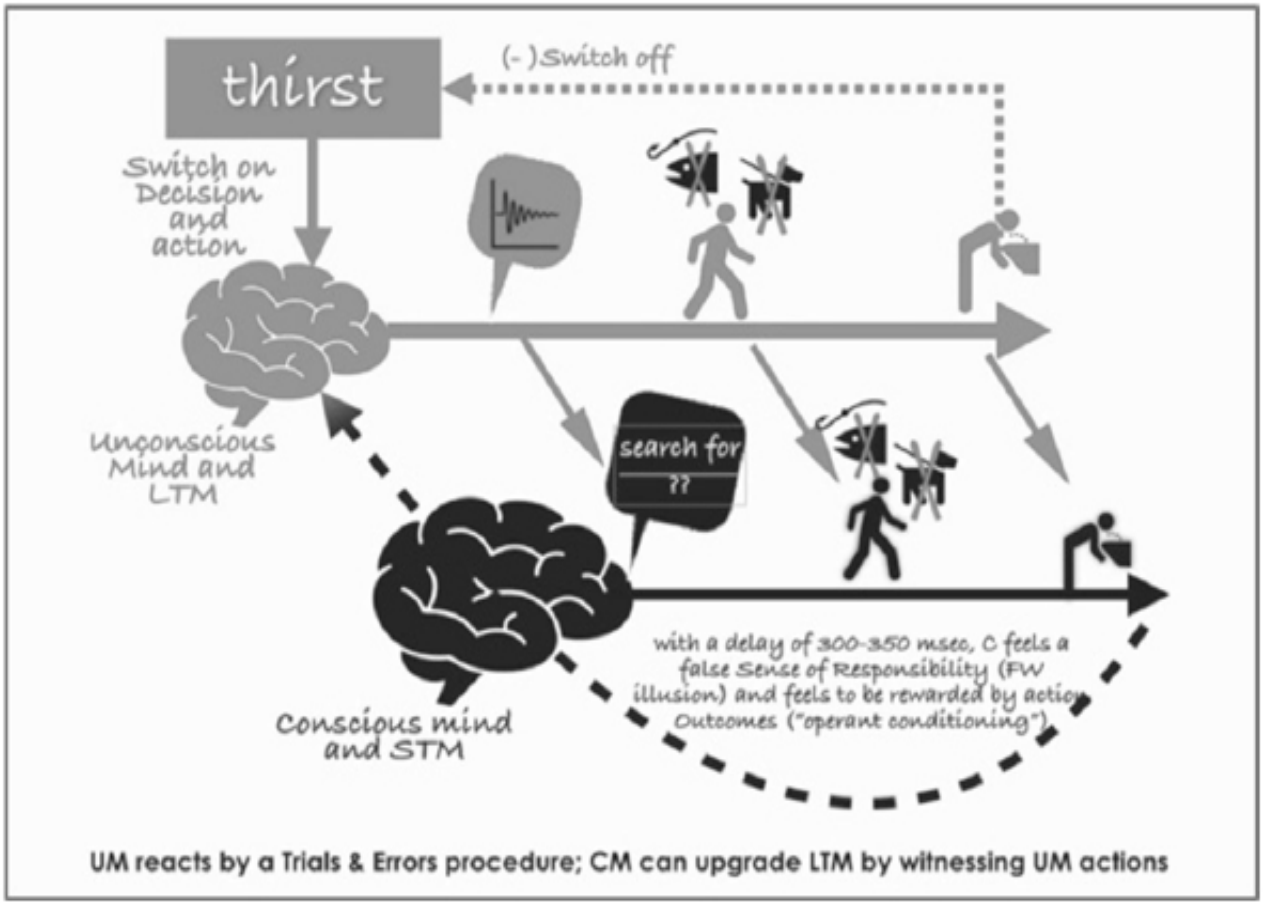

Figure 6: The dynamics of a so-called voluntary action in response to a perturbing stimulus, according to TBM: The arrow above indicates the time sequence of Action (action decision and performance) according to UM; while the arrow below indicates that of COGNITION (self-evaluation of action outcomes on the base of the illusion of the sense of action responsibility), according to CM. If we don't know the nature of the stimulus, we might adopt a Trial-and-Error strategy (for instance, we go fishing or dog sitting, etc.) until we find out the correct paradigm for the proper effect (i.e. drinking to switch the thirst off). The illusion of CM of being the controller of the actions occurs with a delay with respect to the real actions (the delay corresponds to the feedback sensory signals and the witnessing time); this illusion in real life is like the embodiment of a virtual game player in his Avatar.

1. The sense of self-location. This sense leads the player to become aware either of the physical contexts of the virtual game in which the Avatar is moving, and of the general organization and the spatial distribution of the inherent elements of the game, that makes the player feeling at ease.
2. The sense of body ownership. In order to get this feeling, a fine synchronization of the visuomotor reactions of the two entities is required in order to believe that the avatar might really correspond to the real body. Moreover, the visually mediated experience of touching some objects in the game's space may evoke such a realistic tactile stimulation of the player, that it will furtherly contribute to augment his sense of body ownership.
3. The illusion of agency. This feeling leads the player to the illusion of making with the Avatar whatever and whenever he wants, right as it may occur with his own real body.

As already discusses, the presence of two physiologically distinct though cooperating states of the mind (UM and CM) make cognition possible; in this respect, we might interpret our way of living as if we were in a virtual game, then: 1) UM interprets the choreography of the virtual game and, consequently, decides the action on a statistical basis; 2) With hundreds of milliseconds delay, CM makes a critical reportage of the action outcomes; then, believing to be responsible of the so-called voluntary action, CM unwillingly embodies the role of Avatar for UM; 3) Based on the reward or the punishment assigned by the Avatar to the present experience, UM is engaged in repetitive trials or not (Figure 6).

Conclusions

In conclusion, people believe to be and to live holistically thanks to a FW-possessing Ego (or a Soul-inhabited Self) in the mind. In particular, they think to decide and manage their conscious actions on the base of the freedom of the will. Yet, the belief in a FW-possessing Ego originates just in the mind; so that, the mind self-attributes an unlimited power note withstanding the conflict of interest. The divergence between what the mind is from what it thinks to be is striking. However, the conflict can be interpreted in a reductionist way according to "The Bignetti Model" (TBM). According to TBM, a computational machinery that is installed in the mind, creates the illusion of a FW-possessing Ego for reasons functional to cognitive processes. In brief, TBM is the unique cognitive model dealing with the aware, voluntary actions, that retraces the dynamics of the action-decision mechanism from a stimulus to the reaction performance; on this regard, it explains how the experience of the reaction's outcomes may lead to the cognitive processes of learning and memory. According to TBM, UM and CM cooperate in cognition in five compulsory steps: ACTION) UM is genetically programmed to "decide" the reaction in response to the stimulus, either imitating the paradigm already memorized in LTM or adopting the T-E procedure; COGNITION), The feedback signals of UM's action solicit the CM's arousal; from now on, CM falsely feels to be responsible of that action. As a result, CM self-attributes a prize or a punishment; this step will trigger LTM updating, useful for future actions. In summary, the cognitive mechanism proposed by TBM recalls the learning mechanism of Thorndike and his "law of effect" [74], a theory that would later influence Skinner's studies on "operant conditioning" [74,75].

A couple of interesting inferences can be done: 1) the cognitive mechanism described by TBM underlies what we are; though this is unbeknown to our CM. So, we keep living as in a virtual game in which CM moves as the Avatar of UM. 2) Moreover, it is known that "gaming" is used as psychological therapy in pathologies of different gravities, e.g. dysmorphic disorder (characterized by the obsessive idea that some aspects of the body are severely flawed) [76,77], obsessive-compulsive mental disorders, autism or attempts at suicide [77]; maybe that TBM will teach us how to make the therapies based on "gaming" efficacious.

Competing Interests

The author declare that there is no competing interests regarding the publication of this article.

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