



Psychological Space-time Reinforcement Sensitivity Hypothesis & Mental Disorders: From Special to General Relativity Interpretation

Meriama Hansali Mebarki^{1*}

Abstract

The reinforcement sensitivity theory lacks basic sources of any human experience :time, place, and learning contexts that have shaped the reinforcement; therefore I have assumed a missing link in Gray's framework based on special relativity relying on the «what, where, and when of happening»? as major resources of human conscious experience, which under punishment or reward exceed the sensitivity to pleasant or unpleasant stimuli transcending therefore the Weber law, that's why I called it: Psychological Space-Time Reinforcement Sensitivity "PSTRS" axis. The last explains BAS and BIS systems sensitivity to reinforcement across the cognitive space-time continuum of episodic memory, and not only across the two great dimensions of fear/anxiety and defensive distance of the McNaughton & Corr model of 2004. So, based on the disruption of the high-sensitivity information processing system in the brain, the four-dimensional conscious experience is distorted by its underlying sources and context. Thus, one of the time-dominating records prevents the individual from overcoming the present., such in depression, obsessive compulsive disorder and post-traumatic stress disorder (psychological sensitivity to the past). These temporal records clearly lose their sequence and associative nature in dissociative symptoms due to the disruption of the most important milestone on which Einstein's physics was based. Consequently, psychological space-time reinforcement sensitivity supposes that psychological disorders can be interpreted according to the laws of special relativity (acceleration / deceleration), but this seems more complicated when it comes to mental disorders where the self is disturbed on its spatio-temporal axis as observed in schizophrenia. Schizophrenia looks like a three-componements disorder characterized by a disruption of the experience of time, place and self, which could be assumed up as a "self space-time disturbance". Notably schizophrenic patients appear losing the ability to gather in a dynamic way these componements, as if the world seemed missig the gestalt characteristic or fragmented. The past felt like an inevitable destiny inhibits the direction towards the future; sometimes disorient the self to the point of feeling lost, as if the psychological time slows down to the point of feeling separated from the « now » the physical time. So are we dealing with an Euclidian space? The article attempts to provide a non-traditional interpretation of mental disorders by including general relativity in psychological studies, based on the neurobiological bases involved in the spatio-temporal processing of the conscious experience in the quantum brain.

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Key Words: Einstein's Relativity, Human Conscious Experience, Inhibition / Activation Systems, Schizophrenia, Limbic – striato-pre - frontal Circuit Sensitivity, Autozoetic Consciousness.

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Introduction

Gray's theory has determined the neurobiological systems of Eysenck traits personality theory,

although, the difference is clear between them regarding the extraversion dimension, which was

Corresponding author: Meriama Hansali Mebarki

Address: ^{1*}Member of the Research Team Entitled "Neuropsychology and Chronobiology" at the Laboratory of Psychological and Sociological Studies of Mohamed Khidher University, Algeria.

^{1*}E-mail: Psychologie0736@yahoo.com

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rotated by Gray 30° west, confirming by this the tendency of extraverts to impulsivity and thus their proneness to certain disorders like psychopathy, mania, addiction behaviour etc, which reflects excessive sensitivity to their behavioral activation system.

In contrast, the sensitivity to pain and punishment reflects an atrocious increase in behavioral inhibition system, which makes introverts vulnerable to all anxiety disorders kinds and depression. However, sensitivity to punishment or reward lacks an important dimension that largely controls the reinforcement of conscious experience of such non-adaptive behaviours. Therefore, I have proposed an additional axis to Gray's and Eysenck's theories, based on the fact that human experience is conscious and four dimensional as it was confirmed by Sieb (2016, 2018). This could pave the way for Einstein's relativity to be introduced, relying on: what, where, and when things happen? as major resources of conscious experience, which under punishment or reward exceed the sensitivity to pleasant or unpleasant stimuli transcending therefore the Weber's law, that's why I called it « Psychological Space-Time Reinforcement Sensitivity » axis.

So, based firstly on the essential role of episodic memory in associative learning, and its ability to travel through mental time to the past and future (Tulving 2002, 2005); and secondly on the cerebral circuits responsible for temporal processing (for more see, Kitamura et al. 2015; Lusk et al. 2016; Gordwood. 2010) and thirdly, on the crucial role of the biological clock in providing harmony between psychological and physiological functions (Wittmann et al. 2011) I have proposed a non-traditional interpretation of mental disorders based on special relativity laws as the individual's internal space is the pot of psychological experiences where thoughts movement simulate objects motion in Minkowski's space.

Subsequently, thoughts orientation speed define « Psychological Space-Time Reinforcement Sensitivity » quality, which would be towards a melancholic future burdened with sufferance like in

major depression, for example; or towards a painful past like in obsessive compulsive disorder leading to the deceleration of behavioral response in present; such deceleration is clearly observed in the two troubles as a permanent comportemental hallmark, resulting in a desynchronization between psychological & physical time on one hand, and another desynchronization between emotional & cognitive content registred in OCD patients; whom, although aware of their absurd & irrational thoughts and behaviors, still unable to overcome the present because of the extreme sensitivity of the painful past.

Post-traumatic stress disorder is a crucial model that allows the application of general relativity as a physical approach in mental disorders; but the problem gets worse when dealing with psychotic disorders because of dissociative symptoms as in schizophrenia for exemple. In this article, I will attempt to explore the possibility of moving from special to general relativity, always relying on purely clinical observations supported by the most recent studies in the neuroscience field.

How can Special Relativity determine the Psychological Space-Time Reinforcement Sensitivity?

The psychological space time Reinforcement Sensitivity hypothesis proposed a new axis to Eyzeneck & Gray's framework based on special relativity laws (acceleration / deceleration), depending on the important role of the grid cells network in the simultaneous integration of the experiences in time and space on one hand (MacDonald et al, 2011) and on the speed of the brain cognitive processing, which simulates the speed of light on the other (Ghaderi, 2015); and finally, on what was published by Richard Allen Sieb concerning the human consciouss experience and relativity theory. The figure summarizes how psychological time accelerates or decelerates as a result of defense systems sensitivity to reinforcement and their interaction with reward or punishment space-times.



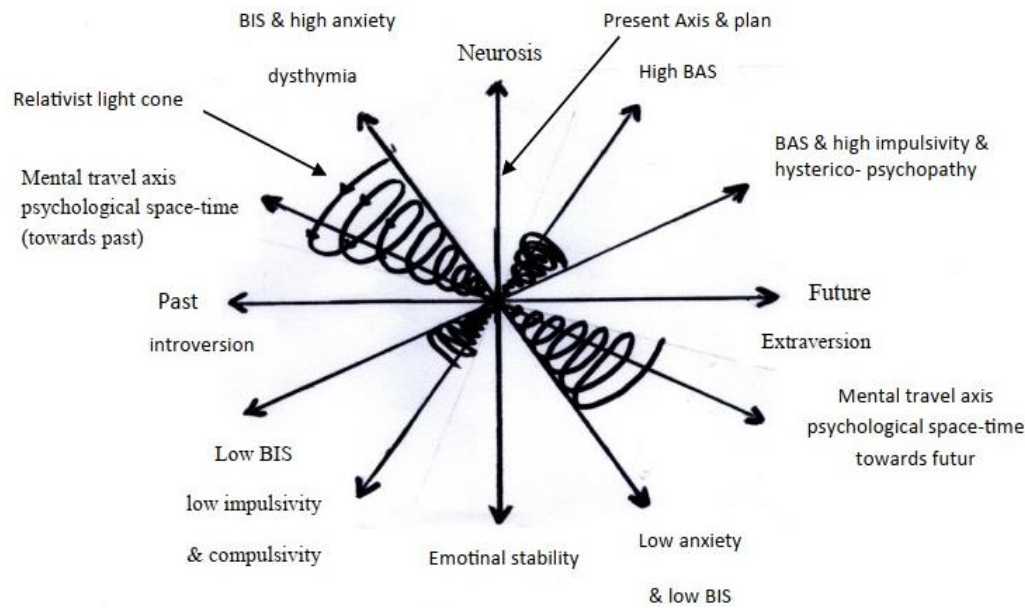


Figure 1. Psychological space-time reinforcement sensitivity framework

The figure shows how thoughts accelerate from past to the future causing psychological time deceleration in the case of punishment sensitivity (Major depression); and opposed to this state, is how thoughts accelerate in the present causing psychological time acceleration in the case of reward sensitivity in order to get immediate gratification. (Manic disorder) (The framework amended according to special relativity laws). Therefore:

Psychological space-time reinforcement sensitivity = psychological time × the degree of extraversion (with respect to behavioral activation system dominance)

Psychological space-time reinforcement sensitivity = psychological time × the degree of introversion (with respect to behavioral inhibition system dominance).

Space-time is therefore determined as an important dimension in the interpretation of both normality / abnormality, accordingly; Psychological Space-Time Reinforcement Sensitivity (PSTRS), would be defined as **“being an indicator of the degree of distortion of the spatiotemporally perceived experience resulting from over expectation of reward or punishment and the acceleration of their proximity in time and space, which, in the end, will cause an incapacity in the spatiotemporal processing of events that hinders the best estimate of time.”** (H.M Meriama, 2018).

By applying special relativity laws, “PSTRS “ can explain many mental disorders ; So that, biophysical time in patients with major depression

is decelerated because of the acceleration of their thoughts towards the future, such cognitive acceleration marked with negative emotions increases the level of anticipation to punishment or pain, slowing down therefore the behavioral response in the present, thereby, the gap widens between the psychological and physical times to the extent that the latter stops, and the patient commits suicide under the effects of the extreme sensitivity to the painful past. This acceleration / deceleration aspects reflects in my opinion a kind of desynchronization which could explain the gap between physical and psychological time, the more the latter extends between the two times, the more severe the symptoms of the disorder; exactly as; the gap widens between the cognitive and the emotional sides, to the point that individual response seems to be purely mechanical; and empty from it’s emotional content, a deep gap is also observed in spectrum disorders e.i schizophrenia (the case of John Nache. e.i) and autism spectrum disorder in which the autistic exhibit a very high cognitive performance (in contrast to the extreme decline of emotional aspects).In accordance with the above (Stanghellini et al; 2015) have confirmed this slowing/accelerating aspects in schizophrenia (Stanghellini et al, 2015)

In post-traumatic stress disorder, the intrusive act of past thoughts and images confuses the patient’s present and makes it impossible for him to overcome it, despite his full awareness of the seniority of the experience, causing a slowdown in his psychological time in present so more, but with



regard to the manic episode in bipolar disorder, the psychological time accelerates in present (spatio-temporal sensitivity to reward in "here and now"); This justifies his hasty comportement and his quest for pleasure "here and now", a sensitivity that explains also addictive behaviour. According to Minkowski the patient with mania loses the capacity for 'unfolding in time' or *durée*, and his vital contact with reality necessarily shrinks as a result, 'absorb[ing the world] so avidly that he does not penetrate it at all. The melancholic patient also experiences profound temporal disturbance in which 'ego-time seems slower than world-time'. This causes such a patient to lose future-orientation and to fall out of sync with the environment. (Sass and Pienkos, 2013).

Based on neurobiological researches concerning spatio-temporal processing in the brain, I have proposed the involvement of the septo-hippocampal - prefrontal circuit in this kind of sensitivity; by emphasizing the critical role of the hippocampus as an anxiety system on one hand and as a GPS on the other hand (Burgess, 2014) plus the core function of grid cells in filling the gaps between experience spatio-temporal intervals (Kraus, 2015). In addition, psychological space time sensitivity to punishment activates the core structure in anticipating risk and managing fear (Amygdala), affecting then the cognitive processing of conscious experience «Thus Amygdala and hippocampus are two highly interconnected regions that have a common influence on the effect of emotional memory» (Henigsberg et al, 2019).

This neuroanatomical fact has been used by LeDoux (1996) to argue that fear affects cognition more than it is controlled by it. Once activated, fear runs its course, with limited possibilities for cognitive interventions (Ohman and Mineka, 2001). Moreover "thalamic inputs to the amygdala allow sensory signals to activate it either before or simultaneous with the arrival of signals at the cortical level, and may, therefore play an important role in preconscious and precognitive emotional processing" (LeDoux, 1992). These last, may be one of the underlying factors contributing in Psychological Space-Time Reinforcement Sensitivity; so while ruminative anxiety -as a key component in the above disorders- explains surely the hippocampus sensitivity, the amygdala determines the feeling of threats and fear experienced by the proximity of stimuli in time and place as an expectation's result. "Recent studies have provided neurophysiological evidence that

responses of amygdala neurons to aversive (or appetitive) stimuli are also modulated by expectation" (Belova et al, 2007). Subsequently, as expectations are the product of an interdependent process based on associative learning, the interconnectedness of the circuits between fear and anxiety seems to constitute a primordial structure here.; so while fear based on aversive stimuli expectation emerges threats feeling, anxiety rumination rises in a positive feed-back loop the cognitive emotional processing of the conscious experience, whatever, it was lived, imagined (expected) or remembered as in PTSD for exemple. In line with this idea the finding propose an hyperactive brain network involved in re-experiencing the traumatic event(s) in PTSD (Engdahl et al, 2010) which may be related in my opinion to the cognitive- temporal processing speed which reaches the speed of light leading to a psychological time deceleration in present (intrusive thoughts, Images etc.) due to the sensitivity of the painful past. "It is important to emphasize too, that hyperactivity of amygdala is also associated with other anxiety disorders» (Etkin and Wager, 2007). So, is it possible here to consider this brain hyperactivity as a proof of psychological time dilatation? Especially after the great controversy concerning the involvement of the amygdala in memory capacity to make dilated time trials retrospectively because of its richer coding and perhaps secondary memories (Stetson et al, 2007).

At the same time, a feeling of threat and stress may trigger dissociation, also characteristic of PTSD. Dissociation can be viewed as a disintegrative attentional process, in which attentional resources are divided between many stimuli, resulting in reduced conscious attention directed to any of them. Dissociation in PTSD and BPD has been associated with altered activations in the insula and prefrontal cortex. These structures also play a role in awareness to (noxious) stimuli (Defrin et al, 2015) and could then be parts of the psychological circuit of the spatio-temporal sensitivity hypothesis.

According to these disrupted attentional resources, dissociative symptoms can be viewed as a wide hole resulting from a temporal desynchronization between psychological & physical time. Dissociation, included now in DSM-5 as a PTSD subtype boost clearly the possibility of a distorted mental time travel as a cognitive process implicated in space-time sensitivity.

In this regard (Quoidbach, J et al, 2009) « rely past and future travels on a common set of processes by which past experiences are used to envision the future and both importantly involve auto-noetic consciousness; ‘the kind of consciousness that mediates an individual’s awareness of his or her existence and identity in subjective time extending from the personal past through the present to the personal future», so the problem here resides in feeling what happens as « Antonio Damasio » said, a kind of self awareness in the present moment that contributes in my opinion to the self orientation towards past or future; this last is based on episodic memory, for this reason (Tulven, 2002; 2005) emphasize the role of this memory and coined the term « auto-noetic episodic memory.

Schizophrenia: When Minkowski’s Space becomes Collapsed

A focus on the positive symptoms of schizophrenia puts hallucinations, delusions and dissociative symptoms at the top of the major diagnostic criteria confirmed by psychological studies; So that, the latter reflects loss of sense of self, by attributing the actions and mental states to the other, separating thus the self from reality as a significant clinical criterion in psychotic disorders.

With regard to negative symptoms, the difficulty in starting and performing the tasks reflects a manifest disruption of the will, due to the sensory motor information processing deficiency, which contributes to the lack of mental organization (Franck, 2005). Owing on the inseparability of this sensory motor deficit from the emotional cognitive side, we stand on well-observed dysfunctions in executive functions in schizophrenia: lack of planning of the act, and therefore the initiative to start tasks, the inability to judge and solve the problems, and therefore the inability to make a decision, as evidenced by disorganization of thinking and its fluency disruption observed in the daily life of schizophrenic patient.

In regard with this, alternative theories attribute timing disturbances in schizophrenia to cognitive impairment or deficient sensory-motor integration (Peterburs, 2013); which is based on the essential role of the basal ganglia not only as a biological basis of movement; but also for its currently confirmed intervention in cognitive function (Yanagisawa, 2018) for example, the striatum’s ability to predict an event (Pennartz et al, 2011) which might explain the avoidance/approach

behavior according to the dominating system emphasizing therefore the paramount dysfunction role of executive functions in schizophrenia as well as in obsessive compulsive disorder.

In line with this idea neuropsychological research has often focused on deficits pertaining to “executive functioning” (e.g. attention, working memory, and planning). These deficits are thought to be related to frontal lobe dysfunction and have historically been associated with the daily living difficulties patients with schizophrenia face. Relatively few researchers have addressed the possibility that deficits in everyday living may instead be affected by difficulties with temporal processing» (Davalos et al, 2003). Temporal processing requires functional harmony in timing which is the core of self awareness, in parallel path, studies involving individuals who suffer from attention deficit hyperactivity disorder (ADHD), depression, schizophrenia and Parkinson’s disease (PD) have revealed that individuals with such conditions often have an impaired time perception (Pradhan and Tripathy, 2018) stressing then the important role of motor processing in such disturbance; in which parietal cortex, which acts as an interface between sensory and motor processes, is involved in translating temporal information into action (Grondin, 2010) this explains the spatio temporal processing overlap in the brain, from their part (Alústiza, I. et al; 2016) have suggested that a deficit in timing be tentatively considered as a trait marker of the schizophrenia cognitive profile. The implication of basal ganglia in schizophrenia as well as in temporal processing was well documented.

Schizophrenia looks like a three-components disorder characterized by a disruption of the experience of time, place and self, which could be summed up as a “self space-time disturbance”. Notably schizophrenic patients appear losing the ability to gather in a dynamic way these components, as if the world seemed missig the gestalt characteristic or appeared fragmented. The past is felt like an inevitable destiny inhibiting the direction towards the future; sometimes disorienting the self to the point of feeling lost, as if the psychological time slows down to the point of feeling separated from the « now » physical time. That’s what Clara Kean, (2009) from Department of Physiology and Pharmacology of Bristol University, Uk confirmed by publishing her own experience with schizophrenia in her proposed” Existential Permeability Theory « I was totally separated from



my self, not knowing what action. I am disconnected, disintegrated, diminished. Everything I experience is through a dense fog, created by my own mind, yet it also resides outside my mind. I feel that my real self has left me, seeping through the fog towards a separate reality, which engulfs and dissolves this self. So the question here is: What would happen then if this self is misoriented on her spatio-temporal axis? Especially after conceding «Minkowski space-time as the model of space-time for special relativity, quantum mechanics, and human consciousness experience (Sieb, 2018) in line with this, Kimura consider time perception as a principal factor in psychiatric diseases, especially in schizophrenia (Kimura, 2003).

To be self-conscious means to be aware of one self as a temporal relation; as a set of narratively shaped active temporal relations in the progressive tense. Past experiences are localized at a point in the remembered past, expectancies are projected as events that are still to happen in a future that gradually comes closer and closer. Conscious reflection being cognitively penetrable, it enables the organism to plan its actions and to adaptively tune to the prevailing circumstances in the world (Michon, 2014).

Starting from «experience of time as the conscious product of processes that enable us to cope with the sequential contingencies of reality (Jansen, 2018); the self therefore turns into an observer of two kinds of reality, the internal one vs the physical reality which is no more than a mental representation. According to (Franz KlauJansen, 2018) «Observable physical reality is distinguished from its mental representation and are separated by a great gape» in which language plays an important role in the connection between these mental representations and the physical world (Song, 2018); The complete lack of connection or sequential nature of the succession of thoughts and their interrelation is reflected in distorted language, so that the diffusion of thoughts in the schizophrenic brain often reflects jumps in unconnected blanks; According to (Song, 2019) language plays a similar role as cyclical time in attaching the physical reality and the conscious understanding of the observed object. Consequently dealing with this hole in my opinion would be a real challenge for this self, conscious obviously about her existence on an hypothesized spatio-temporal continuum fails to minimize this

widened gape as observed in dissociative symptoms in PTSD.

Neuronal activity dysfunction in the brain becomes more complicated in schizophrenia, when Minkowski's space becomes collapsed as a result of the ambiguity which encapsulate the time axis- even if -it is a mathematical axis-; therefore disrupted time as one of the main basic sources of human conscious experience "when had it been happened?" So the paramount question here is: what would happen then if the conscious reflection swings out of time's axis tune? In this case it was assumed that «unlike in major depression, in which the crisis of life-drive that projects into the future leaves the person dominated by the past; in schizophrenia, temporality may lose all organization and meaning» (Stanghellini et al, 2015) means a psychological space time sensitivity to past in the first place instead of the complete disconnection from the physical time leading to an unreal existence as described above by Clara Kean.

There is evidence in schizophrenia patients for a fragmentation of time continuity fluidity and the temporal coding of events, loss of experiential continuity, consisting of the subjective fragmentation of the experienced world, including its temporal dimension, and a distorted perception of subjective time. Abnormal time experience is correlated to distorted sense of continuity of self across time and to difficulties in effectively performing scheduled activities (Stanghellini et al, 2015). In the same contexte clinical and experimental data suggests strongly that time estimation of patients with schizophrenia is less accurate than that of healthy subjects. Memory impairments in schizophrenia are well known, in both working and episodic memory, and attention deficits are also well documented (Montalembert et al, 2016), dysfunction of long-term and working memories with attention deficit leads to dissociative symptoms which once disappeared; emotional inertia overwhelmed the patient daily life expressing the complete absence of volition and motivation that pushes the patient in the negative closed feed back loop symptoms.

Back to the Physical Time: A Schizophrenic Patient Reveals his Tragedy

Minkowski describes the fundamental disorder or trouble générateur in schizophrenia as a 'loss of vital contact with reality', a profound disturbance of the patient's sense of vitality and of his dynamic



relationship between self and world (Sass and Pienkos, 2013). In order to better understand the mechanisms underlying this emotional-cognitive related time distortion let us analyse these confidences revealed by a schizophrenic patient.

Fateh 46 years old, single, was a victim of the black decade in Algeria; reveals his ordeal with schizophrenia. Traumatic events and a threatening environment that has put him in turmoil for 27 years; despite his early resistance to the disease and his attempt to emigrate three times (France, Italy, Germany), he could not tolerate. Frustrated by this situation, he tried to commit suicide. When positive symptoms disappear, melancholy still characterizing his mood, preventing him from starting again. I asked him if he could remember these events, he said "memories are here; yes, I remember all the events, but the problem resides in their succession in my mind. I do not remember when they happened exactly. Everything was black in my head...there was only a terrible emptiness... just a huge void...in where I felt lost.... it seems that I was alone... nobody could hear me. Now I'm recovering my lost self".

Paying particular attention to the phenomenological approach paved the way, perhaps for highlighting the mysterious claimed in this omnipresent emptiness. Jaspers remarks on these changes in schizophrenia, and also notes the experience of infinite space, citing one schizophrenic patient who said: 'Space seemed to stretch and go on into infinity, completely empty. I felt lost, abandoned to the infinities of space, which in spite of my insignificance somehow threatened me'. Another patient said: He only saw the space between things; the things were there in a fashion but not so clear; the completely empty space was what struck him "(Sass and Pienkos, 2013). Clara Kean summarizes the dilemma in schizophrenia as a disorder of the self, a disturbance of one's subjective self-experience and the external or objective reality (Kean, 2009). According to the previous statements, the events were well recorded, the problem lies in their succession; disability in the case of Fateh relates to retrospectivity deficit, means a disorientation of the temporal axis towards the past, whereas the deficit resides in a lack of integration or a disconnection from the real world (governed by physical time) for Clara Kean. What brings the revelations above is the completely empty space, engulfed by an overwhelming ambiguity due to the collapse of conscious experience across the time axis.

Conscious experience is essentially an orientation in space and time, an awareness of the existing situation with reference to space, time, and identity. It is an understanding of the position of the observer in space and time (Sieb, 2016) the lived space in schizophrenia is a kind of *espace figé*, defined by Callieri et al; in analogy with the time described by Le Guen. In this kind of space, things may not appear meaningfully related to one's own body. People with schizophrenia may find themselves living in a strange and uncanny space, at times dull, at times as an infinity plane, in the boundlessness, or in a space where objects are fragmented, flat. Patients try to describe these quasiineffable experiences using generic terms as "unreal" "inscrutable", "fake", "meaningless", and define their condition as characterised by "disorientation", "bewilderment", "incertitude", "awe" and so on (Mancini et al, 2014). So, are we dealing with an Euclidean space?

The case reports correspond to those previously referred to schizophrenic patients. Fateh was unable to grasp the chronology of events, therefore to move in his inner space, which relies mainly on episodic memory. This, translates into a fragmented perception of the timing of events or, more specifically, a period of time divided into adjacent elements that is difficult to integrate into a unified experience that constrains (when did it occur?) as the main time interval in the conscious experience formation. The interior space was been described as a terrible emptiness that confirms its collapsed aspect as mentioned above, thus ; reflecting a deformation and difficulty of the movement of thoughts due to the lack of the supreme coordinate "time" and because it is integrated in a spatio-temporal axis, Marie-Paule Daniel et al; (2007) affirm that « The reconstruction of the chronology of the landmarks is disrupted in schizophrenics, which confirms that the problem they are confronted with pertains to spatiotemporal coordination and affects the memory of the sequence in which landmarks have been encountered during the navigational episode.

Spatio-temporal Processing Distortion in Schizophrenia: Towards a General Relativistic Interpretation

Let's summarize the cases's declarations to stand on the spatio-temporal distortion in patients with schizophrenia in two main ideas: the absence of the sequential nature of events, means a deficit in their

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flow across the time axis; in addition to the place rigidity, in other words the emptiness which includes separated objects (Ideas or events that are not related to each other), means a failure in reconstructing the previous perception parameters in their real context. The "feeling of loss" in the dark space accurately described by the cases, expresses in my opinion a clear distortion of the spatio-temporal processing of conscious experiences in the brain; due to an excessive sensitivity to their pain contents.

Psychological sensitivity to reinforcement renders patients unable to move past their painful experiences due to the depletion of their wasted energy in previous non-adaptive changes. The momentum of flying thoughts in the schizophrenic brain distorts the self-awareness in the present as a power of attraction from the Newtonian perspective; Moreover the mass of suffering renders the present overloaded to the point of the relative absence of action, which results in catatonic symptoms for example; or accelerated, as observed in the case of hyperexcitation.

I often wondered how this young man was standing in a cold weather wearing dirty clothes; -Saif 25 years old exhibited dissociative symptoms during his early adolescence which were later intensified to schizophrenia spectrum - for long hours in front of the building entrance in a catatonic position without the slightest physiologic reflex swallowing and blinking specifically. Despite the saliva that flows from his mouth and the mucus descending from his nose and despite flies flying over his face he was standing lost as if he was staring in emptiness. Has he lost feeling pain to the point that his legs didn't hurt him? I looked into his vacuous eyes and I asked myself about the quantum of grief that imprisoned him there, until one day, he looked at me and smiled; in the blink of an eye, his rigid face changed his features and let out a smile that I could not explain. Did he realize my sympathy for him and my sorrow because of his suffering? The case was in the neighborhood since his childhood. He had leaved many years ago because of his harsh family conditions, every day he wanders around the neighborhood as if he was seeking for his innocence in the details of the distant past.

Maybe my approach seems rather speculative and anecdotal. In this case, shall I give myself the opportunity to rely on my imagination as I always do? I think in this case, gravity is transformed into a spatio-temporal curvature due to painful past experiences. The mass of suffering felt by the case

sometimes modifies the fluidity of thought movement and this may increase the acceleration of thought to a speed beyond light; consequently the case can be fragmented from reality as if he had entered the world of black holes embodying the laws of physics in a state of complete separation from "The here and now". In my opinion, the substantia nigra represent one of the main basis for the activation of what I have termed « Brain Black Holes » according to Einstein's hypothesis -proved recently-, which requires the collaboration of different scientific disciplines to test it empirically.

Schizophrenic patients suffer from significant cognitive difficulties such as impairments of working memory, selective attention, and the speed of processing (Röder et al, 2015), In this regard Peterburs & colleagues (2013) « have supposed an accelerated internal clock which is associated with excessive alertness, usually related to the positive symptoms, and that this lack of temporal processing may also contribute to the emergence of other positive symptoms such as delusions and disorganized behavior, and that this acceleration is due to an dopaminergic dysregulation»; In particular, the prefrontal cortical networks, which are involved in the cognitive control for goal-oriented tasks and inhibition of contextual and emotional distractors, are affected in people with schizophrenia, and are highly susceptible to alterations in circadian rhythms and sleep (Bromundt et al, 2011). The dopaminergic system in the basal ganglia plays also « a key role in arousal, emotion-driven behavior and motivation. In addition, the dopaminergic system plays a major role in the recognition and prediction of reward, in selecting guiding behaviors to obtain rewards (planning), as well as in reward-based reinforcement learning » (Perez-Costa et al, 2010) Undoubtedly this dopaminergic circadian system is affected by the speed of processing in an interwoven way across the reward pathway in this regard. Helen Bull (2016) argues that schizophrenic patient have a diminished ability to anticipate pleasure which may contribute to lack of goal directed behavior, as the anticipation of future pleasure motivates us to act in order to achieve a goal, means to move.

Can dopaminergic dysregulation clearly explain these symptoms? Can thoughts acceleration (objects in a quantum space) inhibit movement? Does this really confirm the inseparability of sensory motor treatment in the brain on which I have built my imagination? I think that the circuit



should be expanded now and that the neurobiological basis of the proposed hypothesis could include other parts of the brain, certainly the limbic - striato -prefrontal -dysfunction /dysconnection might be one of the main factors contributing to this kind of sensitivity; therefore, other neuro-modulatory systems, in particular glutamatergic and GABAergic need to be seriously discussed at the pharmaceutical level. But before elaborating my second part of hypothesis, it should be noted that Gray's theory did not deal with schizophrenia, therefore, I will rely on studies that have attempted to study the relationships between behavioral activation / inhibition systems and schizophrenia on one hand; and on the neurobiological bases involved in temporal treatment and schizophrenia on the other hand.

Given the neural structures involved in the perception of time and schizophrenia, is it possible to accept such imagination? The structures include the prefrontal and parietal cortices, thalamus, basal ganglia and cerebellum (Grondin, 2010; Peterburset al, 2013). These brain areas have been implicated in the pathophysiology of schizophrenia, in terms of impaired coordination of activity among these regions (Lee et al, 2009). In summary, while the prefrontal-striatal circuit as a part of the reward pathway would present positive symptoms, the septo-hippocampal-prefrontal circuit as part of the punishment system could explain the negative symptoms; and here we can clearly understand the role of grid cells in the entorhinal cortex to fill gaps between separate events (mental time travel towards the past which contributes in future orientation); which means that it is the spatiotemporal integration of conscious experiences that is disrupted in the schizophrenic brain, and this could reinforce the idea of the necessary harmony (which is impaired in schizophrenia) between the two systems. This may also explain the sensitivity of the BAS and BIS systems to reinforcement in the cognitive space-time continuum of episodic memory.

Our sense of time is subject to various prejudices, perhaps the most relevant ones focuses on the type of the dominated behavioral system, thus, both reward and punishment stimuli affect our responses. The question is whether is it painful experiences, for example, which reinforced the sensitivity to pain in exchange for pleasure since schizophrenics fails to anticipate pleasure? In this respect, evidence on differential effects of pleasant and unpleasant stimuli on timing demonstrates an

underestimation effect for both pleasant (Gable and Poole, 2012) and unpleasant stimuli (Lui et al, 2011). In contrast (Scholten et al, 2006) study concluded that high BIS sensitivity amplified affective reactions to negative events and perhaps increases the level of threat anticipation »

Starting from the crucial role of the prefrontal cortex in the formation of conscious experiences, including emotions and its three distinct cytoarchitectural and functional areas, the dorsolateral prefrontal cortex (DLPFC) is the central executive for cognitive control, the orbital prefrontal cortex (orbitofrontal cortex) is the central executive for emotion and social control& the medial prefrontal cortex (with the anterior cingulate cortex) mediates drive or motivation; each subdivision of the prefrontal cortex does not produce its functions exclusively (Sieb, 2013) without neglecting the representation of time and space in the hippocampus which is a fundamental mechanism for organizing the elements of experience (Eichenbaum, 2014) in addition to striatum's ability to predict events as part of the sensory motor system, therefore of the executive system through the prefrontal interconnection.

A little attention to the function of the common structure can illustrate this strange paradox observed in the approach / avoidance behaviors of schizophrenics. The involvement of the amygdala in the facilitation of emotions and in memory has been highlighted, as well as in the temporal processing of conscious experience, both for coding and retrieval. Furthermore, it is known that the amygdala, thalamus, and cerebellum are subcortical structures that assist the process of selecting a course of action from among two or more alternatives by considering the potential outcomes of selecting each option and estimating its consequences in the short, medium and long term. This process also includes cortical structures, such as the dorsolateral prefrontal cortex, orbitofrontal cortex, anterior cingulate cortex (Monara et al, 2016); The anterior cingulate cortex, parts of the basal ganglia (ventral striatum and nucleus accumbens) medial temporal area (amygdala and hippocampus). prefrontal cortex are parts of the reward system (Leibenluft et al, 2003); the amygdala, thalamus, hippocampus the dorsolateral prefrontal cortex and the posterior cingulate cortex are parts of the punishment system (McNaughton & Corr, 2004) the nucleus accumbens and the DLPFC are known to be



involved in delayed reward processing; The reticular activating system and the cerebral cortex are necessary to maintain consciousness; the reticular system is part of both of the reward and punishment systems and the two systems are activated together (de Leeuw et al, 2015) noting that, the majority of these structures are implicated in schizophrenia.

Depending on dopaminergic projections from the midbrain, the basal ganglia control the speed of movement. The implication of these set of subcortical cerebral nuclei in schizophrenia, temporal processing and cognition could pave the way for the introduction of general relativity into psychological studies. Striatum is the main input nucleus, «the major target too of dopaminergic projections, with the highest density of DA receptors in the brain. It also receives extensive and topographically organized glutamatergic projections from the cortex and thalamus. The important feature of the basal ganglia is the existence of two neuronal pathways; whereas the direct or striatonigral pathway expresses D1-type DA receptors, projecting thus to the substantia nigra pars reticulata (SNr) and the internal segment of the globus pallidus, and because the output of

the SNr is inhibitory, the activation of the direct pathway is expected to disinhibit downstream structures, the indirect or striato pallidal pathway expresses D2-type receptors projecting to the external segment of the globus pallidus (GPe), which in turn projects to the SNr, this pathway has a net excitatory effect on the SNr outputs that's why it produces the opposite effect (Yin, 2014) So; while D1 receptors in the prefrontal cortex are related to negative symptoms, D2 receptors in the striatum and the mesolimbic system are concerned with positive symptoms; thus basal ganglia didn't controls just velocity of body movement but also the speed of thoughts in order to organise the self leading to a self awareness. So did DA receptors rythm the speed of imformation treatment in the brain through another pathway? Maybe the answer was brought by Nobuo Yanagisawa (2018) who explored functions and dysfunctions of the basal ganglia and adopted the Dynamic model of the basal ganglia function in Parkinson disease. At the left side of the figure we can see the contribution of the indirect and hyperdirect pathway in selecting the appropriate movement emphasizing therefore the essential role of the substantia nigra in the sensory-motor speed processing.

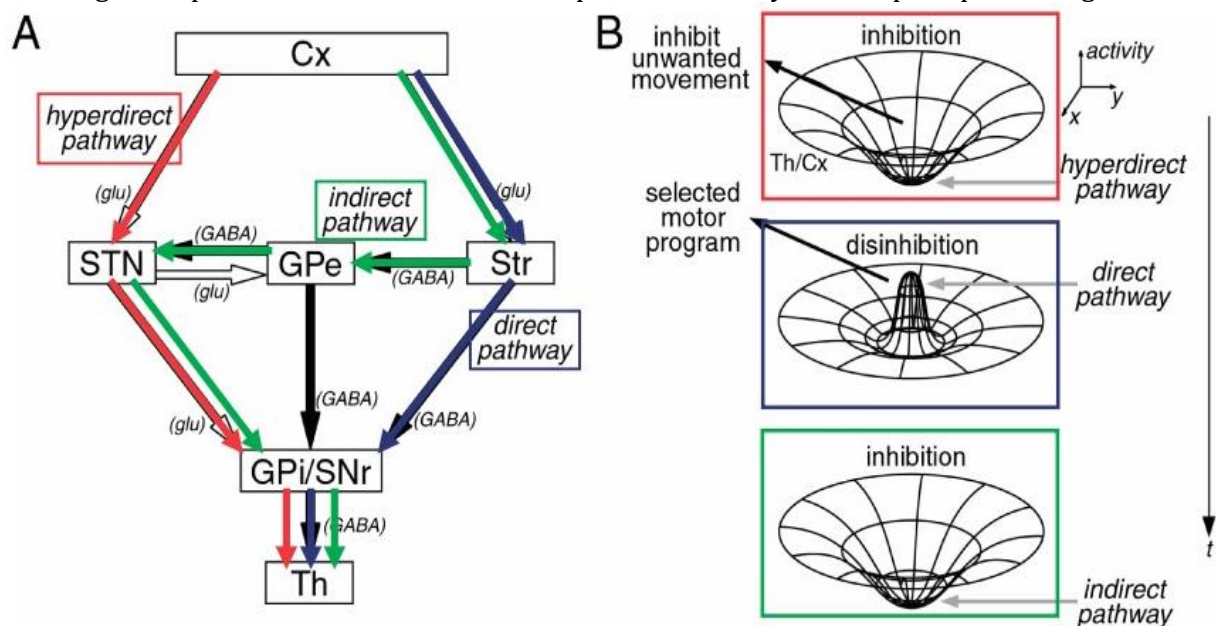


Fig. 2. Dynamic model of the basal ganglia function. The direct pathway releases only the selected motor program. Hyperdirect and indirect pathways inhibit other competing programs and help the direct pathway to release only the selected motor program at the appropriate timing. (Nobuo Yanagisawa, 2018, p 277)

So, given the inseparable nature of the conscious experience sensory motor processing that enhances executive functions, is it possible to integrate this model with schizophrenia? Dissociative symptoms in this later elucidate the disconnection from the physical time described

previously by the cases. In addition, schizophrenics have a greater sense of body property disturbance that can illustrate the dysfunctions of the hyperdirect and indirect pathways clearly observed in loss of the own hand movement, as in money counting syndrome for exemple (The syndrome



manifests itself clearly at Fateh), as well as in catatonic symptoms in the case of Saif. Accordingly the two neuromodulators systems (GABA, Glutamate) should have a critical role in the inhibition/ disinhibition movement process; but what about melatonin as a circadian hormone? Further more as a pleiotropic neuro-hormone? (Hardeland et al, 2011); recently, it has been suggested that melatonin, the pineal gland hormone, regulates the development of dopaminergic system and MT1 (melatonin receptor 1) is expressed in SN area (Uz T et al, 2005). It was mentioned above that schizophrenics have an accelerated internal clock which is associated with excessive alertness due to a dopaminergic dysregulation. Is it really a simple dopaminergic dysregulation? Does not this excessive vigilance reflect an imbalance in melatonin too? In the same context (Gordwood, 2010; Ghaemi, 2006) confirm that psychological time slows down among depression patient, as a result of the slowing down of their biological clock, and accelerates among manic disorder patients, as a result of an acceleration of their biological clock. Indeed, several studies stressed the melatonin implication in mental disorders but how can this hormone contributes in this kind of sensitivity? Is there another brain structures involved in the process of the spatio-temporal conscious experience concerned by this hormone?

Conclusion

To propose a schizophrenic framework according to Gray's theory on one hand & based on the general relativity on the other isn't an easy work at all. Firstly, because of the complex and interconnected activity of the brain, which has made it more difficult to adopt a neurobiological model consistent with the idea of a spatio-temporal collapse from a psychophysical point of view. Secondly, the reinforcement sensitivity theory did not address this disorder; therefore, an appropriate position within the psychological space-time reinforcement sensitivity framework needs to be clarified for schizophrenia; this may help to talk about black holes that embody the positive symptoms of the disease.

I think that schizophrenic patient is localised in the behavioral inhibition axis, which perhaps explains the difficulty of his orientation towards the future, as mentioned previously, because of his extreme sensitivity to painful experiences. As a result, the

gravitational acceleration of thought overloaded with pain and suffering leads to shrinking his space and extending his time. It is the situation that explains perhaps the position of Saif who still standing for long hours without the slightest physical pain. The collapse of his psychological space creates fission between the self and the physical reality that Clara Kean accurately described. The graphic collapse highlights the lack of turning back which is the base of future orientation.

Perhaps creative moments illustrate it differently where part of the mass of painful thoughts turns into energy that allows separation from here and now; leading to an overlap between normality / abnormality in a gray area which refutes the double classification to which we are accustomed in our lives, therefore it turns into a metacognitive domain, a meta-emotional case always described as spiritual, in which the gifted feels the pleasure through the pain instead of a more complex pain hypersensitivity observed in the case of the collapse of executive, cognitive and psychological functions are we really dealing with an Euclidean space?

Curvature requires geodesic geometry thus allowing access to another space in which the schizophrenic is isolated, Fateh describe this space as a dark vacuum; in contrast, the gifted in his creative moments may see it rich and refreshing. This is what needs to be studied in order to understand the complex activity of the schizophrenic brain. However, common symptoms of many disorders such as obsessive-compulsive disorder, schizophrenia, autism post-traumatic stress disorder and major depression, as well as degenerative diseases, frontal lobe syndrome and Alzheimer support the idea of the space-time collapse. Consequently, the focus on the neurological basis of these disorders may help us to propose, possibly, an expanded circuit based on the septo - hippocampal - prefrontal loop, which has its own multifaceted connections, specifically those in which the activity of the substantia nigra overlapped by the melatonergic system.

Let's go back to what was proposed in the first article about the hippocampus as a GPS, thus enabling mental time travels, especially after confirming the essential role of grid cells in the integration of time intervals. I think that the expansion to other brain structures of the septo-hippocampal system, which has been supposed to be the neurobiological basis of the psychological



space-time reinforcement sensitivity, is necessary. Thus, the role of the basal ganglia is highlighted through its cognitive functions (striatum prediction ability mentioned above) as well as the important role of substantia **nigra** in reward (Mehraein et al, 2011) and in dopamine D2 regulation of value-based decision making (Shinae Kwak and Min Whan Jung, 2019) as a proposal worthy of research and scrutiny which could bring the problem of neuro-regulatory systems back to the discussion. The opposing function of the striatonigral (direct) & striatopallidal (indirect) pathways is also discussed in the context of motivation and cognition, with the direct pathway being involved in learning from positive outcomes and the indirect pathway in learning from negative outcomes. Both are important not only for regulating motor activity but also for motivational and cognitive behaviors. Regulating the extent of bridging collaterals may therefore be important not only for refining locomotion but also for regulating cognitive and motivational behaviors. It was hypothesized that changes in the balance of the two pathways may also exist in patients with schizophrenia (Maxime et al, 2014). Does this confirm the dopamine hypothesis, which has always been at the forefront of the interpretation of schizophrenia? Or is it the dysfunction associated with the behavioral inhibition system, as a supposed axis of the schizophrenic position within the PSTRS, that will include the two famous opposite neuromodulatory systems? Are there other possible structures that would be involved in this type of sensitivity on which such interpretation could be constructed?

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