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PSYCHOPHYSIOLOGICAL REGULARITIES OF THE DYNAMICS OF INDIVIDUAL EXPERIENCE AND THE "STREAM OF CONSCIOUSNESS"

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ABSTRACT

The views are formulated on the regularities of formation and dynamics of individual experience developed in the framework of systemic psychophysiology on the basis of ample experimental material. The formation of a new element of individual experience - new system - is considered to be a fixation of a stage of individual development. Behavioral continuum is viewed at as a chain of behavioral acts, the results of which are achieved due to the simultaneous realization of functional systems of different "age", these systems representing the elements of individual experience. This approach to a behavioral continuum made it possible to describe the contents and dynamics of consciousness and to define its levels. The first level of consciousness is related to the stage of the realization of a behavioral **act** during which the predicted parameters of intermediate subrcsults arc compared with the actual ones. The second, higher level - with the transitional processes of comparison of the predicted and actual parameters of the result of a performed act linked with the processes of organization of a next act. The contents and significance of consciousness are described as an organism's evaluation of its relations to environment at the mentioned stages that depends on the individual experience and results in its updating.

1. Introduction

The main task of the present report is to analyze the linked problems of "temporal organization of eonsciousness" (Fessard, 1954) and its significance in the framework of the systemic psychophysiology (Alcxandrov, 1997; Alexandrov & Jarvilehto, 1993; Shvyrkov, 1989, 1995). As is clear from the recent discussion on the neural correlates of consciousness (C) (Block, 1996), in order to investigate this problem it is essential to have a precise definition of the concepts "experience" and "consciousness". It will be demonstrated below that the concept "experience" is vital for the development of views on "consciousness" because these two are quite different, whatever the level of C is under consideration (cf. "phenomenal consciousness is just experience" (Block, 1996, p. 456)). This statement will become clear after we analyze the individual experience (IE) and see what must "happen" to IE (dynamics of its realization) to make it possible to speak about C.

2. Individual Experience

2.1. Theory of Functional Systems and Systemic Psychophysiology

In order to describe the cerebral basis of IE, we should, first of all, define the elements of IE (EIE).

Today only a few researchers doubt the conception that the "properties ... of a brain are emergent"; they are "systemic", not "just the sum ... of properties" of neurons but a specific quality that emerges as a result of "dynamic interaction" of neurons within system (Mountcastle, 1995, p. 294). From the analysis of possible levels of the studies of behavior it may be concluded that the level of "unified group of neurons" subserving respective behavior is the lowest possible (i.e. most elementary) level of analysis where behavior may still be described as an emergent function (Bottjer et al., 1994). In connection with this, a cerebral equivalent of EIE, which is established during the formation of a new behavior and realized during its subsequent performance, may be defined as an organization of a group of neurons composing the corresponding system. Naturally, the question - what does the author call a system? - arises, and this question must be answered before we can use this understanding of EIE in order to describe the formation and realization of IE.

From our point of view, the most well-developed and consistent version of systemic approach to the analysis of neuronal basis of behavior is the theory of functional systems elaborated by P.K.Anokhin and his school (Anokhin, 1973). The pivot of this theory is the definition of a system-creating factor - the result of a system, which is understood as a desired relation between an organism and environment, achieved through the realization of that system. In other words, the principal determinant of a system is an event that is not in the past with respect to behavior - a stimulus, but in future - a result. Thus a system is understood as a dynamic organization of activity of components with different anatomic localization, the interaction of which takes form of mutual cooperation in the process of ensuring a result, adaptive for an organism.

Taking into account the aforementioned ideas, if we consider the Behterev's statement "the reaction to external influences takes place not only in living organisms, but also in objects of non-living matter" (Bchtcrcv, 1991, p. 21) we can thus agree only with its second half. Indeed, the object of non-living matter do respond to external influences. As for a living organism, if we consider it not as a physical body but as a integral individual performing adaptive behavioral acts, then we have to admit that it anticipatory reflects the world and that its activity in any moment is not a response to the past, but preparing, shaping future.

So the first major advantage and distinction between the theory of functional systems and other variants of systemic approach is incorporation of the result of

action into the conceptual framework. Thus theory of functional systems, firstly, included the isomorphic system-creating factor into the conceptual apparatus of systemic approach, and, secondly, it radically changed the understanding of the causation of behavior.

According to the classic interpretation oi the theory ol lunctional systems, the activity of all elements is integrated into a system through the special systemic mechanisms. Afferent synthesis during which, on the basis of motivation, taking into account the environment and former experience, the conditions are created to eliminate the redundant degrees of freedom - make decision what should be done and how to achieve the adaptive result. Decision making ends with the formation of the acceptor of action's result, i.e. the apparatus to predict the parameters of future results - intermediate subresults and final result - and to compare them with the parameters of results actually achieved during the realization of the program of action. The comparison with the parameters of intermediate subresulls reveals the correspondence of the stages of realization of the program to the planned ones; the comparison with the parameters of the final result reveals the correspondence between the achieved organism-environment relation and the relation that was planned when the system was formed. These systemic mechanisms compose the operational architecture of any functional system. The incorporation of these mechanisms into the conceptual apparatus is the second advantage and another feature distinguishing the theory of functional systems from other variants of systemic approach.

It was demonstrated that the mutual assistance during achieving any behavioral result is ensured by uniting synchronously activated neurons located in different brain structures into a system (Shvyrkov, 1990). Facts, confirming this suggestion, have been constantly accumulated, they are considered to be more and more important for the understanding not only of a definitive behavior, but of learning as well. The association of synchronously active cells may subserve the achievement of the result even during the first trial acts and serve as a base for further consolidation: "Neurons wire together if they fire together" (Singer, 1995, p. 760).

Thus neurons from different brain regions are involved into systemic processes synchronously. These processes have an all-brain nature and cannot be localized in any brain structure. Different brain regions during behavior house not local afferent or efferent processes, but universal all-brain systemic processes of organization of neuronal activity into a system which is neither sensory, nor motor, but functional. The fact that neurons of different brain regions are synchronously involved into all-brain systemic processes does not imply that brain structures are cquipotential - the role of a certain structure in subserving of behavior depends on the specificity of projection of IE to this structure (Alexandrov et al., 1997).

2.2. *Behavioral Continuum*

The theory of functional systems considers behavioral act not as an isolated entity, but as a component of a behavioral continuum, the succession of behavioral acts performed by an individual during life. Then it appears that the next act in a continuum is realized after the result of the previous act is achieved and evaluated. Such evaluation is the necessary part of organizational processes of the next act; these processes then may be considered as transitional, or processes of transition from the realization of one act to the realization of the subsequent act. There is no room for stimulus in a continuum (fig. 1). The environmental changes that arc traditionally considered to be a stimulus for the given act are informationally linked with the preceding behavior in course of which these changes were anticipated, planned in the model of future behavioral result - the goal of behavior.

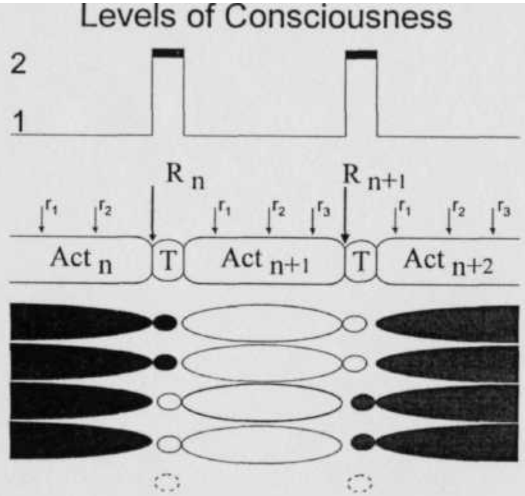

Fig. 1. Levels of consciousness and behavioral continuum.
Above - levels of consciousness **1** and **2** corresponding to the evaluation of intermediate subresults (**r_1**, **r_2**, **r_3**) and results of behavioral acts (**R_n**, **R_{n+1}**), accordingly. **T** - transitional processes.
Below - the sets of systems that subserve the realization of the successive acts in continuum (each set is represented by its own shading). Open dashed ovals - systems to which "non-redundant" neurons belong (see text).

Then what about unexpected changes? What modifications of the succession of behavioral acts may result from the change in the environment that was not anticipated during the previous behavior and thus is not a result of that behavior? Such change will either have no effect on the planned succession of the acts in a

continuum (and in this sense will be "ignored"), or interrupt the succession, determining the formation of different kinds of behavior depending on the situation: repeating the interrupted behavioral act, formation of a new behavior (e.g. orienting behavior) etc. And again, all these behaviors will be aimed at future and their organization will be an informational equivalent of a future event.

Behavior may thus be considered as a continuum of results (Anokhin, 1978) and a behavioral act - as a part of a behavioral continuum between one result and the next one (Shvyrkov, 1990).

2.3. Systemogenesis

Besides the aforementioned systemic idea, another important source-concept of the theory of functional systems was the idea of development. Both ideas were merged into the concept of systemogenesis which stated that during the early ontogenesis those differently localized elements undergo selective and accelerated maturation that are essential for achieving the results of the systems, providing for the survival of an organism at the early stages of individual development (Anokhin, 1973). Nowadays the idea that many regularities of modification of functional and morphologic characteristics of neurons, as well as of a control of genes expression, serving as a basis for the formation of adaptive behavior in adults, are comparable to those found at the early ontogenctic stages becomes a commonly accepted point (Anokhin & Rose, 1991; Bottjer et al., 1994; Singer, 1995)).

The idea that systemogenesis takes place not only during the early ontogenctic period, but also during adult development, because the formation of a new behavioral act is always a formation of a new system, was formulated within the framework of the theory of functional systems nearly 20 years ago (Shvyrkov, 1978; Sudakov, 1979). Later it was suggested that the principal aspect of understanding the role of different neurons in the organization of behavior is to take into account the history of behavioral development (Alexandrov, 1989; Alexandrov & Alcksandrov, 1982), i.e. the history of the successive systcmogenies, and the system-selective concept of learning was inferred (Shvyrkov, 1986, 1995). The latter concept is in line with the modern ideas of "functional specialization" which substituted the idea of "functional localization" (Mountcastle, 1995) and with the idea of selective, instead of instructive, principle underlying learning (lidelman, 1987). This concept considers the formation of a new system as the fixation of the stage of individual development - the formation of a new IillI during learning. The base of this process is the specialization of some "reserve" (silent) neurons, but not the change of specialization of previously specialized units. Thus, the new system becomes an "addition" to existing EIE. The selection of particular neurons from the reserve is governed by their individual features, i.e. by the characteristics of their "metabolic needs" that arc genetically determined. To make the last statement more clear, we will need a more thorough analysis of the modern views on determinants of ncuronal activity proposed by systemic psychophysiology.

2.4. Systemic Determination of Neuronal Activity

In the framework of reactivity paradigm individual's behavior is a reaction to stimulus. This reaction is based on the propagation of excitation along the reflex arc: from receptors through central structures to effector organs. This paradigm treats neuron as an element of reflex arc, while its function is a propagation of excitation. Then it would be absolutely logical to consider the determination of activity of such element as follows: "...response to stimulus that affected some part of its (nervous cell - Yu.A.) surface may travel further along the cell and act as stimulus on other nervous cells..." (Brink, 1960, p. 93). Thus reactivity paradigm methodologically treats neuron quite logically: neuron, just like an organism, responds to stimuli. Impulses that a neuron receives from other cells act as stimuli, while the response of a neuron is its discharges following the synaptic input (fig. 2).

Unfortunately, such methodological consistency was absent in the activity paradigm. Usually the analysis of "neuronal mechanisms" of goal-directed behavior led authors to the idea that an organism performs goal-directed behavior, whereas its separate element - neuron - responds to incoming excitation - stimulus.

This eclecticism was overcome and the views at the determination of ncuronal activity were adapted to the demands of systemic paradigm when the interpretation of neuronal activity as a response to synaptic inflow was abandoned. At the same time it was accepted that a neuron, like any other living cell, realizes a genetic program which requires metabolites received from other cells (Shvyrkov, 1995). Then the succession of events in neuron's activity appears analogous to that characterizing an active goal-directed organism, while neuron's discharges are analogous to the activity of an individual (fig. 2).

Neuronal activity, like a behavior of an organism, is not a response, but a way of changing the relation to environment, "action" that removes discrepancy between "needs" and microenvironment, causing modifications in blood flow, metabolic inflow from glial cells, activity of other neurons. If these modifications are adequate to the current metabolic "needs" of a neuron, they enable the cell to achieve a "result" (receive a set of metabolic substances binding to neuron's receptors) and cause the cessation of unit's discharges. It is assumed that the discrepancy between genetically determined "needs" and metabolic substances actually received may be due to genetically determined metabolic changes in the cell as well as to the change of metabolic inflow from other cells. Thus neuron is not an "encoding element", "conductor", or "summator", but an organism within organism, providing for its needs with metabolic substances received from other elements.

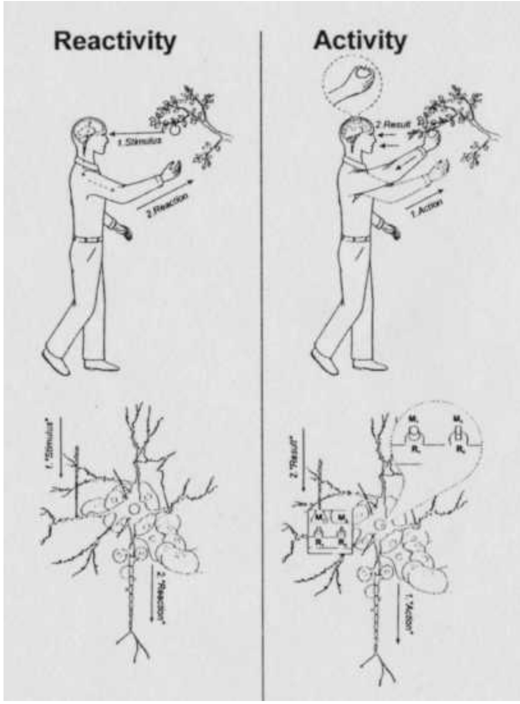

Fig. 2. Individual and neuron in activity and reactivity paradigms. Digits in the schemes indicate **the** order of events. According to the reactivity paradigm. **Stimulus (1)** is followed by **Reaction (2)** - behavioral in human, discharges in neuron. In the latter case, the role of a stimulus is played by discharges of a neuron, the axon of which (parallel to the arrow labeled **"Stimulus")** contacts dendrites of the target neuron. **"Reaction"** implies discharges of target neuron. According to activity paradigm, **Action (I)** (behavior in human, discharges in neuron) leads to achievement of **Result** and its evaluation **(2)**. Dashed lines encircle the model of a future result: for human - contact with the goal-object and for neuron - receiving certain metabolic substances (**M^1** - from a contacting neuron, **M^2** - from a neighboring Gail cell) that bind to neuron's receptors (**R^1, R^2**).

Neuron may provide for its metabolic "needs" only by joining with other elements of an organism to form a functional system. Their cooperation, joint activity subserves achievement of a result, i.e. new relation of a whole individual and environment. "From within", at the level of separate neurons, achievement of a result appears as satisfying metabolic "needs" of neurons, and it stops their activity.

So, metabolic heterogeneity of neurons, genetically programmed and based on individual development, i.e. being the product of interaction of phylo- and ontogcnctic memory, underlies (he diversity of functional specialization of neurons and determines the specificity of their involvement into the newly formed systems.

2.5. History of Formation of Behavior and its Systemic Structure

Newly formed systems do not substitute previously existing ones, but "superimpose" over them: the appearance of neurons with new specializations results in the increase of the total number of units activated in the behavior whereas the number of neurons with old specializations does not decrease (Gorkin, 1988; Shvyrkov, 1986). The data supporting the suggestions that the number of active neurons is increased during learning, and that learning is accompanied rather by the involvement of new neurons than by "re-learning" of the old ones have recently been also obtained by other laboratories (Bradley et al., 1996; Wilson & McNaughton, 1993).

What docs it mean - "superimpose, but not substitute"? Many experiments in our laboratory have demonstrated that a complex instrumental behavior is ensured not only by the realization of new systems (fig. 3, NS), that were formed during the process of learning of the acts composing this behavior, but also by the simultaneous realization of older systems (fig. 3, OS), that had been formed at previous stages of individual development. The latter may be involved in the organization of many behavioral patterns, i.e. belong to E1E that are common for various acts (fig. 3). It must be noted that if the same neuron belonging to "common" systems is involved into different acts, characteristics of its activations in these acts differ, since it must coordinate its activity with the activity of different sets of neurons (Alexandrov, 1989).

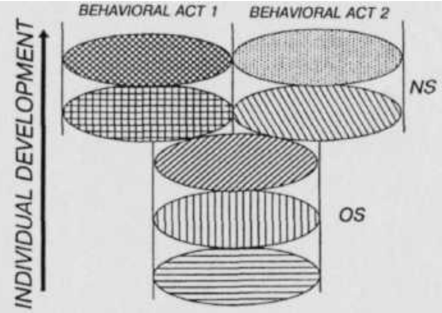

Fig. 3. Systemic structure of behavior.
1, 2 - different behavioral acts. OS - old systems. NS - new systems. Arrow - course of individual development.

The experiments studying the activity of neurons in the freely moving rabbits (Alexandrov et al., 1990, 1990a) demonstrated that during any behavioral act, e.g.

taking of food, that is presented after pressing a pedal, from one of two feeders, the simultaneous activations of neurons belonging to different systems is displayed. 1. Neurons belonging to the most archaic systems - they are activated in relation to any mouth opening (food taking, chewing, defense behavior, etc.). 2. Neurons, belonging to systems formed later than the previous ones, but before an animal was trained to perform instrumental behavior in the experimental cage - they are active only during mouth opening for taking food presented into any feeder, from the floor of the cage, from experimenter's hand, etc. 3. Neurons belonging to the newest systems formed during learning the instrumental food-acquisition behavior - they arc active during only specific food taking - from one feeder, but not from the other.

Therefore, it appears that the realization of behavior is the realization of the history of development of behavior, i.e. of many systems, each fixing the certain stage of development of the given behavior.

2.6. Systemic Solution of the Psychophysiological Problem

From the behavioristic point of view it is possible to assume that the way of solving the mind-body problem does not affect neither the type of selected scientific task, nor the formulation of this task (Watson, 1980, p. 25). We believe that it is the solution (even if it is implicit) of this problem that determines the conceptual apparatus of a study, its tasks and even methods. The above thesis is evidently applicable to the elaboration of views on C, this elaboration being most tightly linked with the preferred way of solving the mind-body problem (Hilgard, 1980).

The major drawback of traditional psychophysiology is the direct psycho-physiological correlation which inevitably results in understanding the psychic and physiological processes either as identical, parallel (then psychic appears to be an cpiphenomenon), or as interacting (thus admitting the influence of non-material mind on brain matter). These solutions of psychophysiological problem are centuries old - only the terminology was changed within the same alternatives (Leontycv, 1975). For example, Cartesian dualism implying the influence of mind upon brain through epiphysis is substituted by "trialism" of K.Popper and J.Ecclcs (1977) who define three worlds: World I - of physical objects and states, World II - of states of mind, and World III - of knowledge in the objective sense (including knowledge imprinted in material objects - diskettes, books, etc.). Mind influences brain via synapses.

As noted by P.S.Churchland (1986) many psychologists and physiologists today define the major obstacle on the way towards the synthesis of psychological and physiological knowledge - the fact that psychic phenomena arc emergent: at the psychological level, such specific qualities appear that are not characteristic for the physiological level. Systemic solution of the psychophysiological problem turns this emergent properties from the gap between psychology and physiology into a "conceptual bridge" linking these two branches of science thus creating a new research field - systemic psychophysiology (Shvyrkov, 1989, 1995). For such "conceptual bridge" between psychology and physiology, systemic psychophysiology uses the concept of qualitative specificity, emergent properties of systemic processes, into which separate, local physiological processes are organized to achieve behavioral result, but which cannot be reduced to the latter processes.

The essence of systemic solution of the psychophysiological problem is the following. Psychic processes, that characterize an organism and behavioral act as a whole, and physiological processes that take place at the level of separate elements may be related not directly, but only through the informational systemic processes, i.e. processes of organization of elementary mechanisms into a functional system. In other words, non-localized psychic events may be related not to the localized elementary physiologic events themselves, but only to the processes of their organization. Then the psychological and physiological descriptions of behavior appear to be just partial descriptions of the same systemic processes.

In the framework of these views mind is considered to be a subjective reflection of the objective relation between an organism and environment, while the structure of mind - a "system of interrelated functional systems" that were accumulated in the course of evolutionary and individual development. Studying this structure is studying the subjective, psychic reflection.

In accordance with the proposed solution of the psychophysiological problem, the tasks of systemic psychophysiology are formulated. The range of tasks of systemic psychophysiology includes studies of formation and actualization of systems, which are EIE, studies of their taxonomy, and dynamics of intcrsystemic relations in behavior which may be described qualitatively as well as quantitatively (Alexandrov et al., 1997).

2.7. Dynamics of Individual Experience

The views at the specialization of neurons as at systemic one, i.e. specialization with respect to EIE, and systemic solution of the psychophysiological problem that were presented above suggest that the description of systemic specializations of neurons is, at the same time, the description of the subjective world, while the study of the activity of these neurons is the study of IE dynamics. This dynamics may be characterized as the change of sets of active systems during the realization of behavioral continuum.

Transitional processes of a change of one behavioral act by another that were described above may now be viewed at as a stage when the change of one specific set of functional systems **(**EIE**)** and of related neurons by another set occurs. This stage of a continuum is characterized by the maximal modification of the

mentioned sets.

Transitional processes in humans and animals are correlated with ERP which different authors relate to change from one behavioral act to another, or from one "perceptive system" to another and with updating operation; the characteristics of ERP arc determined by the interaction between a trial's outcome and subject's expectancy concerning that outcome (Desmedt, 1981; Donchin et al., 1978; llorst et al., 1980; Maximova & Aleksandrov, 1987; Shvyrkov, 1990), as well as by the age of the actualized EIE (Alexandrov et al., 1997a). It was noted that transitional processes were also characterized by the "overlapping" activation of neurons related to the preceding and following behavioral acts, and by activations of "redundant" neurons that were inactive in processes of realization of the studied behavioral acts (Grinchcnko, 1978; Maksimova & Aleksandrov, 1987; Shvyrkov, 1990). However, it would be more adequate to speak here about a "co-activation" of neurons, during which the states of simultaneously active cells that belong to the systems of different acts linked by the logic of intersystemic relations, are coordinated. Such coordination is basic for the systemic processes that include the individual's evaluation of the achieved result, organization of the next act depending on this evaluation, and reorganization of relations among the systems of just realized act. Activations of "redundant" neurons indicate that these processes involve and, possibly, modify also the remaining EIE which arc represented by actually "non-redundant" neurons. Thus transitional processes arc considered here not as simple "overlapping" of the preceding and following behavioral acts but rather as the specific whole unit.

It is necessary to stress the principal role of the transitional processes in the organization of behavior in all cases, including the situation when the continuum is represented by definitive behavioral acts that are organized in constant, repeating sequences. What is this role, then?

As long ago as in 1932, F.Bartlett suggested abandoning the views on retrieval from memory as on the repeated excitation of unchanging "traces" (Bartlctt, 1932, p. vi). Later it was clearly demonstrated that not only complex acts may become progressively more perfect in course of thousands or even millions of realization (Gottlieb ct al., 1988), but even the most simple acts are actually "repetition without repetition" (Bernstein, 1966), and every perception may be considered as "an act of creation" (Edclman, 1987).

Analysis of activity of neurons in behavior (Alexandrov et al., 1997) reveals - we never deal with an isolated ("pure") retrieval from memory of the specific set of systems corresponding to the given act. Because of relations among EIE and depending on these relations, actualization of one EIE specific for the given act "affects" other elements, including those specific for other acts. Then it appears that processes of realization of a single behavioral act are corresponded by complex and dynamic system structure that is represented both by the systems always involved into the realization of the given act (specific set) and by systems, the set of which is modified from realization to realization of this act, but which are always involved into the realization of other acts.

The modification of the set is determined by the impossibility to reproduce completely the structure of intersystemic relations in repeated realizations of an act. Each of the successive acts differs from the previous ones at least due to the fact that it is preceded by a larger number of realized acts and thus may be characterized by another level of motivation, degree of automatization, etc. Moreover, the parameters of the achieved result arc not "exact mathematical correspondence to the anticipated ones" but "are always sort of a dispersion around ... the template anticipated in the acceptor of action's results" (Anokhin, 1978, p. 275). Thus transitional processes determine the concrete structure of intersystemic relations that cannot be an exact copy of the previous one. One must also take into account the necessity of urgent reorganizations of intersystemic relations that are due to changing environment of behavior.

3. Consciousness

3.1. "Stream of Consciousness" as a Alternation of Levels of Consciousness

The analysis of systemic organization of a behavioral continuum presented above makes it possible to define different stages in it and relate them to the "stream of consciousness" (James, 1890), taking into consideration that C is neither "one particular state" (Granit, 1977), nor "an enduring entity" (Ecclcs, 1992), and that degrees or levels may be selected in C (Granit, 1977; Fessard, 1954; Freeman, 1990).

Many authors relate conscious events to the process of matching of anticipated and actual parameters of a "perceptive state" (Gray, 1995; Kostandov, 1994; Ivanitsky, 1995 and others). It is apparent from the above that these processes take place during both the realization of a behavioral act (evaluation of subrcsults) and its consummation (evaluation of the final result). It is these processes that are considered by the theory of functional systems to be of vital importance for the organization of behavior during both the development of a behavioral act and during its subsequent use.

Taking into account all of the above, the following systemic description of the "stream of consciousness" may be formulated. Comparison of the actual parameters of subresults with the predicted ones during the realization of a behavioral act corresponds to the first level of C. Transitional processes from one behavioral act to another (comparison of the actual and predicted parameters of the result of the behavioral act) correspond to the second, higher, level.

It is possible to see some analogies between the first and second levels defined here with the levels of C defined earlier by Zinchenko & Morgunov (1994) - the level that may be related to the biodynamical structure of actions and the level related to ideas, concepts, etc. We, however, do not reduce the first level of C to only the "biodynamical structure" (see Alexandrov, this volume, on the transformation of results of whole acts to subresults).

3.2. The Contents and Significance of Consciousness

After we related the "stream of consciousness" to the stages of behavioral continuum that have different systemic meaning and defined the levels of C corresponding to these stages, we can now formulate the following definition. The contents and significance of C is the evaluation by an individual of its relation to environment during the realization of behavioral act and after the realization during transitional processes - this evaluation depends on IE and results in its updating.

From the viewpoint of the concept of co-activation of neurons occurring during transitional processes and resulting in the updating of IE and modification of relations among EIE, the ideas proposed by C. Von der Malsburg look interesting. He suggested that "the formation of assemblies is not only essential for the storage of information in learning and memory but also part of the "normal" information processing", during which "transient assemblies within 100-200 msec" are formed. Their formation is related to "rapid synaptic changes". It is suggested that the activity of such assemblies is coupled with these synaptic changes and with the "activity-dependent reorganization of the network architecture" (see in Flohr, 1995, p. 159). It is natural to assume, that the reorganization of relations among EIE and. consequently, among the neurons specialized with respect to these EIE, is characterized by such synaptic modifications. These modifications probably affect all co-active neurons belonging to the systems of the previous and subsequent act, as well as "non-redundant" neurons.

3.3. The "Seat of Consciousness"

There is an often arising question related to the neuronal basis of C - is it possible to link C with the activity of any certain structure, i.e. "localize" C, find the "scat of consciousness"? Many authors are skeptic about it (Dennet, 1995; Mersney, 1995; Umilta & Zorzi, 1995). Both processes of behavior organization (transitional) and of behavior realization to which we relate the levels 2 and 1 of C, correspondingly, have, as it was noted above, the all-brain nature. From this viewpoint the aforementioned skepticism looks well-grounded. Loss of C resulting from reticular formation damage (see in Flohr, 1995), or impairment of a conscious report as a result of a damage of cortical and subcortical structures (blindsight - Coway & Stroeg, 1991) or of interhemispheric connections (experiments of Spcrry, 1976) do not prove the localization of C in any certain brain structure or hemisphere. These facts just demonstrate that a damage of a given structure results in these or those alterations in all-organism organization, which are more or less specific. It seems obvious that clinical data and experiments with lesions of brain structures help localize "a symptom, but not a function" (Luria, 1973).

3.4. Delayed or Anticipatory Consciousness

The present work is certainly not the first one attempting to analyze the temporal organization of C. The most significant contribution to the development of views on the timing of C was made by classic experiments of B.Libet (1993). His works, as later the works of other authors, dealt with the problem what time did input stimulus require to "enter consciousness". Authors present values ranging from 50 to 500 msec (Gray, 1995; Ivanitsky, 1993; Libet, 1993). Whatever the interval is, it is considered to be a "delay" necessary for C to appear, or an index of "dissociations in timing between brain and conscious processes" (Rosselti, 1992, p. 467).

Such views make authors formulate the question: what is the significance of C for the organization of behavior? "If consciousness is a product of Darwinian evolution, it must confer survival value and therefore it must affect behavior". However, "consciousness occurs too late to affect the outcomes of the processes to which it is apparently linked" (Gray, 1995, pp. 675, 672).

This problem is rooted in considering a stimulus as an event which is a starting point for all processes related to the formation of a conscious report. At the same time, to solve this problem one must also analyze the processes occurring before the given event.

Laboratory S-R task may be described in the same terms as any other behavioral continuum composed of behavioral acts linked by transitional processes (see fig. 1). An instruction to report some environmental changes (appearing stimulus) shapes the following structure of behavioral continuum, i) Behavior of waiting (passive waiting or active "getting" the required change that would become a result of this behavior); ii) transitional processes including the evaluation of parameters of the achieved result (appearing stimulus) with the predicted ones (provided by the instruction or learning) and the organization of iii) the following act - "report" (pressing a button, verbal, etc.) and/or "self-report" (e.g. counting); iv) transitional processes including the evaluation of results of report act and the organization of the following behavioral act - waiting (i). C relating to the transitional processes characterizes the processes of evaluation of the outcome of behavior of "waiting-getting" stimulus and makes possible the realization of a report act, anticipating it. Thus it is possible to consider not the "delay" of C, but the processes of a "change" of C, corresponding to the act of waiting, by C, corresponding to a report act (cf. overtones of C in James, 1890); it is also possible to consider the change of the levels of C, corresponding to the realization of behavioral acts and to the evaluation of their results. Thus it actually appears that C has neither beginning, nor end (Freeman, 1990) and that C is a correct succession

of changes combined and distributed in a special way (Spencer, 1876, p. 304).

Since, as it has already been noted, evaluation of results leads to update of IK used in behavioral acts that were realized previously and to the organization of IK for the realization of the following act, one may agree with the idea that "with consciousness, we actively reorganize the past as well as shape the future" (Lubow, 1996, p. 689). But with one edition - reorganization of the past is also essential for future and is directed towards the future: to the next phase of the realization of the program, to the next behavioral act in a continuum, to the next realization of a behavioral act just performed, to the IK as a whole. Thus, C is not delayed, but anticipatory.

The above idea may be considered as an answer to the question about the evolutionary significance of C It is the anticipatory nature of reflection that is the principal and specific property of life, that determined the ability of individuals to prepare for the forthcoming events organized in certain temporal sequences, and, in connection with this ability, the most fundamental characteristic of the living matter - survivability (Anokhin, 1978).

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