The Psychological Dynamics. A Mathematical Approach to the Tensional Adjustment Mechanism

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Abstract: This paper - representing a personal point of view of the authors - proposes a new psychological approach to tensional dynamics. The theme requires a theory of the representation of tensional states. For this purpose the hypothesis of the germination of tensional states is presented. Starting from a group of four differential equations the metrics of the tensional states, including the tensional adjustment mechanism, results.

Key–Words: Amplitude of the tensional state, Extinction of the tensional state, Lie group, Metrics, Neuropsychological activation, Psychological experience, Tensional dynamics

1 Introduction

The dynamics of the tensional states [5], [6] dictated by complex informational feedbacks, is a remarkable regulator for the outlets of personality manifested in the behavioral plan.

The evolution mechanisms of the tensional states are responsible for the repartition of the excitation energy, a possible source for the appearance of psychological lack of balance. Their functioning is analogous to the functioning of selectors, influencing the quality of psychological statuses.

The preservation of un-altered psychological statuses involves the permanent activation of certain commands for the rehabilitation of the psychological system, materialized in the inhibition or the excitation of tensional dynamics [3], [4].

The regulation of tensional states in conditions of altered dynamics asks for the employment of certain "optimal control" type programs that should transform the system into a viable one, under conditions of utmost efficiency (time, resources, etc.).

Dealing with the dynamics of psychological statuses raises the problem of finding corresponding forms of the representation of tensional states.

The tensional state, modulated by the perception of the tension, is determined by the lack of balance materialized in needs (physiological or superior needs). The association between tensional states and needs offers flexibility in representation, using Maslow's idea in a form generalized through the imaging of a construct with "c" levels.

The register of any tensional state has three phases: birth – evolution – gratification. If the phase of evolution obeys the laws of dynamics, the birth and the gratification phases are the effect of the strategies of the cognitive system to allow or repress the tensional state. Thus, the tensional state can be defined by a couple of measures (α,β), designating the activation level, respectively the gratification strategy adopted by the psychological system. At each level of activation "c" possible strategies of gratification are associated and a total of "cxc" gratification strategies are also associated to "c" activation levels.

In this frame of representation the dynamic laws of the tensional states should be identified. Amazingly, at the psychological level, things seem to be in contradiction with the reality of the physical world, where bodies of high density attract the flow of matter positioned in a certain area of proximity. At the psychological level, we deal with the flow of attention.

The only way to solve the contradiction, at least at the conceptual level, is to accredit the idea of the existence of certain "germination processes of the tensional states", an idea that we will be dealing with in the following paragraphs. At the psychological level, the more a tensional state increases in amplitude, the more it tends to attract

the flow of attention. The dynamics of the tensional states is limited by the capacity of administration of the cognitive system. The guarantee of the strategy given by the cognitive system to the gratification of the tensional state is doubled by the expected horizon of a gratification (in terms of psychological experience). The amplitude increases in the same time with the approach to the expected limit of tensional extinction and in the same time with the increase of the ratio between the current neuropsychological activation and the minimal one needed for the activation of attention. For the dynamics of the amplitude of the tensional state, we propose the following relation:

$$b_n(t_i) = a^{-(n+1)} \frac{1 + \ln m(t_0)}{\ln m(t_0)} \frac{\ln m(t_i)}{1 + \ln m(t_i)} \quad (1)$$

where: i – the degree of the tensional state; t_i – the psychological experience – the unit of measure is "second x piece of information" - which is associated with the tensional state i; t_0 – the resident psychological experience which is determined by personality; n – the degree of the failed gratification; a– the number of sources which generate the tensional states; $m\,(t_i)$ – the ratio between the current neuropsychological activation and the minimal one which is necessary for the activation of attention; $m(t_0) \neq \{0, 1\}$. When $t_i = t_0$ then $b_n(t_0) = a^{-(n+1)}$. In the following paragraphs we will analyze the interesting case $t_i \neq t_0$.

What is the meaning of the number of gratifications and what is the connection with the consistency of the tensional state? The reach of the horizon of expectation for the gratification of a tensional state coincides with the exhaustion of the possibilities of administration of a superior dynamics. In the absence of tensional extinction, the cognitive system interferes through the identification of a "derived tensional state" connected to "the original tensional state" and through the evaluation of a new horizon of expectation. The derived tensional state increases the consistency of the original tensional state, tending to quantitatively orientate the flow of attention toward the last one. A new failed horizon of expectation will attract "the germination of another derived tensional state" from the tensional state previously derived, and so on. The hermetic quality of this point of view is checked through the fact that the germination of the tensional state supposes a tensional amplification, determined by the capacity of the cognitive system to identify the original causes. The passing from the original tensional state to the derived tensional state is followed by an amplifying, at least at the perception level, of the psychological tension. This is an adapted form of Heisenberg's uncertainty principle, which leads to behaviors of the "black hole" type.

In the psychological plan, a tensional state, disposing of a certain degree of "failed gratification", becomes a sufficiently powerful attractor in order to make impossible a psychological detensioning. The same effect is produced by the inhibition of the original dynamics of the tensional state, associated with a correct dynamics of the derived tensional state(s). The register of the resetting of a psychological system on wrong formulae should be completed with the situation of a correct dynamics of the original tensional state associated with an incorrect dynamics of the derived tensional state. In this case the cognitive system interferes by correcting the altered dynamics.

Beyond these specific aspects of representation, very important by the perspectives they offer in the research of psychological pathology and, in the same time, in the research of the conditions for the resetting of the psychological system on correct formulae, we believe that interest should be focused on the research of the laws of the administration of tensional states, applied by the psychological system. The enunciation of these laws, provided they are correct, would describe the administration capacities of tensional states.

In the following chapters we present a mathematical point of view starting from the theoretical framework of the representation of tensional states described above and from a group of four differential equations, describing the behavior of certain essential psychological measures which are involved in the tensional dynamics.

2 The Mathematical Model of the Qualitative Dynamics of Tensional States

The approach starts from the following hypothesis:

1. The variation of the psychological experience (t_i) function in physical time $(\bar{t})$ is given by the capacity of the stimulus to attract attention (c). In its turn, the capacity of the stimulus to attract attention is dependent on the capacity of the person to value the stimulus (v_i - apperception);

$$\frac{dt_i}{d\bar{t}} = c(v_i) \quad (2)$$

2. The variation of the ratio between the current neuropsychological activation and the one necessary for the activation of the attention (m_i) function in physical time ($\bar{t}$) is inversely proportional to this ratio (m_i);

$$\frac{dm_i}{d\bar{t}} = -\alpha m_i \tag{3}$$

where α is a positive constant.

3. The variation of apperception (v_i) function in physical time ($\bar{t}$) is inversely proportional to apperception (v_i);

$$\frac{dv_i}{d\bar{t}} = -\beta v_i \tag{4}$$

where β is a positive constant.

4. The variation of the amplitude of the tensional state $b_n(t_i)$ function in physical time ($\bar{t}$), is:

$$\frac{db_n(t_i)}{d\bar{t}} = -\frac{1+\ln m(t_0)}{\ln m(t_0)} \frac{\alpha a^{-(n+1)}}{(1+\ln m(t_i))^2} \tag{5}$$

It is easy to see that this relation can be obtained by computing the temporary derivation of the relation (1).

Taking into account the fact that the measures {t, m, v, b} are associated with the tensional state "i", in the following paragraphs we will ignore this index. The measures which are associated with the index "0" are constant because they depend on personality and not on a tensional state.

3 The Tensional Adjustment Mechanism as a Defense Mechanism

The defense mechanism theme has made a strong come back in topical preoccupations field, although it was excluded from academic speech for a number of years [1], [2]. Many cognitive psychologists assign a major role to defense mechanisms in the approach to the explanation of psychological functionality.

It's difficult to identify a coherent theory of the functionality of defense mechanisms because they cannot be seen. They constitute unobservable pieces of a puzzle which defines an observable structure – behavior. We have the strong conviction that the reason of the credible existence of defense mechanisms submits to certain laws which define the fundamental formulae of the functionality of the psychological system, specific to the person. In this statement there is a seeming inconsistence generated by the term "fundamental formulae". The term must be understood as an essential structure which must be maintained by another structure or other structures which describe the particular. The essential visible structures in psychology present the characteristics of repeatability, measured by constants or recurrences. The essential structures are strong structures which are also maintained in the specific conditions of psychological lack of balance. It is interesting to treat the case in which the weak particular structures become strong structures in the sense mentioned above. We infer here the activation of certain severe mechanisms of overlapping between homeostasis and entropy with negative consequences in distinguishing between these two natures. The approaches which focus on the essence of defense mechanisms suffer of inconsistency, just by being inefficacious in identifying the essential.

The purpose of this paper consists in identifying the essence of the defense mechanism – involved in tensional adjustment – by pointing out the dynamic laws of the main tensional psychological measures which are influenced by this mechanism.

The particularity of the action of defense mechanisms consists in the breaking of the equivalent evolution tendencies of the psychological measures (constants, linear, exponentials etc.) for the purpose of the preservation of unaltered psychological statuses. The defense mechanisms become active when the meters of the cognitive system detect values which are placed in the tolerance area of the psychological system integrity.

The couple "defense mechanism action – psychological measures (those dynamics)" is governed by invariance laws (laws of the type $M^{\alpha}M_{\alpha} \rightarrow invariant$) which assure the dynamics of the psychological system in its functional parameters. The invariance laws, at least in psychology, could be interpreted as dynamic equilibrium laws, which have the capacity of describing the whole functional register of the psychological system, from the right (re)structure formulae to the wrong resetting formulae.

The essence of the defense mechanisms functionality consists in the preservation of certain specific restoring formulae of the psychological system as an effect of annihilating entropic ten-

dencies (internal or external).

The activation frequency of the sources generating tensional states is, to a large extent, determined by the specifics of tensional habituation which restricts the domain of activation of the tensional states selector to those options that are meant to avoid the unpleasant and to conserve the pleasure. Each of the two components – the unpleasant and the pleasurable – amplifies in its dynamics the potential of switching to the opposite state.

There are serious reasons to advance the idea that the action of defense mechanisms can be described by using gradient type measures. These refer to the target of these actions, which consists in the counteracting of non – specific tendencies of dynamics of psychological measures. The effects of the action of the defense mechanisms appear - as purpose - in psychological experience. We could interpret the action of these mechanisms by using a function of psychological experience that should, of course, be a gradient. However, this gradient influences simultaneously the dynamics of apperception, of the ratio between the current neuropsychological activation and the minimal one needed for the activation of attention and of the amplitude of tensional state, which makes it possible to identify it mathematically through a coefficient (a_{ij}) of the metric tensor $ds^2 = a_{ij}dx^i dx^j$. For reasons presented above a_{ij} should not be a constant. The presence of constant coefficients designates a non specific situation, determined by the blocking or the lack of defense mechanisms.

Taking into account the aspects mentioned above, we present a mathematical procedure of the determination of the action of defense mechanism which is involved in the dynamics of the ratio between the current neuropsychological activation and the minimal one needed for the activation of attention, of apperception and of the amplitude of tensional state.

3.1 The mathematical expression of the mechanism of tensional adjustment

Let's suppose that c(v) is a constant. The R^4 manifold's fields of tangent vectors which generate actions determined by the above mentioned equations are written:

$$X_1 = c(v)\frac{\partial}{\partial t} \tag{6}$$

$$X_2 = -\alpha m\frac{\partial}{\partial m} \tag{7}$$

$$X_3 = -\beta v\frac{\partial}{\partial v} \tag{8}$$

$$X_4 = -\frac{1+\ln m(t_0)}{\ln m(t_0)}\frac{\alpha a^{-(n+1)}}{1+\ln m(t)}\frac{\partial}{\partial b} \tag{9}$$

A simple algebraic calculus leads to the R^4 Lie group endowed with the law

$$(a,s,c,d)\cdot(a',s',c',d') = (a+a', s+s', c+c', d+d') \tag{10}$$

where: $c\bar{t}1 = a$, $\alpha\bar{t}2 = s$, $\beta\bar{t}3 = c$, $\frac{1+\ln m(t_0)}{\ln m(t_0)}\frac{\alpha a^{-(n+1)}}{d}\bar{t}4 = \mathrm{d}$. The Lie algebra of the R^4 Lie group is isomorphous with the Lie subalgebra

$$L = \left\{\lambda_1\frac{\partial}{\partial x^1} + \lambda_2\frac{\partial}{\partial x^2} + \lambda_3\frac{\partial}{\partial x^3} + \lambda_4\frac{\partial}{\partial x^4} \mid \lambda_i \in R\right\} \tag{11}$$

where x^i are the coordinate function associated to the R^4 manifold.
The associated metrics has the following form:

$$\mathrm{d}s^2 = \left(\mathrm{d}x^1\right)^2 + \left(\mathrm{d}x^2\right)^2 + \left(\mathrm{d}x^3\right)^2 + \left(\mathrm{d}x^4\right)^2 \tag{12}$$

The presence of the constant coefficients in this metrics describes a tensional psychological dynamics with entropic valences. In this metrics there is no involved the tensional adjustment mechanism.

The presence of the tensional adjustment mechanism should fit in the metrics formula in the form of a function of psychological experience that should modulate the dynamics of the ratio between the current neuropsychological activation and the minimal one needed for the activation of attention (m), of apperception (v) and of the amplitude of tensional state (b). The metrics should have the form:

$$\mathrm{d}s^2 = (i\mathrm{d}\bar{t})^2 + h(t)\left[(\mathrm{d}m)^2 + (\mathrm{d}v)^2 + (\mathrm{d}b)^2\right] \tag{13}$$

Using the tridimensional metrics $\mathrm{d}s^{(III)2} = h(t)\left[(\mathrm{d}m)^2 + (\mathrm{d}v)^2 + (\mathrm{d}b)^2\right]$ and the corresponding expressions of the Christoffel coefficients, the expression of the tensional adjustment mechanism h(t) results:

$$h(t) = \frac{4}{(\mathrm{o}t + \mathrm{p})^2} \tag{14}$$

where o and p are constant, $K = -\frac{3}{4}\mathrm{o}^2$, $\mathrm{o}t + \mathrm{p} < 0$. Thus, the complete metrics for tensional state dynamics is written:

$$\mathrm{d}s^{(IV)2} = (i\mathrm{d}\bar{t})^2 + \frac{4}{(\mathrm{o}t+\mathrm{p})^2}\left[(\mathrm{d}m)^2 + (\mathrm{d}v)^2 + (\mathrm{d}b)^2\right] \tag{15}$$

4 Conclusions

1. There is a serious difference between tensional state amplitude and tensional state amplitude perception. The theory of tensional state germination – a unifying theory of physics and psychology – shows that in the context of the cognitive solving of a certain tensional state, passing from the general to the detailed is felt by an amplified perception of the tensional effort. The finest detail of a certain unsolved problematic situation would be felt at the maximum level in the conditions of blocking the tensional adjustment mechanism.
2. The action of the tensional adjustment mechanism reduces at the perception level the tensional effort.
3. The tensional adjustment mechanism defends the psychological system by strong stimuli imposing restrictions on the neuropsychological activation and on the apperception.
4. The psychological system collapses when $\mathrm{o}t + \mathrm{p} = 0$. The avoidance of the collapse is possible if the psychological system changes the psychological experience scale through the law $t \to f\left(-\frac{p}{o}\right) \neq 0$.

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