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Unasked questions and unused answers in psychology

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Contemporary psychology and cognitive neuroscience create many opportunities for studying the brain functions, but also generate numerous challenges. To date, scientists face common conceptual problems which are relevant to almost every research study/case such as: classification of functions, unified methodological approaches, explanation of the psychological phenomenon etc. The Sino-German Workshop which took place in Hamburg in 2013 aimed to address unasked questions and unused answers, attracting scientists from different countries and different fields of psychology, neuroscience, medicine, history, and philosophy. The present discussion on the 9 unasked questions was initiated by Professor Ernst Poeppel and was held on by Russian participants from various academic institutions.

The international Sino-German Workshop in the Neurosciences and Psychology with 80 participants from 15 countries, held in Hamburg, Germany (1-4 September 2013), was dedicated to the general topic of neglected questions in the field. In addition it discussed the knowledge available in psychology that is is applied in different fields of medicine, education, technology, economics, politics, humanities or the arts. The largest delegation at this workshop came from Russia, and Russian

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participants comment below on nine unasked questions that were made available before the workshop to each participant. In fact, there are many more such unasked questions which should be made transparent, in order to protect psychology from unnecessary prejudices.

One: The lack of taxonomy or classification of functions

We do not have a taxonomy of functions in psychology. Compared to biology, chemistry or physics, psychology lacks a classificatory system which everybody agrees upon. What do we refer to in empirical work or theoretical considerations? For some it is physical "reality" (as conceived in classical physics), for some it is language (using "words" as representatives of subjective phenomena), for some it is behavioral catalogues (as described in human ethology), for some the repertoire of human needs, for some it is just common sense as reflected in everyday psychology. As there is no generally accepted taxonomy, we operate within predefined frames of models. This results in an increasing diversity, leading to "speechlessness" between the members of the psychological community.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

Properties of objects are determined by research methods. Thus, the number of properties is proportional to the number of methods and stimuli used in research, and therefore can be infinite. In this situation, researchers need a convention concerning standardization of research methods of studying of the brain, and a standard classification of the corresponding brain functions, respectively.

Comment by Artem Kovalev (Student of faculty of Psychology, Lomonosov Moscow State University):

We know about psychical phenomena from our subjective experience and people's reports. However, nobody sees or touches cognitive processes, character or personality traits. How can we classify something that we cannot grasp? The classical nouns used in general psychology, such as memory, perception, and attention, describe only the general principles of the system's functioning. In other words, the problem of taxonomy lies in the determination of object and subject. Since 1879, progress in psychology was dependent on the methods of measurement. W. Wundt conceived psychological reality in the light of introspection. I.P. Pavlov perceived the world through the conditional and unconditional reflexes of his dogs. Now, we analyze cognitive processes BOLD signals and spike numbers. Consequently, psychology and psychophysiology have become only descriptive sciences, but the taxonomy of function can help not only to describe psychological phenomena but also to explain brain activity in functional terms.

Comment by Yuliya Zaytseva (Research Associate of Institute of Medical Psychology, LMU; Senior Researcher at Moscow Research Institute of Psychiatry):

It has been proposed by Luria (1976) that cognitive processes, being higher cortical functions, may represent functional systems and are not localized in narrow, circumscribed areas of the brain, but rather take place through the participation of groups of concertedly working brain structures, each of which makes its own particular contribution to the organization of the functional system. The notion that different functions are represented in different brain areas or have different algorithms which are interconnected leads to the question of how the activity of these different regions is temporarily coordinated. To understand brain function, one must understand how brain areas extract information from perceptual input, integrate that information over time and sources, and make decisions and plan motor actions. For many years, the spatial connections and their temporal coordination in cognitive functioning were difficult to grasp as the technology in this field was quite limited. Since neuroimaging methods were introduced, new possibilities to study more precise mechanisms of cognitive processing appeared. Modern technology as well as experimental evidence may indeed help us to understand the brain better and lead us towards creating a new classification of cognitive functions. However, the limitations of the technology must be also taken into the account. Also, multidisciplinary approaches must be used in order to stratify the components of cognitive functions, thereby giving an insight into cognitive machinery. An approach which might be pursued following the work of Luria has been suggested by Pöppel (1989), distinguishing between content and logistical functions using neuropsychological observations.

Two: Time as a discrete or continuous variable

In 1868 the Dutch physiologist Karl Donders came up with the idea that differences in reaction times can be used to analyze cognitive processes. This method of chronometric analysis is used probably in every psychological laboratory in the world, but it suffers from an implicit assumption, in that time (temporal processing) is treated as a continuous variable. However, there is clear evidence for discrete temporal processing, and such a mode of processing would create a different frame for theoretical concepts (Pöppel, 1997). The view on whether time is treated as a continuous or a discrete variable has also important implications for experimental work, like the selection of bin widths when measuring reaction times. An oscillatory component in the 30-Hz domain which could indicate discrete processing would remain undetected with a bin width of 30 ms when reaction times are measured.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

The roots of the concept of time and the formulation of the evolutionary paradigm are placed in natural sciences. The main physical aspects of the 'concept of time' are as follows (I. Prigogine, I. Stengers, 2005): in physics, the dynamic description is fundamentally different from the corpuscular one. The continuous nature of the acceleration described by the equations of dynamics is in contrast to the discrete instant collisions of solid corpuscles underlying the dynamic changes.

At the end of the XIX century, with the introduction of the kinetic theory of gases, atomic chaos re-entered physics, and the problem of dynamic law and statistical description became one of the central problems. Science is rediscovering time. Due to this, there are two unresolved questions: classical or quantum physics describe the world as reversible and static. In this description there is no place for evolution, neither to order nor to chaos. Information extracted from dynamics remains constant over time. On the other hand, the famous law of increasing entropy (2nd law of thermodynamics) describes the world as constantly evolving from order into chaos. However, from the evidence of social and biological evolution we know that the complex arises from the simple. How may chaos be structured? So, there is a clear contradiction between the static view on the dynamics and thermodynamics of the evolutionary paradigm. Another, even more fundamental question is: what is the essence of the contradiction between the static view of the dynamics and thermodynamics of the evolutionary paradigm? What is 'irreversibility'? What is 'entropy'? Matter becomes "active ": it produces irreversibility and irreversibility organized matter (I. Prigogine, I. Stengers, 2005). As in physics, time as a new natural stimulus variable should be rediscovered in neurosciences.

Three: Space being homogeneous or inhomogeneous

Like continuity of time, homogeneity of visual space is also generally assumed to be evidenced by constancy of brightness throughout the visual field; both assumptions, continuity of time and homogeneity of space, may reflect the powerful tradition of Newtonian physics. But there is a paradox: Empirical evidence suggests an inhomogeneity of visual space, if one looks at perceptual processing as a function of the eccentricity of visual stimuli (Bao and Pöppel, 2007), or the dissociation of spatial coordinates in neglected patients. Furthermore, it is still an open question in spite of substantial research, as to how intermodal maps are constructed to create *one* perceptual space; the challenge remains to integrate the retinocentric visual map and the head-centered auditory map, and not to forget the importance of the vestibular and the somatosensory systems in constructing peri-personal and extrapersonal spaces. The problem of a homogeneous or inhomogeneous space may be irrelevant when one studies object recognition for near-fovea targets, but it is an important problem for spatial attention and navigation. Particularly in this area of research one gets the impression that we depend on technical limitations: Because computer screens have only a certain diameter, the far periphery of the visual field may escape the necessary attention; because the spatial resolution in fMRI is still rather limited, neuronal mechanisms are preferably identified in the cortical mantle, and subcortical structures which are involved in the control of spatial attention may not create sufficient neuronal activity to become detectable.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

Presumably, the intermodal interaction underlying the construction of the complete picture of the world may be fulfilled in the "time domain". It arises from

some counterexamples providing evidence on direct anatomical intermodal interactions: (a) phenomenon of synesthesia; (b) surgically created neural pathways in newborn hamsters that mediated visual pattern discrimination via ascending auditory pathways (Frost et al., 2000, 2002). Investigation into oscillatory brain nets and pacemaker neurons may bring up an answer to this question.

Four: The language trap in the misguided use of nouns

Most likely we are caught in a language trap. Some years ago the neuroscientist Valentino Braitenberg said that if somebody wants to work on "consciousness", he should not be allowed to use the word "consciousness" for ten years. And this recommendation applies to the majority of terms which are used in psychology. The use of these terms as *nouns* indicates the tendency to "ontologize" neuronal or psychological processes. As the English philosopher Bertrand Russell once remarked: "We are justified in saying that there is thinking. We are not justified, however, in saying further that there is a *thing* which thinks, and that this thing is my mind." This human tendency to ontologize ("the" mind, "the" attention, "the" self, ...) has catastrophic consequences for our research. Higher activities (as judged from BOLD signals) in circumscribed areas "attract" psychological attributes and interpretations that result in confusion or mental chaos. An example: in well respected journals one can read (in different publications) that the insular cortex represents: negative emotions, interoception, attentional shifts, pain, sex, craving, and time perception (and perhaps others). This does not make sense. This is worse than phrenology 200 years ago.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

There are the following possible explanations of this issue. Firstly, we deal with complex (integral) brain functions like "attention", "thinking" etc. Secondly, we haven't correctly reflexed and formulated classification system of terms (see Question 1). Most likely, the reasons are both 1) and 2).

Comment by Professor Dmirty Ushakov (Head of the Psychology and Physiology of Creativity Lab., Institute of Psychology, Russian Academy of Sciences):

It seems that we are often caught in a language trap in the area of behavioral genetics. We particularly tend to ontologize the heritability of individual differences. Behavioral genetic models often attribute heritability coefficients to different mental abilities or personality traits as if they were their inner properties.

However, terms like "genetic variance" or "environmental variance" are relevant for populations but not for individuals. Heritability or percent of genetic variance can be calculated only if we investigate a population with a given genetic diversity living in given environmental conditions. These concepts are senseless for neurophysiological analysis. Moreover, the conception of environmental variance that is added to genetic variance contradicts the biological view on this problem. Genes encode proteins and the conditions under which the proteins are

produced in the cell. Proteins in turn influence the properties of neural cells, including their properties of proliferation and building networks. Neural networks process information, and their processing capacities seem to depend on neural cells properties.

Environment provides the organism with the tasks to be solved. Neural networks process information to solve these tasks. The functioning of the network requires the expression of genes. Whereas environment provides a purpose for building a neural network or its clusters, genes supply this construction with building blocks. The quality of information processing by a network depends of course on both genes and their environment. But it would be erroneous to conclude that they are added one to the other, as is currently stated in behavioral genetic models. In mathematical terms they are rather multiplied.

A thorough examination reveals the correlates of this biological view on the behavioral level. As was reported at the workshop, increased social requirements for a given type of intellectual behavior are associated with higher heritability of this behavior. This corresponds to the model of "multiplication" of genes by environment, and contradicts the additive model.

Five: The power and neglect of single cases

Important discoveries have been made with single cases. It may have started with the famous "tan tan" case by Paul Broca some 150 years ago. Other cases would be Phineas Gage, HM with his loss of referential memory, the shattered-mind patient of Alexander Luria, or the blindsight patients like DB, GY or FS. Such exploratory studies sometimes lead to tests of hypotheses in confirmatory studies using statistical methods. One gets the impression that psychologists have become blinded by statistics giving more credit to an ANOVA than harvesting unique constellations of phenomena in a patient allowing unique insights into cognitive functions. One of the founders of modern neuropsychology, Hans-Lukas Teuber, used to say that brain-injured patients are unfortunate experiments of nature; on the basis of their brain injuries a specific path of research is opened that allows a better understanding of mental processes. Exploratory single-case studies and confirmatory hypothesis-testing studies should be looked at on an equal level, in a complementary way. My own work has gained a lot from studying in detail single cases as on residual vision or "blindsight" (Pöppel et al., 1973), restitution of function (Pöppel et al., 1978), color vision (Pöppel, 1986) or plasticity or rigidity of representation (Pöppel at al., 1987).

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

Along with "isolated cases", the investigation of the "mistakes" of the brain's functioning, such as illusions, can assist in the understanding of brain activities in the norm. So, illusions may serve as a good example of "isolated cases" — as "special cases".

Comment by Yuliya Zaytseva (Research Associate of Institute of Medical Psychology, LMU; Senior Researcher of Moscow Research Institute of Psychiatry):

The balance between case studies and large samples is currently biased and puts them at a disadvantage within most disciplines. However, the main benefit of conducting a case study lies in the particular details and holistic understanding researchers gain from a specific case.

Six: binding and debinding of functions

Scientific literature is full of contributions on binding (on a neuronal level) or blending (on a conceptual level). But how about "debinding"? Neuroanatomical evidence indicates massive interconnections between distributed neurons. The eminent neuroanatomist Walle Nauta emphasized a minimal distance between neuronal elements, i.e., every neuron in the cortical mantle not being farther away from any other neuron than four synaptic contacts. This strong interconnection requires neuronal algorithms to separate local activities, to "debind" them in order to prevent computational chaos; selective binding is at the same time efficient debinding. And a further question which remains unanswered: What is the binding force which controls binding? Another point: Where there is no strong selective debinding, there is no longer any independence of local activities, with the consequence that, for instance, every perceptual act is always flavored with emotional evaluations or mnemonic components.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

On the one hand, the answer could lie in the process of formation of synaptic contacts in neuron networks. Examples of approaches to the explanation: a) Connectionist model relying on "Hebb's synapse" (Kohonen's networks; vector model of synaptic interaction, offered by E.H. Sokolov; mathematical models of artificial neural networks); b) Time synchronization of activity of different parts of the brain through mechanisms of frequency modulation (rhythms of the brain); c) On the other hand, the selective activation of local synaptic combinations in widely branched neural networks (for example, the problem of selective reproduction of memory traces).

Seven: Explicit and implicit knowledge

It is said that the visual cortex receives much more input from other cortical areas (extrastriate cortex) than from the lateral geniculate nucleus. It has been observed that a lack of direct input from the geniculate nucleus results in blindness, although some residual vision ("blindsight") has been found in such patients (Pöppel et al., 1973). If the cortical structure is still intact, only lacking direct retinal input, why is blindsight only blindsight? Why should it not be possible to again create conscious vision? As this appears to be almost impossible, the question arises of whether one is forced to conclude that to create states of being conscious, a direct

link to the external world via the sensory channels is necessary. This would apply similarly to the other sensory channels when they are deafferented. This may sound trivial and may support the classical view that nothing is in the mind which has not been in the senses ("Nihil est in intellectu quid non ante fuerit in sensu"; Thomas Aquinas, John Locke). However, is it not also possible that we put too much emphasis on states of being conscious? To always stress the importance of "consciousness" may be over-emphasizing only a partial set of mental activities. Most of the activities usually remain "tacit" or on an implicit level not reaching reportability (Pöppel and Bao, 2011).

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

The cognitive activities of the brain (perception, thinking, consciousness) depend on the prevalence of actual (current) inputs into the neural systems of interpretation. Under "normal" conditions the brain is working under the control of sensory inputs on line. This means of interaction between intact sensory systems and the brain is formed during the pre-and early postnatal development of the nervous system. The restructuring of established sensory inputs alters the properties of the corresponding cortical neurons, even in the adult brain. Some demonstrative examples: experiments by M. Merzenich with cutting sensory afferent fibers innervating the tactile sensitivity of a monkey palm; experiments by Douglas O. Frost et al. (2000, 2002) on newborn hamsters with an artificial, surgically formed afferent path from the retina to the auditory cortex; as a result, the neurons of the auditory cortex exhibited properties of neurons in the visual cortex. Similar experiments were conducted by P. Flourens (1794–1867), a French physician and physiologist by cutting off a cock's nerves controlling the flexor and extensor muscles. In the absence of intact sensory inputs brain has to work with what is left — with 'traces of memory' (e.g., contents of dreams, and experiments with artificial stimulation of the brain). During REM sleep, the mechanisms of consciousness can turn on from time to time in absence of striate cortex activity (so called 'lucid dreaming').

Eight: Occam's razor misunderstood in monocausal explanations

One gets the impression that scientists are often victims of Occam's razor, i.e., to look always for the simplest explanation. The simplest explanations are monocausal explanations, and these may often be too simple. Possibly, we can adopt the thought pattern of complementarity from theoretical physics. To give just two examples of where this thought pattern would apply: Perceptual processes as reflected in object recognition or face perception are necessarily both bottom-up and top-down; this does not mean that components of the process cannot be just this or that (transduction at the receptor level vs attentional control), but "at the end of the day" they have to come together. Another example of complementarity as a thought pattern can be taken from the nature / nurture debate: There is good evidence for genetic factors, as for the experience of the emotions of pain and pleasure, or of the phonetic repertoire in language; but there is also evidence for the importance of imprinting, i.e., the selection or confirmation of a partial set of

these repertoires in different environments. Here epigenetics enters the field, and one is forced to conclude that it is both, the genetic endowment and the cultural frame, that determine subjective realities. Having said this, it becomes clear that complementarity would not only be a "thought pattern", but that complementarity is a generative principle for cognitive processes; thus, monocausal explanations would be misleading.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

The problem addresses the nature of the relationships between a "gestalt" (system) and its "parts", or in another words, between "system" and "system's functions". One can draw an analogy between this problem in the neurosciences and the problem of the relationships between the laws of classical (Newtonian) physics and the laws of quantum physics. For a discussion of the problem, the following its aspects are of special interest: The opposition of the views of A. Einstein (determinism, causality) and the views of N. Bohr (probability is not a "measure of ignorance of real determinants", but the one of the laws of nature). The 'uncertainty principle' formulated by W. Heisenberg. I. Prigogine's acts on nonlinear dynamics involving terms "chaos", "bifurcation", "arrow of time" etc. (in fact, the development of ideas of N. Bohr).

Comment by Artem Kovalev (Student of faculty of Psychology, Lomonosov Moscow State University):

It is possible to reformulate this unasked question into a task: How could we use the system paradigm in psychology? With an increase of complexity and the enhancement of a new organizational level, the amount of the features is increasing. This is called an emergence. I suppose this is a simple rule about which researches usually forget. They start to solve an experimental task, i.e. from cell registration level in the animal brain. Then, they compare spike data from animal cells with human brain functioning. At this level researchers use terms known as general brain functions. The final point of this way is a consciousness problem following the pattern: from simple facts to complementarity. Obviously, there is an attempt to move regularity from one level to another. The elements of which regularity consists are changed, but sometimes researches do not notice it. There are many experiments that posess a strong methodological basis and clear results. How can we integrate many descriptions of reality from different organizational levels? This is a well known question in psychophysics. The psychophysics regularity and fMRI or EEG signals from the same tasks have a strong correlation. In fact, there are substituted data of people providing subjective feedback, and objective data based on the brain activity. How can we argue that activations in different areas or on different frequencies explain our subjective world, our sense of contrast, of colour? "Entia non sunt multiplicanda sine necessitate", Occam said. So, let us explain the whole psychological reality in simple physiological terms. This is not a progressive way, unfortunately. Therefore, we have to use the maximum extent of criticism, when we extrapolate our results on all levels of the brain.

Nine: Languages used are not neutral with respect to content

A very practical question: Is it true, as is implicitly assumed, that it does not matter in which language scientific thoughts are expressed and experimental results are described? Personal experience shows that this is not a trivial question: I cannot express myself the same way in English as in my mother tongue (German). And publishing together with colleagues whose first language is Chinese or Russian is always a linguistic challenge. It is a great advantage that we can use a common language, but it would be a mistake to believe that the language is neutral with respect to content to be communicated. The language does not only refer to the *way* content is communicated, but also to the *selection* of content itself.

Comment by Professor Alexander Chernorizov (Head of the Department of Psychophysiology, Lomonosov Moscow State University):

It would be interesting to know the opinion of linguists. This problem is closely related to another problem, already reflected upon the scientific mind — the problem of cross-cultural differences in approaches. The most famous opposition here is the opposition between the Eastern and Western styles of thinking.

Other unasked questions:

Ten: Experimental conditions (Are lab experience and real life experience the same?)

Artem Kovalev (Student of Faculty of Psychology, Lomonosov Moscow State University):

The experimental paradigms require the registration of all factors and a strong determination of dependent and independent variables. However, real life has different processes. Investigations in natural conditions are characterized by their low extent of reproducibility. In addition, they are often devoted to unethical themes. In research into deception with using eye-tracking technology, there are no questions about unfaithfulness or burglary. Usually, the question batteries are very simple and neutral. The results show that strong indices in eye-movement or pupil diameter in these laboratory experiments are not detected. The example from my own experience: subjects in a CAVE virtual reality system perform the same task differently compared to subjects in front of PC monitors. What do we study? Real people or real people in experimental rooms? L. Vigotsky noted that psychology must pay more attention to practical tasks. This is a very important methodological remark. In my opinion, usability development confirms his words well. Although marketing studies are far from scientific ideals, the fact of their existing is an alarm bell for academic psychology. Maybe, it is time to round psychologists, their intellectual potential, and devices toward practical real tasks on town streets, carrier decks and sport stadiums. Perhaps, we have to direct our efforts to optimization experimental schemes and the reduction of extraneous factors.

Eleven: Cultural influences on brain functioning, and does brain activity manifest simultaneous actualization of individual experiences?

Alexey A. Sozinov (Researcher at the Shvyrkov's Lab. Neural Bases of Mind, Institute of Psychology, Russian Academy of Sciences):

Recent discoveries in cultural and social neuroscience are of importance. One the one hand, cultural differences in functional neuroanatomy are not national, but correlate with individual traits that are also variable within cultures (Han et al., 2013). On the other hand, such differences are often derived from the diversity of teaching methods (Tang et al., 2006) and other cultural factors of personal history. One of the unused answers in this field is that brain activity manifests simultaneous actualization of individual experiences, acquired at consecutive stages of learning and development (Shvyrkov, 1990) — which is based on the definition of function devoid of uniform localization or ontologization (Anokhin, 1974; see also Forbes, Grafman, 2013; Luria, 1976). Contemporary research methods reveal implicit social interactions (Yun et al., 2012), brain synchronization during common happenings (Nummenmaa et al., 2012), etc. Considering the implementation of systems theory in an evolutionary view of culture and "complementarity of cultures" (Alexandrov, Alexandrova, 2007), we may assume that an individual is too close-bodied for a function. A function is not confined to an individual. An issue that may further address an unasked question is whether "brains can work together" is not just an inspiring metaphor.

Twelve: Highlighted questions in the specific field: visual illusions phenomenon.

Professor Galina Ya. Menshikova (Head of the Department of Perception, Lomonosov Moscow State University):

One of the interesting phenomena of visual perception is that of visual illusions. It provides researchers with important insights into the rules of visual system processing. Although visual illusions have been investigated for more than 150 years, their causes remain poorly understood. There are numerous questions which may help us better understand the problems of perception of visual illusions.

One of them is the question of the classification of illusions. Several different types of its taxonomy have been proposed, based on neurophysiological and psychological mechanisms of illusion formation (Coren, Girgus, 1978), rules of "appearances & kinds of causes" coupling (Gregory, 1997), or predictions of future movements of the observer (Changizi et al.,2008). Currently there is no generally accepted classification of visual illusions. The question arises as to whether *brain-activity data can be used as* an appropriate *basis for* the classification of visual illusions?

Another question concerns the problem of temporal processing of visual illusions. Visual illusions (except after-effects and ambiguous figures) are considered to be stable phenomena forming within 100-150 ms and perceived without any changes over time. However, in some cases their perception is pronounced at a

glance, and in other cases the illusion pattern should be considered within a longer period of time to notice an illusory effect. Furthermore, some empirical data show that long-term observation of illusion patterns leads to a reduction of illusion strength. As visual illusions are significantly variable in the time domain, the question arises: what is the "temporal window" for illusion strength measurements?

Another issue concerns the use of the mono/multicausal principle of the explanation of the illusion formation. Most previous studies have focused on a single mechanism underlying illusion perception. However, in a number of works the integration of different mechanisms has been suggested to explain the results. So the multicausal explanation should be applied, i.e. bottom-up and top-down processes should be considered to describe the process of illusion perception. Accordingly, the question arises concerning the binding rules of different mechanisms underlying the illusion perception.

It is possible to solve some of the listed problems using modern technology, possessing a number of advantages against traditional methods (Zinchenko et al., 2010). Lately, virtual reality systems were applied successfully to investigate 3D visual illusions. This technology allowed the creating and presenting of patterns of 3D illusions within a wide (near 180 °) field of view to find out the role of disparity and eccentricity cues in illusion perception.

Thirteen: The Sense disamguation in polysemous words.

Professor Vera Zabotkina (Vice Rector of Russian State University of the Humanities):

In response to the unasked question number 9 that Ernst poses regarding "selection of the content communicated by the language", I would like to pose another unasked question. It has to do with sense disamguation in polysemous words.

Resolving polysemy has always been and remains one of the key issues both in traditional semantics and in cognitive semantics. In cognitive semantics a polysemous word is interpreted as a mental structure resulting from the complex nature of human experience, and our understanding and interpretation of it.

We are trying to address the question of polysemy resolution in our paper "Cognitive Modelling of sense disamguation in polysemous words" with my postdoctoral student Elena Boyarskaya. We put polysemy, studies into the broader context of research in mental lexicon, conceptual priming and probabilistic conceptual modelling. We adopt a novel approach to the resolution of polysemy and put it to an empirical test. We argue that priming plays a key role in the activation of an adequate meaning of a polysemous word. Mental structure, represented by a prime lexical unit, contains relevant conceptual information about the target polysemous word. Since most words in natural languages are polysemous, we may assume that every word has a complex mental representation associated with it. This complex mental structure presents a combination of cognitive contexts which store information about all types of situations of words we use, real or potential participants, their actions, the sequence of these actions, etc. Thus, a cognitive context is a men-

tal phenomenon of a complex nature. Cognitive contexts are not static properties; they reflect the dynamic character of human cognition as such.

We employ the method of conceptual modelling of the mental lexicon to reconstruct the process of the formation of certain fragments of cognitive context related to perception, processing, storage and retrieval of information linked to particular senses of a polysemous word.

Special attention should be paid to culture-specific cognitive context, which includes information about the cultural specificities of the situation that the meaning of a polysemous word is associated with. This is a kind of knowledge that is characteristic of a particular community sharing the same physical and social environment.

Thus, returning to unasked question number 9 that Ernst poses, we can say that the "selection of the content communicated" by a polysemous word depends on the cognitive context triggered by the prime.

Fourteen: Vygotsky- Luria school traditions and postnonclassical perspective in clinical psychology research.

Professor Yury Zinchenko (Dean of the Faculty of Psychology and Chair of Department of Methodology of Psychology at Moscow State University, Corresponding member of the Russian Academy of Education).

The present state of affairs (in general science, and clinical psychology, in particular) provides an illustrative example of the increasingly differentiated structure of scientific knowledge. The state is characterized by the marked 'methodological liberalism and pluralism', shaping in plenty various theoretical and applied branches of the science. Under certain conditions the increase in methodological pluralism may be regarded as a sign of crisis (L. Vygotsky, 1997). Hence, the issues of methodological reflection come to the foreground of scientific endeavors.

In recent times the Russian psychology has witnessed repeated attempts of methodological analysis of psychological accomplishments with conducted on the basis of a widely-known classification of the types of scientific rationality, suggested by V.S. Styopin. The classification provides grounds for designation of the following types (and stages) in development of scientific knowledge: classical, nonclassical and postnonclassical (Styopin, 2003, 2011; Zinchenko, 2011; Zinchenko & Pervichko, 2012, 2013, etc.).

V.S. Styopin suggests the following criteria for the types of rationality: 1) distinctive features of a systemic organization of investigated objects and different types of world view; 2) certain distinctions of means and operations of activity, represented in ideals and norms of a science; 3) peculiar values and purposes of the subject and their reflectional assessment, expressed in specificity of philosophical foundations of the scientific world view (V. Styopin, 2003). To study objects represented in elementary systems the means of classical science will suffice; non-classical science should operate with self-regulating systems, and postnonclassical science may cope with complex self-developing systems (V. Styopin, 2003).

In accordance with the theoretical principles of postnonclassical model of scientific rationality, the research object of clinical psychology is an open self-developing

system, capable of selecting the aims and purposes of its development and the criteria for their achievement and of reestablishing its parameters, structure, and other features within the course of development. These characteristics imply a methodological scheme of research, congruous with the complexity of the object.

Psychological syndrome analysis (Vygotsky-Luria school), as a system of principles for conducting a study and interpreting its results, is in tune with the epistemological multiplicity and complexity of the subject of clinical psychology, considered from the perspective of the postnonclassical academic view.

It was shown in our studies that the applying modern philosophical concepts which allow distinguishing between types of scientific rationality (classical, nonclassical and postnonclassical) might be used for psychological field analysis in its historical evolution establishment and further development. Moreover, all this brings an opportunity to define theoretical and methodological principles of the clinical psychology functioning and development (Zinchenko & Pervichko, 2012; Zinchenko, Pervichko & Martynov, 2013).

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