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General Psychology

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Information aggregating as a problem of personal self-orginazation

Efforts of integrating different trends in scientific research have actuated in recent decades. Effective research methods inter-infiltrartion between different brsnches of modern science becomes a standard, just as mathematization of many applied trends in sociology, psychology, pedagogy, etc. Author of this article considers methods of modern formalization and aggregating of psychological-pedagogic concepts of sense, individuality, intellect, etc. to be the most prospective in up-to-date methods. Some models and methods of realizing "sense extraction" procedure based on modern mathematic psychology are suggested in this article.

Key words*: information, aggregating, sense and sense-building, individuality, self-organization, order parameters, fluctuative and controlling parameters.*

In recent years, system approach in psychology has been developed mainly by means of creating systemic theories of distinct psychic processes and structures [12, 23]. System approach, which was formed in psychology due to efforts of well-known psychologists (such as B.F. Lomov, V.E. Klochko, E.V. Galadjinski), suggests viewing various psychic phenomena, processes and formations as multidimensional and multiqualitative objects, that have relatively independent levels and sections. Several models belonging to different areas of psychology act as a core or a prototype in this case. In other words, synthesis of two or several models, each representing certain aspect or section of studied object, is proceeded within system approach. For example, to solve a control problem of engineer-psychological type [26], it is necessary to take into account functioning of perceptive structure, special imagination, motor system, and personal factors of decision making. Herewith it appears that each of these aspects is developed separately and is described in corresponding model, but they have to be aggregated (combine aspects of research object into unified system) to obtain the solution of practical problem. Close to that is a case when several models are aggregated into one while each model becomes a level of the combined one for the purpose of creating a theoretical model [17, 27].

In terms of system approach a more common case would be a multidimensional synthesis [23, 26] of integrated model, when there is no combining of distinct peculiar component models into a common construction, but finding a construction that cancels many or even all previous "section" models. Such kind of situation is seldom

seen in science and is related to heuristic methods. Generally speaking, it is not always possible to determine the way a model was created by simply examining it. This is the methodological meaning of procedure convergence principle, that is rather well known in cognitive psychology.

Systematical development of many psychological science concepts in recent years is quite important, especially in case of sense and sense-building, integral intellect, etc. More and more developed models of these concepts, which are quite effective in their practical application, are being built. Many well-known psychologists (R. Kettel, F Vernon, D. Vescler, V.N. Drujinin, M.A. Holodnaya and many others [1, 5, 23, 25]) have researched models with two, three, and even four levels of hierarchy, with one or several main factors.

System approach is closely combined to evolution approach, which suggests using the principle of developing. Analysis of psyche evolution main principles is inseperable from the analysis of world evolution main principles. Famous psychophysiologist V.B. Shvirkov's words [29]: «Complication of systems and their correlation with environment in the following row: atoms, molecules, cells, multicellular organisms, combinations of organisms, human societies» confirm this directive in psychology. Evolution development principle acquires different forms depending on the area of it's application. So, for example, in area of intellect psychology development should be seen not as just one of research aspects, but as an immanent feature of any whole intellect research [25]. Moreover, the development principle in intellect psychology appears to be connected with the problem of synthesis of different parts of "multiaspect" [19] knowledge.

Herein the problem of correlation between system approach and evolution development principle appears from a different side. B.F. Lomov, while listing principles of system approach, includes the (evolution) development principle too: «System approach… demands studying phenomena in their development. It is necessary based on the development principle… Multiaspect research of psychic phenomena, their multidismensionality and multileveled nature, combination of different order features, complexity of determination building can be researched only when the system is studied in it's development. The existence of the system consists of its development. [12].

When analyzing systems, that appeared in the way of natural evolution, such as living beings, society, culture, language [20], psyche [23], the regularities of system functioning are mostly derived from already formed regularities of development which reflect a stable informational attractor. However, when researches of different evolving systems are being made, regularities of development and functioning may vary.

Certain extremity is connected with F. De Sossure [23] and ctructural approach to language as a full completed and self-sufficient system, that has it's inner regularities, and even a single element of which can not be deleted without breaking system's wholeness and with out changing the whole system.

From our point of view another variant is possible and preferable. It is implied from the research described in works of Nobel Prize Winner I. Prigojin for several physical and chemical (and later even for informational) systems where he showed presence of «bifurcation points» in which a system may take this or that way of development

under the influence of starting conditions [for example, 21]. Similar possibility of multiple development scenario is suggested by methodology of limiting ideal types suggested by M. Weber [7] in sociology and history.

Human being as the subject of psychology in modern postclassical vision is a complex self organizing system. Psychologically correct studying of human it is obvious that he is not only a product of his environment and circumstances, tha not only outer dynamics sets his existence but the inner as well – a human does not only react to outer influence but acts by himself [6]. That is why the term "self-organization" of human as a complex and active system reflects that fact with maximal accuracy.

A.G. Asmolov in his historical-evolution approach [4] allocates three "hypostases of human, revealing his essence and existence as a person:

- Human as a *multidimensional* entity, that shows itself at the same time as a participant of historical-evolutionary process, carrier of social roles and sociotypical behavior and a subject of individual lifeline choice, during which transformation of nature, society and oneself is carried out.
- Human as a discriminatory dialogic polyactive being, entity of which is created, transformed and defended in the world, in other people, in oneself.
- Human as a subject of unbound responsible goal-directed behavior, acting as a value in other's perception, including oneself, and possessing relatively standalone stable *holistic system of variable individual merits*, that characterize his distinctiveness and inimitableness in ever changing world."

And on: "… it becomes more and more obvious, that *multidimensionality* acts as a entitic characteristic of personality. Human, being "a measure of all things", has no measure for himself, since he conceptually can not be measured in one dimension.

Allocating *multidimensionality* as initial characteristic of personality understanding in nonclassic evolution approach allows distinguishing the history of development of personality conceptions as a history of *discovering different personality dimensions…"(* All allocations are ours. V.K.)

Evolution is development, despite the system it is studied relatively to. Human, organism, distinct functional systems, distinct sell, organism communities, etc., can be viewed as open dynamic systems that are not in a state of equilibrium, but are stable on account of potential states chaos self organizing into certain structures.

Many difficulties and contradictions of factorial research and most of their critics are explained by absence of time dimension in their models. From the point of view of suggested approach, forming and possible grounding of a structure lays not in the point on time axis where the structure of certain psychological construct is fixed, but is extended along whole period of previous development (at least from the moment of some bi- or polyfurcation). Thereafter, it's determinants and invariants appear not only inner, but outer alike [25, 27, 28]. Such approach allows broadening the diapason of explained phenomena, by including psycho-genetic phenomena and phenomena connected with intellect development.

Interaction and "contribution" of different organism life-support subsystems in natal system, formed for certain purposes, which in the mean time was written about by P.K.

Anokhin [3], «allows separating subsystems not by life-support functions (metabolism, movement, mirroring), but by functions of supersystem, that includes these subsystems."

Broad integration of multidimensionality and multilevel principles in cognition structures and integral individuality allowed formulating and denoting the direction in polymorphic individuality research. Based on whole individuality model general trait, i.e. it's multidimensionality and multilevel, a thesis [5, 16] about real and unbialedly grounded existence of universal individuality psychology, that possesses properties of self regulating and self organizing system, was profound. The meaning of named system principles reveals itself in other aspects as well [5, 26, 27]. Unti mow identification of personality and temperament was made by ether transitive, functionally-resulting, or processual methods [15, 24]. In all cases homogeneous or single-dimension characteristic of temperament and personality traits was used. Apparently, by matching personality and temperament, it is possible to gain an answer to what really hides in these constructs' correlations [8, 28].

Hereby, taking multidimensional and multilevel model of personality, that evolves (therefore, is dynamic) during the history of humankind and certain human life, allows using it to describe the apparatus of open complex self-organizing dynamic systems.

Research of individuality essentially depends on indeterminacy of qualitative and quantitative valuations of personality traits. Indeterminacy means danger of delusion and demands risk, risk amplifies indeterminacy and begets new problems. Indeterminacy is not a synonym to eventuality, but an independent systemic term, which includes eventuality as a component. Indeterminacy is a system containing unknown traits and their verges as subsystems, and this system is accessible to decomposition, stratification and classification. Allowance of decomposition is a separate problem, which in case of individuality research, lays in terms of well known Krone-Roads theorem [26]/

Probabilistic characteristics of indeterminacy may be used only to cases of indeterminacy, that possess stable statistics. In personality research we deal with particular unique situation. Only some of this situation's properties may have stable statistics. These are usually physical, much more seldom physiological or psychological properties.

Several different types of indeterminacy are specified in individuality research.

1. indeterminacy of traits, connected with nescience of particular values of eventual magnitudes and dependencies, statistical and probabilistic characteristics of which are known with this or that degree of particularity, or limits for maximum and minimum values are given (interval indeterminacy).

In system processes of integral individuality development (oftenly on account of nonlinearity of it's components) stochastic events happen – fluctuations, that sometimes can be marked and measured. Prognostics of fluctuations is rarely possible due to their diverse origin. This leads to detour of measured system characteristics from their actual values. Compared to system characteristic, fluctuation are small, a complex of fluctuations can cause little predictable and uncontrolled consequences, especially if the individual is psychically unstable.

2. Indeterminacy connected with nescience of dependencies characterizing in-personal and interpersonal processes.

Description of these dependencies is always approximate, sometimes unformalizable, and sometimes can be presented only in language of adequate model. But even in the latter case proper description of processes and values of characteristics are not always known. Usually they are known with an accuracy to approximation, defined by specifics of selected scale.

Difference between actual and approximated values can be however small, but it doesn't change the influence of this difference on individual's behavior as a complex system. It is known, that a nonsignificant detour from starting (ideal) conditions can lead to sifnificant change of phase trajectories of the system, even to conversion to area of phase space [10, 21]. Insufficient grade of approximation can lead not only to loss of accuracy of individuality identification, but to loss of terms – different areas of phase space of individuality as a complex system may required to describe different term complexes (psychological, medical, juridical, etc.).

3. indeterminacy, connected with nescience of some factors (processes), influencing the development and structure of personality.

Insufficient information about processes and factors, that influence personality's behavior can cause not taking into account of necessary model components, and therefore, to excluding important factors and effects from consideration. This means not ignoring of those factors, but not knowing them. This can lead to detour of calculated phase trajectories from actual ones, and therefore, to unpredictability of individuality dynamics, or to lapse of quasistohastic areas. This indeterminacy is quite typical in research of individuality as a complex system as particular social and physiologic effects may be unknown.

Analogical indeterminacies can be caused by characteristic factorization [2, 11, 22], when only "meaning" characteristics are extracted or linearly aggregated. A typical case is not taking into account of a correlation between characteristics due to nescience of factors in which the correlation reveals itself.

3. Indeterminacy, connected with technical impossibility to take in account all factors that influence personality development processes, though these factors are clearly known [18, 30] (insufficiency of mathematic system and/or organic model).

4. Indeterminacy, connected with new, previously unknown to psychological science phenomena and effects [18, 19].

Nowadays discoveries in psychology do not lay on the surface. The are connected with fine research, informational-structural firstly, results of which are capable to seriously influence general model of individuality.

5. Indeterminacy, connected with insufficiency or inadequacy of term complex and impossibility of matching facts [19, 24].

6. Indeterminacy, resulting from additionality principle [19].

Main gnoseological value of additionality principle is that any judjement, how ever strictly was it proved, in it's essence contains an alternative, the more categorical is the judgment, the deeper is the alternative. This is the source of deep, important indeterminacy.

Given list of indeterminacy is limited by the research interests, it can be differentiated and developed, named sources of indeterminacy are connected and

have multiple meanings. Difficulties of handling indeterminacies of various origin are obvious.

Grounded and researched by given moment mathematical structures allow integrating indeterminacy into descriptions of psychological research in following ways:

1. By means of spreading probabilities of states of researched components on phase information space. Omnifarious phase (simplex) spaces (multidimensional psychological [1, 5], educational [8], intellectual [23] and other spaces) are taken into account with operation of direct composition.

2. States and observed values are described by matrixes (operators) on gilbert spaces with operation of trenzoric composition.

3. States of system characteristics (order parameters) on phase space are described by means of solving system of non-linear differential equations. Upon certain values of coefficients bifurcations and sequences of bifurcations appear.

First method composes the contents of classical law of probability and theory of indistinct multitudes, based on which is kinetic theory of matter. It's essence lies in presence of hidden system parameters, inaccessible to account and observation and creating indeterminacies as a consequence of incompleteness of knowledge.

Second method is borrowed from quantum mechanics and gives a possibility to describe information microobjects interaction. In this conception parts of whole individuality (system) exist virtually [8]; This is the essence of quantum indivisibility.

Third method is connected with interaction of inner processes of integral individuality. If the system (AI) state nonlinearly depends on processes in and outside of system, it may become unstable and consequence of states may become a consequence of instabilities [18]. This means, that under same conditions system (or identical systems) state will not absolutely match, but will be only asymptotically close. However, due to cumulativity, small (in limits of asymptotic) detours may be amplified to whatsoever big values, so actual states of AI possessing traits of complex system, can differ greatly, despite identical conditions.

Both in second and third methods make indeterminacy indescribable in classic probability way.

An additional trait to indeterminacy is self-organization. Factors of self-organization are auto synchronization of processes and their cumulativety.

Differences between people, specified by their individuality, determine their character, actions, behavior, and, at the end, influence their fate. That is why it's important for a psychologist to understand the mechanism and sequence of individual differences development, reveal the space of their realization an functioning. Initial moment in studying individuality is considered to be uniqueness, individual singularity as an inimitable combination of all traits, differing one human from another. "Term "unique", meaning "one of a kind", is undoubtedly generic for "individuality" construct – central element of human differences science…" [11]. Inimitability is a serious values, as it establishes equality of all people by the right of birth. But to be the only, it is enough to have papillary lines, which differ particular human from any other. A number of human "inimitabilities" establishes a question of criteria for allocating most es-

sential of them to build accordable hierarchical structure. Individual does not become individuality just because he differs from the others in a row. "This difference alone does not make up the phenomena of individuality, which is connected with forming *a synthesis of traits* as a closed self-regulating system".

From the position of *system* understanding of individuality it is stated, that individual particularities, whatever level of hierarchy they are on, normally result from wholeness of personality as open dynamic system, possessing most different inner and outer connections. In conception V.S. Merlin [16] ground is given to the term of *"integral individuality"* as a special connections between all human properties, starting from biochemical specifics of organism and to social status of person in society.

Using exact sciences system, B.G. Ananyev [2] and his employees mathematized complex (multidimensional and interdisciplinary) approach to human individuality and discovered the influence of one different leveled bases of individuality on others.

Continuing this direction, the given work suggests paying attention to informational (qualitative [22] and quantitative [15, 22]) approach to research of individuality. For this purpose, the author and his students have analyzed known determinations of information (and have collected nearly 180 such determinations) applicably to different phases of informational process, its multidimensionability was proved [28], basing on principle of additionability of N. Bore.

In terms of this work (and because of it's size limits) let's use brief pragmatic determination [30] "information is what (*all* what!) helps human… practically realize his activity". In detail about information as a phenomena, including applicably to psychopedagogic research, see [26, 27]. Note several properties of information important for this research. The first: it is always connected with the structure of object or phenomena, to which it relates. The second:, macroinformation [27], and this is the level we'll describe individuality on, always leaves a trace in according environment (psychological, educational, program, etc.). The third: the more complex system individuality is, the bigger is quantitatively information with account of emergency.

For clarity reasons, let's stop at three information characteristics: attitude towards information object (individuality), dependence from time and dependence from source. Let's use Weich-Karno diagram for description (figure 1).

		Time dependence			
		Static		Dynamic	
Attitude towards information object	Inner	1 (ABC)	2 (ABF)	3 (AFE)	4 (ACE)
	Outer	5 (BCD)	6 (BDF)	7 (EFD)	8 (CDE)
		Objective	Subjective		Objective
		Source dependence			

Figure 1- Variant of choosing types of information exertion

Let's use geometric interpretation of information in form of octahedron Herewith flatness BCEF- divides inner information, including "self cognition" and outer information, gained through communication with environment. ACDF divides static, long-

term information, and dynamic, current information. ABDE divides objective information, gained by technical means, and subjective information.

We'll refer to persons integral individuality as a combination of features of psychophysiological and social nature that vary individually within given multidimensional nonlinear scale [5, 22, 26].

We'll refer to individuality identification as a process of building mathematical model based on measured input and output psychological characteristics. As learner's basic psychological characteristics we will take current intellect level, presense of positive motivation to learn and character and temperament properties.

In terms of this work aggregating means "operation of calculating of values, connected with parent positions in hierarchic dimensions. This consolidation can be summing, averaging or any other complex operation to get secondary value that is of interest to analyst" [25].

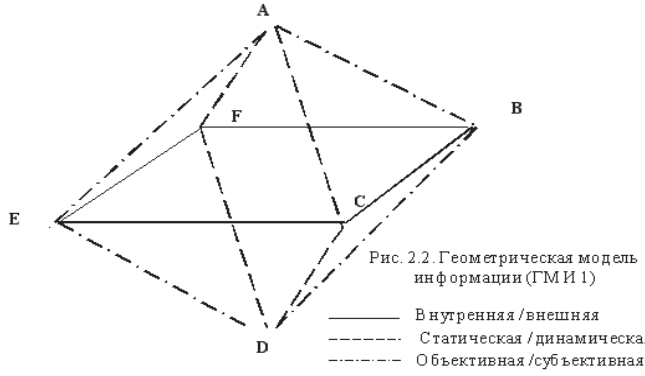

Figure 1- Geometric model of information

The main assumption is that initial information (indexes) is an exertion of some objectively existing, but not measurable factors that determine differences between research objects. These factors in terms of open complex self-organizing systems (one of them is integrated individuality) are called order parameters [10, 21]. They might not have any dimension or established name from area of psychology, didactics, physics, physiology and other.

The basis of suggested approach is a problem of building unified aggregated parameter (order) – slowly changing within given attractor variable, that describes dynamics of purpose-oriented state (sense) forming. This problem is, in general, of approximational character and is close to problem of scaling [17, 22, 26].

Following components appear in this problem:

A multitude *m* of objects in form of *n*-dimension vectors x_i; $i = 1..m$; *n*- the number of measured or valued indexes;

Function class $f(x)$ F, that gives every object an according number – class of allowable aggregated number scales;

Approximated structure of objects in form of double reference;

Method of generating approximating double reference on *f(x)* scale;

Functional *Φ*, that gives every *f(x)* *F* scale an according number, which characterizes proximity of structure under research and structure, generated by *f(x)* function in certain fixed way.

The purpose of solving given problem is finding $f_{onm}(x)$ *F* scale, that provides *Φ* functional minimum: $\Phi \to min$. Thus, *Φ* functional acts as quality criteria for *f(x)* scale, and $f_{onm}(x)$ with method of generating approximating double reference integral order parameter [8, 10].

In the number of problems of processing information, that describes informational object or it's components, appears a necessity to conduct functional scaling [17, 26] and aggregating of data, received from several spectators, that are characterized by limited definition and therefore, limited validity. Let's examine an aggregation method for such data on the example of system of individuality research in two-dimension psychological space but without approach generality limit.

Let $b_{i,j}^{k}$ be objective digital data on element with (*i, j*) coordinates. $i = \overline{1,n}$ and $j = \overline{1,m}$ reflections of AI in two-dimension space, gained from spectator number *k*= $\overline{1,l}$. In particular case, if every *k*-sensor has an according λ_k-position (point of view) a normalized display can be formed as $\left\| I_{ij}^{\lambda_k} \right\|$, matrix,

Where
$$I_{I\emptyset\emptyset}^{\lambda_k} = \frac{b_{ij}^{k} - b_{\min}^{\lambda_k}}{b_{\max}^{\lambda_k} - b_{\min}^{\lambda_k}}. \qquad (1)$$

As a pre prepared standard the most probable (expected or goal, depending on the research phase) value of display element, gained from λ_k: $I_{\acute{Y}}^{\lambda_k}$ point of view. When proceeding to problem display of researched individuality, we form a $\left\| \mu_{ij}^{\lambda_k} \right\|$ matrix, elements of which are calculated as appertain functions values formed by experts [15, 17, 22]. Applicably to physiological functions display several analutic countenances are used to describe appertain function (AF) [26]. The following one is relatively universal:

$$\mu_{ij}^{\lambda_k} = \exp\left\langle -\alpha \left| I_{ij}^{\lambda_k} - I_{\acute{Y}}^{\lambda_k} \right|^{\beta} \right\rangle, \qquad (2)$$

where *α* and *β* are appertain function parameters given by experts.

As AF is ceaseless on $I_{ij}^{\lambda_k} \in (0, \infty)$, then to value a display element by means of majoritary conversion, let's replace disjunction and conjunction operations with operations of choosing minimal and maximal AF values accordingly.

Let us cite the following *theorem* (see the substantiation in [26]):

Let $\{\mu_i\}$, $i = \overline{1,2k+1}$ *be the indistinct multitudes appertain function value* $\{A_j\}$. *Then logical sampling m from 2n+1 has an according m-element in arrayed variational row* $\mu_1 \le \mu_2 \le \ldots \le \mu_m \le \ldots \le \mu_{2k+1}$.

An important particular case is majoritary sampling *k+1* from *2k+1*, realized trough median function:

$$\overline{\mu} = med\left\langle \mu^{1}, \mu^{2}, ..., \mu^{2k+1} \right\rangle = med\left\langle \mu_{1}, \mu_{2}, ..., \mu_{k+1}, ..., \mu_{2k+1} \right\rangle = \mu_{k+1}. \quad (3)$$

Last value $\overline{\mu}$ provides minimum detour modules sum:

$$\sum_{i=1}^{2k+1} \left| \overline{\mu} - \mu^{i} \right| = \min. \quad (4)$$

Aforesaid aggregating method provides, except improvement of virtual individuality (model) display, improvement of validity in decision making systems on given individuality development direction, for example during education or upbringing process, under indistinct or incomplete initial data.

Hereby, using suggested approach, it is possible to "return holistic human into psychology", as suggested a third of century ago A.N. Leontiev. Practical solution of this problem will allow to speak about humanization of education, «aboutstopping of obvious violence over human nature»[9].

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