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Metaphysics and Fundamentals of Transcendental Psychology Approach

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Abstract

The Transcendental Psychology Approach to the study of perception has been developed by A.I. Mirakyan at the Psychological Institute (Moscow, Russia) about 30 years ago. This article considers the results of theoretical and experimental investigations and provides a historical overview of the approach's development. Started with the investigations of constancy in perception, it went beyond the traditional Product Basis Paradigm (relying on perceptual features for finding perceptual mechanisms) into Philosophical Metaphysics of "nothing" and "something" concepts for revealing the form-generating principles as fundamental axiomatics of the Transcendental Psychology Approach. Several principles were developed and justified: structure-process anisotropy, spatial-temporal discreteness, the formation of anisotropic (particularly, symmetric) relations, the coexistence of alternatives, and some others. Principles are explanatory for the regulations of sensory-perceptual processes and are the direct object of further specification and experimental verification using hypothetical transcendental models of perceptual structures. The theory suggests that the internal mechanisms of these models would not naturally manifest themselves in experiments within the functional range of perception, and to see the phenomena, it is necessary to bring the perceptual system out of its natural functional range. The form-generating processes are named adiaphorous in the sense that they specifically generate new structures and forms, regardless of the characteristics of products used and produced in the processes. In general, it is possible to speak about the class of so-called structurally-generative processes that are specific to the process of transition between the system-generating structures studied by different hierarchically interrelated sciences. The proposed two-staged qualitative model of the perceptual process consists of two substantially different parts: the direct sensory perception and a process of form designation or sensory name assignment. Further investigations of structurally-generative processes seem likely to shed light on the mechanisms of brain function and to contribute strategically to

new directions in philosophical psychology and neuroscience.

Keywords

Metaphysics, Psychology of Perception, Product Basis Paradigm, Transcendental Psychology Approach, Form-Generation, Structurally-Generative Process, Model

1. Introduction

Studies in the field of philosophy of science have shown that scientific research is updated within the framework and concepts of a specific paradigm, which implies the presence of certain metaphysical premises that underlie science (Wartofsky, 1967; Kuhn, 1962; Agassi, 1964). These assumptions, which may have the character of heuristic metaphysical ideas, are often taken unconsciously and determine the fundamental or important topics and problems considered in science. They also act as the basis for the development of important scientific norms defining theoretical and experimental approaches in science (Artemenkov, 2019).

At the same time, often the problem is the choice of the reasons for legitimate explanations. In many cases, this situation is explicitly resolved in one direction or another, depending on the choice of the original grounds. However, these grounds often do not mean an adequate solution to the issue. Special difficulties with the philosophical understanding of their own premises, in our opinion, are characteristic of psychology. Striving to become an objective science, the same as natural sciences, modern psychology abandoned the conscious use of metaphysics as a way of a philosophical approach to the study of the root causes of psychic phenomena. The well-known attempt of dynamic psychology (Lewin, 1935) to consciously come to the Galilean way of thinking and make external (objective) and internal (subjective) factors equivalent, does not allow solving philosophical problems of psychology. In contrast to other sciences, in psychology the psyche acts simultaneously as an object of research and as a means (way of thinking) of its own research, that is, the psyche coincides as an object and as a means of its research.

When accepting metaphysical foundations unconsciously, it becomes impossible to analyze and select metaphysical representations and, therefore, transform and develop the science that grows out of them. Particularly, most recent advances in Psychology and related disciplines draw upon a small set of recognized, though sometimes conflicting, paradigms such as information processing, cognition, connectionism, and ecological psychology. Often these paradigms do not study deeply the methodological questions.

For example, the usual informational frame of reference supposes that an unknown process is possible to construct based on its initial, intermediate, and final products or their features. If so, it is possible, for example, to construct per-

ception just as we recreate the information processes using known input and output data, or in the same way that we assemble an unknown gadget or machine using its exemplar and knowledge of all its local parts. It is clear, that this method of reconstructing a process (using its products) is not always possible. For example, the secret of making Parmesan cheese is not kept inside the cheese or in milk as the main product it is made from. Growing cheese is an example of a process generating a new structure. The final state of this process does not provide any information about the process of its implementation. We argue that the same situation refers to sensory processes, which have the structure-generating nature proposed in the so-called, transcendental psychology of perception (Artemenkov & Harris, 2005a).

A novel alternative approach, called Transcendental Psychology Approach (TPA), was worked out by Arshak I. Mirakyan (1929-1995) and his group at the Psychological Institute of the Russian Academy of Education. The use of the "transcendental" predicate in the name of this methodological approach goes back to the critical rethinking of metaphysics by I. Kant, which laid the foundation for the direction of transcendentalism in philosophy.

The TPA was developed to overcome crucial limitations and contradictions in traditional approaches to perception, arising largely because of their basis in the Product Basis Paradigm (PBP). Firstly, TPA seeks to understand the internal generative processes underpinning psychological experience, attempting to develop universal generative principles from original axioms. Secondly, TPA provides a new point of view that predicts new phenomena and views old ones afresh. In effect, TPA provides an overall epistemological methodology and ontological framework.

Speaking about this framework, it should be noted that it remains little known or completely unknown to many scientists in the West. Therefore, the purpose of this article is to provide a brief historical overview of the Transcendental Psychology Approach, its historical roots, metaphysics, foundations, methodology, and some results. It should be emphasized that this approach is fundamentally different from traditional approaches and, in our opinion, may be important for the further development of psychology.

The second and third sections of the article are devoted to studies of the constancy and polyfunctionality of perception, carried out by A.I. Mirakyan, and the formulation of the limited Product Basis Approach to the study of perceptual processes. The following description of the Mirakyan's experiments and some of his theoretical results are taken from our article (Artemenkov & Harris, 2005a), where one can find old links to original Russian-language sources. In this article, we mostly provide links to our existing articles published in English due to the lack of other relevant works.

In the fourth section, the Transcendental Psychology Approach is considered. In the fifth section, this approach is presented as a new research paradigm in comparison with the well-known epistemological and ontological approaches.

The sixth section presents the results of some studies carried out according to the TPA and the seventh section considers the Two-staged Qualitative Model of the Perceptual Processes.

2. Constancy and Polyfunctionality in Perception

In this section, we present the history of the primary experimental studies of the constancy of perception, which served as a starting point for the development of original ideas about the flexibility and polyfunctionality of perception. The development of TPA methodology began with Mirakyan's work on perceptual constancy. Constancy phenomena are associated with the perception of world features as constant despite changes in the sensory input. Although constancy has been investigated in a wide variety of situations and different sensory modalities, the traditional explanation of visual size constancy has remained essentially unchanged, since Descartes proposed that the perceived size of objects depends on perceived distance as well as on the size of the retinal image. Constancy is thus important to philosophers, as a powerful demonstration that conscious perception does not necessarily correspond directly to the sensory input, and psychologists, as a potential way to gain insight into perceptual processes (Artemenkov & Harris, 2005a).

From a philosophical point of view, it is important to emphasize that the very formulation of the problem of constancy as such, is based on the once accepted normative premises of the Descartes model. However, these premises do not mean an adequate solution to the issue (Artemenkov, 2019).

According to the laws of optics, the magnitude of the light projection of images of objects on the retina of the eye decreases with the distance of the object of perception from the subject. This law in all evidence explains the phenomenon of the non-constant nature of the perception of the visual size of an object located at different distances from an observer. The known phenomena of constancy of visual perception of objects' sizes then require a special scientific explanation.

On the other hand, it is known that in ancient Greece the process of visual perception in the school of the Greek philosopher Democritus was explained with the help of the teaching about eidolon, a kind of emanation from external objects that constantly expire from them, being their thin copies. This explains that sensation is formed due to the influence of eidola, which particularly have a constant size. Of course, this view is not adequate to the modern level of knowledge, but it is interesting to illustrate the influence of the initial position of a scientist on the final formulation of a scientific problem. Based on this view, the magnitude of the image of perception somehow corresponds to the magnitude of the thing itself. Thus, the property of constancy of size in visual perception here does not require additional explanation, but the problem is the explanation of non-constant perception of the sizes of distant objects. Particularly, it is difficult to explain why a prospective decrease in the values of objects occurs when

they are moved from the subject of observation.

Examples of the ideas of Democritus and Descartes show that in science the initial basis of knowledge determines the way of thinking of the researcher. The content of the problem, the specific research tasks, and the type of generalizations obtained often depend on this way of thinking. According to the TPA, both initial ideas are inadequate for the search for mechanisms of perception. Constant and non-constant phenomena equally require explanation not based on any products of perception, regarded as a form creation process.

Meanwhile, historically, Mirakyan began studying visual size constancy following traditional methods (Artemenkov & Harris, 2005a). He was systematically varying viewing conditions, attempting to determine the role of such potential factors as accommodation, convergence, and eye movements. He first measured discrimination thresholds for simple angles ranging from 3 to 26 degrees presented at the same distance (2 m), and then studied constancy by repeating the matching estimates when the angles were presented at different distances (2 m and 1.5 m), but with the same retinal dimensions.

Results were obtained both for monocular and binocular viewing, and using both the Method of Adjustment and the Method of Constant Stimuli. The findings were later replicated at different viewing distances of 6 and 10 m.

The results did not show the expected "perfect" constancy under normal viewing conditions. Instead, there were consistent differences in the perceived size of objects at different distances that were ten times larger than discrimination thresholds. Similarly, as distance cues were reduced, perceived size became more dependent on retinal size but it never achieved "perfect" correspondence. This suggested to Mirakyan that, in any viewing conditions, conflicting tendencies towards perceptual constancy and dependence upon changing sensory data (i.e., "sensory correspondence") always coexist, and that the balance between them varies according to circumstances.

This important concept of coexisting representations does not emerge naturally from the traditional approach because if one is looking only for sensory correspondence, the observed variations in perceived size are easily dismissed as being too small to support it; whereas if one is looking only for perceptual constancy, the same variations seem important only in refuting it. Mirakyan's key insight was to view the question, not as a simple dichotomy between different alternatives, but to recognize that perception might essentially be characterized by the coexistence of different acts (using initial representations), and that the interactions between these acts might provide the flexibility needed to support the wide repertoire of human actions potentially available at a given moment and in a given situation.

This gave Mirakyan the understanding that the usage of a retinal image as an initial representation hides the real laws of the process of perceiving the sizes of objects located at different distances from a person. The perception was characterized by the coexistence of two simultaneous tendencies, towards constancy

and non-constancy, with their flexible interaction within the general process. It turned out that the presence of these tendencies has a single mechanism of distortion of spatial relations, due to the special effect of reducing the size of an unfixed object.

Recent studies of the perception of the visual space of works of art have shown that the size of objects visible on the periphery of the field of view seems smaller than those visible in the center of the field of view. This phenomenon is observed for both long and short-term exposure of objects (Pepperell et al., 2016) and was indicated earlier by Newsome (1972). Meanwhile, Mirakyan studied it in 1968 and called it "the effect of reducing the size of an unfixed object". The effect is manifested in the fact that, if there are two objects in the field of view that are equal in size and equidistant from the observer, the size of the unfixed object is perceived as smaller than the relative value of the fixed object. This decrease is several times higher than the threshold error and is characterized by a wide range of variability, which expands with increasing observation distance.

Mirakyan found that the effect of reducing the size of an unfixed object plays an important role in the process of size perception due to a sequence of distortions that provide general final adequacy of vision and at the same time ensure its functional flexibility. According to Mirakyan's initial conception, polyfunctional representation involves at least three types of transformation. Firstly, it is the identification of anisotropic spatial relationships between initial events. Secondly, it is the retention of these relationships over time, and the subsequent identification of temporal relationships. Thirdly, it is distinguishing relationships that are markedly different from the others in the population. These general principles are illustrated by Mirakyan's more specific investigations of the perception of object size.

For example, the perceived size of objects at the same distance was traditionally thought to be based simply upon retinal size. To confirm that the involved processes are, actually, more complicated, Mirakyan performed a series of experiments in which subjects matched the size of pairs of real visual angles presented at the same distance (2, 6, or 10 m). He showed that when subjects fixated one visual angle and judged the relative size of the other, the perceived size of the non-fixated angle was consistently underestimated. Thus, even though the retinal sizes of both angles are identical, their perceived sizes will generally differ during a single fixation. The normal conscious impression of equality during free fixation results not from a single direct process, but from the combination of several fixations in which the sizes of each are represented as unequal. Each fixation can be regarded as a "micro-act" producing an unequal relationship between the estimated sizes of the angles. The successive fixation of each object in turn allows the unequal relations to be compared and, since they are symmetrical in this case, allows the normal conscious impression of equality to emerge.

Mirakyan proposed and confirmed empirically that similar processes operate when objects are presented at different distances such as 2.5 and 10 m. This

might explain the observed trends toward constancy or sensory correspondence. Mirakyan's emphasis was very different from the traditional view that focuses on which process can lead to perceptual bias within a single fixation. He focused on the implication that even simple perceptual tasks can be thought of as a sequence of "micro-acts", each potentially producing discrete and different results. Consequently, the apparent unity of conscious perception is not the inevitable result of some fixed and unitary process, but instead, it requires additional, distinct processes that operate upon and reconcile these discrete raw results.

The implications of this manner of thinking stretch far beyond the visual size constancy phenomenon that was its original impetus. The simultaneous existence of different representations and the potential flexibility of the processes that operate upon them, jointly provide important insights into the polyfunctionality of perception by opening the way to different sorts of reconciliation processes suited to different perceptual tasks. This refers both to the need for similar perceptual processes to perform various functions and for the same perceptual processes to perform the same function but under different conditions.

As a first step towards establishing the generality of his ideas, Mirakyan extended his experiments to other kinds of perceptual constancy and phenomena in different modalities. Particularly, a series of experiments were carried out by his colleagues and students in the field of visual, tactile, and auditory perception (V.I. Kozlov, V.I. Panov, E.I. Kochurova, O.A. Adamyan, G.V. Shookova, N.L. Morina, T.S. Pogoreltseva, A.M. Zaltsman, and some others). This rather general study of spatial perceptual processes, and of the circumstances in which conscious perceptions change or remain constant with variations in the stimulus, led him to a clearer understanding of the limitations of traditional methodological approaches to perception, which he crystallized in the notion of the Product Basis Paradigm (PBP). A brief description of PBP is provided in the next section.

3. The Product Basis Paradigm (PBP)

The PBP is Mirakyan's term for traditional psychological approaches that begin with the consciously observable results (or products) of the perceptual process and that the characteristics of these results are thought directly to reflect the characteristics of the underlying processes (Artemenkov & Harris, 2005a). It is known that sensory processes begin with physical input and generate psychic sensory products. In developed form, they are practically automatic and subjectively seeming mostly effortless. Though the unconscious process does not directly manifest itself, it is possible to approach it theoretically and make hypothetical predictions about the character of the sensory process and its machinery. The usual way to do this is to rely on the features and characteristics of the perceptual image. For example, the problem of seeing can be a "problem of building up a symbolic description of a scene using information contained in an input visual image" (Frisby, 1979: p. 26). This information is often provided by knowledge of the respective properties and characteristics of the images. Similarly,

Hubel and Wiesel's seminal neurophysiological studies start from the notion that special geometric figures such as squares form part of our conscious visual experience; they then seek to explain how neurons might detect and combine their component features such as lines or edges.

Although this does not plainly characterize the position of anyone writing today on perception, it can be argued that in thinking about the mechanisms and laws of perception, people in one way or another rely on the already reflected properties of objects. It means that perceptual processes are presented in human minds through their own products: images, ideas, properties of objects, etc. This deeply empirical fact accounts for a naturally formed in philosophy, psychology, physiology, and neuroscience tradition to explore perceptive processes through their own products in the form of already perceived and fixed terms, phenomena, features, etc. Because of that, the description and research of the processes of perception are actualized on "results" or so-called "product-based" level of research. For all this, the process of perception in its initial directness, as a generative process of creation of these products, and these products' generative regularities are closed for an adequate understanding.

PBP is associated with the important functional and practical significance of the adequate relationship between the object and the product of perception for the successful human activity and, on the contrary, with the lack of importance of the direct procedural aspect of reflection for human activity. The natural-scientific way of product basis thinking formed as a result of a fact, that the cognitive process has been more open for the consciousness of the practical man than the unconscious process of perception. This was stipulated also by the centuries-old philosophical discussion about Object to Image (as a Product of cognitive process) correspondence, Object primacy, and Image adequacy to reflected Object.

Indeed, the perceptual phenomenon research usually is starting up with a consideration of already reflected, detailed, individual features (in the form) of Images and Notions, which are a priori evident to the consciousness. Then, based on this knowledge about the features and characteristics of objects, the mechanisms, which govern the perception of these features and characteristics, are retrieved.

Although such an epistemological approach can and has brought notable success in many sciences, its application to the ontology of perception and cognition brings with it some limitations, contradictions, and the obvious danger of trying to interpret the data in terms of an illusory pre-determined goal. PBP limits the ability to understand the mechanisms of processes that can be independent of the results produced. In particular, the inclusion of these results in possible mechanisms for obtaining them leads to an obvious contradiction.

In contrast, according to Mirakyan's view, the task of studying direct sensory-perceptual processes is to discover those principles and mechanisms that instead of being associated rigidly with some special pre-determined feature,

might enable the creation of any figure under appropriate circumstances. Accordingly, to avoid the dangers inherent in PBP, Mirakyan instead proposed that we should seek new methods that attempt directly to elucidate the basic processes themselves not seeking to characterize them beforehand in terms of specific product features, and explicitly acknowledging that the processes are likely to be flexible rather than having fixed goals, so that they can support the polyfunctional, sometimes conflicting, demands of the many different tasks served by each perceptual system.

The quest for such basic principles needs to start at a very general level. There is the need to note not only the functional interactions between an organism and its environment, but also the various constraints imposed by the organism's development, evolution, and neurophysiology. To guide the quest, Mirakyan argued that the special ontology of sensory-perceptual study requires nothing less than a special epistemology and, particularly, the abandonment of PBP in favor of a new metaphysical methodological approach.

In an attempt to overcome PBP in the study of mechanisms of perception, Mirakyan had to turn to the broader context of philosophical metaphysics. On this basis, he developed a radically new transcendental psychology of perception. The next section describes this approach in more detail.

4. The Transcendental Psychology Approach (TPA)

Mirakyan's alternative TPA proposes a radical change in focus away from the perceptual phenomena themselves, and onto the processes that create them (Artemenkov & Harris, 2005a). Rather than concentrating on the direct products, or outcomes, of individual sensory processes as in the PBP, TPA seeks to discover the principles that give these processes the flexibility to create complex, coherent representations under different stimulus conditions. These principles do not rely on direct phenomenology and are deduced by him from a broad metaphysical and at the same time materialistic philosophical context. Mirakyan proposed that these principles might provide a new axiomatic foundation for understanding the flexibility and creative nature of perception.

One of the important problems here was the possibility of feeling the extent of space, considered by I. Kant. Since the senses known to us do not give a sense of the spatial extent, Kant believed that space (as well as time) is not derived from experience but rather is its precondition. For Mirakyan, space, being here "a Priori" form of human perception, is a product of awareness of its existence in the ready-made form, which is given to a person and used to explain procedural mechanisms. Thus, PBP is also present here behind the scenes.

To overcome PBP, TPA requires a change in the investigator's point of view from the static third person to that of a dynamic observer within the process (Artemenkov, 2005a). To some extent, this shift is akin to what is suggested in embodied cognition and enactive perception theories (Varela et al., 1991), though Mirakyan proposed it independently and for a different reason. It results in a new

way of thinking that offers a deeper understanding of the problem, without reducing it only to the subject-object interactions.

This new way of thinking requires a new set of concepts, appropriate for the new viewpoint, and avoiding the trap inherent in PBP. Starting at the philosophical level, Mirakyan worked to identify a basic set of opposing metaphysic concepts "nothing" and "something". To some extent, he came to address what Heidegger has called the fundamental question of metaphysics: "why is there something instead of nothing?" (Heidegger, 1959). The model here is the discrete act of reflection and the possibility of observing the reflected as a result of the reflection.

Particularly, "nothing" expresses both the reality of the absence of anything present and the reality of missing in anything present. "Something", which is only to be reflected in this act and be observed, in fact, both in potency and in further implementation, is precisely this "nothing", since, one might say, it is still completely unknown and inaccessible. After the act of reflection, "nothing" turns into something accessible to observation, and "something" is that generated new, in which the initially reflected is already absent, because, according to the idea of generation, it is already turned into something else. The original "nothing", therefore, is initially inaccessible and is a transcendental entity by the very definition of such a reflection model, which, according to Mirakyan also corresponds to the essence of human existence. The question of "nothing" here implies going beyond the limits of the available being and therefore, in general, is a metaphysical question.

However, Mirakyan does not stop at opposing two ambiguous concepts and uses the notions of "nothing" and "something" to analyze the possibilities of evolution of reflection processes in the material world. Here he follows rather the tradition of ancient metaphysics, in which "nothing" is understood as non-existent, as a substance that cannot form itself into something having a form reflected by a person, with which a person and his empirical-functional thinking deal.

In the procedural plan, "nothing" acts as a striving for an undivided one, while "something" expresses the opposite tendency, corresponding to the nature of reflective possibilities, including the perception of a person. Two of his key concepts emphasize the tension between such interactive and opposed notions as uniformity-homogeneity and heterogeneity-anisotropy (Artemenkov & Harris, 2005a). Whereas homogeneity offers the objective possibility of some coherent entity, anisotropy, a departure from homogeneity, constitutes an objective difference and offers the possibility of some discontinuity in the matter. Thus, Mirakyan views anisotropy not only as a spatial characteristic of the system, but as a more general peculiarity of matter that forms the basis of, and makes possible, the formation of relations and the generation of new forms.

In formulating the general ontological principles of the new transcendental psychology paradigm, Mirakyan tried to characterize the anisotropy of percep-

tual systems and processes and to set out their general conditions including discretization of spatial and temporal continuity, the potential to establish and fix relationships among spatially discrete elements within a definite time, and the potential to form relationships between elements fixed at different moments. These conditions suppose that perceptual processes have an essentially creative or generative nature connected with the formation of relations between discrete system entities and emergent results.

This generative relational approach is different from the traditional understanding of these processes in terms of signal transmission or information processing. In general, the relations may be characterized by specific types of structure-process anisotropy as illustrated, for example, by recursive and feedback loops, or by the bilateral symmetry found in the sense organs of many living creatures (two eyes, two ears, a snake's forked tongue, and so forth). Thus, in general, perception is viewed as a unified process of form creation, requiring the dynamic formation of internal anisotropic relations within an explicitly generative self-referencing system.

TPA-inspired studies in Russia of a wide range of visual, tactile, and auditory phenomena have so far suggested basic principles that can be applied to all perceptual processes, regardless of their modality. They are recognizing form creation as a time-consuming (inertial) process, taking place within an anisotropic structure-process system with a fixed discrimination capacity. The resulting Principles of Generative Processes (Artemenkov & Harris, 2005a) provide a new way to think about the processes by which perceptual representations are created, and they include the following principles.

- 1) Structure-process anisotropy, recognizing that form creation needs a special material substrate with the appropriate structural and procedural anisotropic organization. It emphasizes that the system's form and function are inextricably interlinked so that each discrete part simultaneously presents both similarities and differences from the prevailing homogeneity.
- 2) Spatial-temporal discreteness, the minimum anisotropy allowing segmentation of different entities in space and time.
- 3) The formation of anisotropic relations, the elementary and universal mechanisms of form creation that are the focus of the approach; an example would be bi-united and symmetric relations as a general principle underpinning the bilateral symmetry of many sensory organs.
- 4) Process reduction with unaddressed memory fixation; the need for early data reduction is already recognized by sensory physiologists, while unaddressed memory is already commonly used in neural networks and traditional computer stacks.
- 5) The coexistence of alternatives allowing comparisons amongst them, as well as providing the flexibility needed by any polyfunctional perceptual system.

These principles may be regarded as a priori postulates or axioms. On the one

hand, principles are explanatory for the process of perception and, on the other hand, are the direct object of further specification and experimental verification. The studies based on these principles have so far encompassed a range of perceptual phenomena including constancies and the more general perception of size, form, color, motion, and volume level (Artemenkov & Harris, 2005a). Directly-sensory perception is a functionally flexible formation of anisotropic relations in many acts, and an act of reflection (with its procedural and substantive aspect) is a form-generating process. More features of this process are shown in the next section, which compares the Transcendental Psychology Approach with traditional ones.

5. Transcendental Psychology Approach as a New Research Paradigm

It is known that the evolution of views in the field of psychology of perceptual processes is determined by theoretical and methodological foundations of psychology of perception. Following G.V. Shookova (Shukova, 2013), it is possible to distinguish three different approaches to the study of perception: epistemological, ontological, and transcendental. They differ in theoretical and experimental schemes practiced in them. Epistemological approach results in the study of the mechanisms of perception using conceptually mediated characteristics of objects. The ontological approach to perception introduces a more broad research construct when objects and situations are examined together. This allows us to see new sides of perceptual events and to explore perception as a subject's activity.

As we already have shown, the TPA research methodology is quite different. It requires not only revising the initial theoretical foundations of the research but also changing the way of thinking of the researcher to abandon the PBP method of analyzing the processes of perception. As we said, in comparison, the TPA methodology involves the similar radical shift of the investigator's point of view, towards the internal process dynamic, as for the Embodied Cognition or Enactive Approach (Varela et al., 1991; Artemenkov, 2005a) to find the causal relationships between local interaction rules and global properties of an entity. **Table 1** presents several theoretical and practical foundations specific to three paradigms: epistemological, ontological, and transcendental.

Comparison of individual paradigms with each other is often not considered important, since the knowledge of each of them finds its application. If the foundations of the paradigm do not completely contradict the modern scientific character, then the facts established in its context are generally considered reliable scientific knowledge. At the same time, different paradigms can have different powers, for example, with finding unknown phenomena and concerning their predictive capabilities in specific conditions. A deliberately unclear and previously theoretically complicated experimental situation in one approach can be significantly simplified and become simpler and clearer in another one.

Table 1. Characterization of the paradigm areas of the psychology of perception.

Compared concepts	Paradigm		
	Epistemological	Ontological	Transcendental
Knowledge base	Properties of perceptual products	Environment and situation of perception	General natural generative principles
Designation of methodology	Phenomenal	Eventful	Axiomatic
Perception subject	Functional behavior and phenomena of perception	A perceptual event as a process	Transcendental procedural mechanisms
Researcher's position	An external observer of transformations	External Event Observer	Internal partner in the process
The system model is based on	Properties of perceptual products	Event's structure	Form generation
Designation of system structure	Functional heterogeneity	Structural heterogeneity	Anisotropic uniformity
Internal subprocess	Feature detection	Formation of structures	Formation of relations
Direct process of perception	Highlighting and combining properties	Highlighting and structuring events	Form-generating process
Image properties	Individual properties	Event properties	Co-presented properties

Particularly, TPA not only allows us to discover new phenomena (what will be discussed below) but with its help we can predict certain experimental results before the start of the experiment. This is shown in (Artemenkov, 2019) for the experiments of Kolers concerning "seeing of motion or change that is not there" (Goodman, 1978). For the case of Kohler's PBP-defined experimental problem, the transcendental paradigm has greater predictive power. It also determines the practicality of the corresponding new transcendental model and the way of thinking.

Focusing the TPA on principles, as a result, shifts the task of the psychology of perception, as an empirical science, from studying the characteristics and patterns of perception phenomena to studying the operation of new hypothetical models based on certain metaphysical principles. According to our view, the main idea of these models is that they are thought to be based on structurally generative processes (Artemenkov, 2016; Artemenkov & Shookova, 2017). The processes that imply special structurally generative nature, usually characterize transitions between the system-generating structures studied by different hierarchically interrelated sciences (Magarshak, 2008). The processual mechanisms here do not depend on the properties of their parts. Important methodological and theoretical achievements arise here from the need to go beyond the PBP and dispense with the traditional understanding of sensation, in favor of a view of forming of relations without the need to attract perceptual properties or their detection for building and explanation of the sensory process.

In general, these perceptual processes are adiaphorous in the sense that they specifically generate new structures and forms, indifferent to these products of

the processes and characteristics of the products. This also means that the proper perceptual system does not phenomenologically manifest its mechanisms under nominal conditions. In this case, experimental studies should abandon traditional ecological validity, which refers to the ability to generalize study findings to real-world settings. The phenomena of internal mechanisms would not naturally occur within the functional range of perception. To see the phenomena related to these mechanisms, it is necessary to bring the system out of its natural functional range.

Thus, TPA requires a new type of experimentation aimed at revealing the work of hypothetical model principles in special conditions. In the next section, we briefly describe some of the results obtained in these kinds of experiments.

6. Results of the Studies

According to the general principles of Transcendental Psychology, the generative processes (underlying form creation) take place within a discrete temporal and spatial structure such as in the retina or the organ of Corti. This structure determines the types of relationships that are possible, as well as their discrimination capacity, and thus plays a role in defining the functional range of the system. The functional range of the perceptual system is determined by the conditions of perception that make it possible to generate adequate representations of object features. Within the functional range, these representations show certain dynamic stability of observable characteristics. For instance, a certain period is needed for the system to produce a conscious result and this period should depend upon the stimulus, spatiotemporal, and other functional limits of the perceptual system.

The concept of a functional range can be a useful tool for determining the local and global characteristics of the form creation process. It also helps to understand what perceptual effects can be expected under given spatiotemporal conditions, e.g. like in experiments of Bach-y-Rita et al. (1969) devoted to sensory conversion and substitution. In many cases, this concept helps us to identify whether a given visual phenomenon should be regarded as an illusion arising from a genuine processing error, or merely as a predictable behavior within the prevailing conditions (Artemenkov & Harris, 2005b).

The forms created in the TPA are conceived as emerging at specific positions and times. However, to understand the formation of spatiotemporal relations, one must ask how space itself is perceived; it may itself be created as a product of the more general perceptual processes. TPA principles also suggest that because each object may be associated with a very broad range of possible sizes, storing all the possibilities would require an implausible amount of memory.

This led Mirakyan to suggest a form standardization process in which the image data are scaled to the possible maximum to reduce memory load (Artemenkov & Harris, 2005a). This process takes place during the gaze fixation period and, in effect, quantizes time. The initial form-generation stage requires a certain

period during which the object's parts are fixed and the size is standardized by a structural expansion process akin to the ripples on a pond radiating outward from the fall of a raindrop. Empirical evidence for this has recently been provided by the finding that visual space expands after saccadic eye movements (Cho & Lee, 2003).

As a result, perceived object size (or more generally, the sense of spatial extent) depends on the time needed to complete the standardization process, such that time must be considered an important factor in the perception of space. Indeed, rather than being based a priori upon the spatial features of objects as in PBP, it is possible that the perception of space, and the disposition of objects within it, are essentially temporal processes (Shookova & Artemenkov, 2017). Experimental checks of some aspects of this model have been incorporated in other studies of vision and other modalities. Particularly in haptics, it has been shown that the perception of the gap between thumb and forefinger does not emerge in a single, instantaneous touch, but requires a certain time for the comparison of the anisotropy relations created at different instances.

To go beyond the product basis paradigm, a mechanism for generating visual perception of spatial extent should not rely on the spatial or angular size of stimulus as well as other visual-spatial features. That is why the sense of spatial extent is thought to be based on a mostly time-specific mechanism (Artemenkov & Harris, 2005a). The idea of this mechanism is based on a kind of measurement of procedural duration of the sub-sensory process, provided that the rate of this process is constant. Mirakyan hypothetically assumed that the visual process includes a stage of increasing the small-sized retinal images to a certain standard value and the duration of this sub-sensory process can be measured within perception. At a constant speed, this duration grows proportionally with the decrease in the size of the retinal image. It has been experimentally shown that the exposure time of an object, which is necessary for its adequate identification, turns out to be shorter the larger the size of the object, and this dependency is practically linear in a large range of its sizes (Shookova & Artemenkov, 2017). The obtained experimental results indirectly support the proposed new mechanism. Thus, the process for visual perception of the spatial extent of objects can be mediated only by temporal characteristics of the perceptual process and can be obtained in the absence of a specialized spatial analyzer.

This makes it possible to explain a number of perceptual phenomena (like priming effects) in a way that is different from space-structural Gestalt psychology understanding, which is still in practical use (Otto et al., 2006), and find new theoretically predicted phenomena occurring outside the dynamic functional range of human vision (Artemenkov, 2004a, 2004b, 2005b, 2006, 2007a, 2007b, 2009). For example, the recent experimental study is devoted to the verification of theoretical assumptions about the role of time in human visual perception of spatial extent (Artemenkov, 2020). The theoretical model of the formation of temporal relations indicated the possibility of the appearance of a reversed vision

effect in seeing the initial and final positions of stimuli, decreasing in size at high speeds 30 - 60 visual deg/s. Unlike relatively low speeds of up to 15 - 30 deg/s the initial positions of high-speed shrinking stimuli can be better observed than their final position. This new experimental phenomenon results from the theoretical model and arises due to the fact, that consistent symmetrical relationships in time do not have enough time to form outside the dynamic functional range of human vision (Artemenkov, 2005b, 2009, 2020). The theoretical model used in these experiments is a continuation of a part of a general qualitative model explained below. The factor of visual symmetry perception is also used for an explanation of situational aesthetic experience (Artemenkov et al., 2018).

TPA has also led to the development of a general qualitative model that implements its basic principles (Artemenkov & Harris, 2005a; Afanasyev & Artemenkov, 2013). This qualitative model is briefly explained in the next section.

7. The Two-Staged Qualitative Model of Perceptual Processes

Regulation on the form-generating process of perception involves a new explanatory model of the structure of perception, which is divided into two substantially different hierarchically and structurally-procedural related parts, one of which (metaphorically presented as "above-water") serves the perfect functional opportunities of perception, and the other ("under-water") is responsible for unconscious processes of direct sensory perception, which are based on a hierarchical system of formation of anisotropic relations and include, in particular, contextual self-organization, multi-level discretization of time and hierarchical cyclic interaction. The idea of form-generation put forward in the study of mental processes of perception is also methodologically important in terms of its broader generalizations and allocating in the general system of a separate class of structurally-generating processes. The mechanisms of these processes do not depend on the features of their parts or products and are specific to the process of transition between the system-generating structures studied by different hierarchically interrelated sciences (Artemenkov, 2016; Magarshak, 2008).

Thus, according to TPA, perceptual processes hypothetically consist of form creation acts and several micro-acts providing the formation of a set of structure-process relations. This makes it possible to propose an abstract unified model of categorization across sensory domains based on the elementary and universal mechanism of spatial-temporal relations. An example would be bi-united and symmetric relations as a general principle underpinning the bilateral symmetry of many sensory organs. The fact that symmetric relations can lie inside sensorial processes and be important in generating perceptual effects follows from Mirakyan's theory, our experiments (Artemenkov, 2005b, 2007a, 2007b, 2009) and other contemporary investigations (Rashal et al., 2016).

Forming of relations can be taken as a universal platform of form creation and understanding of the production of perceptual concepts and categories assumed

to be direct or indirect. It is important also as a categorization principle across all sensory modalities. The hierarchy of these relations leads to process reduction in a unified deep structured system. Particularly, this model supports the idea of modern researchers about the deep hierarchical structure of a visual system (Krüger et al., 2013). It implements a reasonable transcendental part, which provides for the automaticity of perceptual functions as well as the output cues and features of sensory categories.

The general qualitative model proposed by Mirakyan has at least two main stages. The first stage is organized as a hierarchical 3-D structure consisted of bistable coding elements connected using the symmetric relations to the discrete receptive field elements. The process in this structure provides a reduced code of images placed on a receptive field. Each discrete coding element of the first layer of the structure simultaneously presents both similarities and differences from the prevailing homogeneity of the receptive field. The distributed upper hierarchy levels all relate to the products that have emerged at lower levels, which are organized hierarchically in a kind of convolution relational structure. Altogether, at this stage, the output interface (F) codes represent the form of the image.

The second stage is associated with a process of form designation or sensory name assignment. The output interface (N) of the second stage represents the code name of the form, which can be further used in language. This stage has another type of mechanism than in the first stage and assures conscious access to sensory categories as such. According to the cultural-historical theory (Yasnitsky et al., 2014), this internal mechanism is determined from outside by cultural-social interactions and provides us with higher human functions. It can be noted that contemporary deep neural networks used for modeling biological vision and brain information processing have two similar parts in their structure (Kriegeskorte, 2015).

Altogether, the two-stage qualitative model makes it possible to a certain point to explain the differences in the perception of people and animals. The model as an artificial reflection system has two interfaces (F and N) for an internal agent (either person or animal) to approach external reality. The system should in principle be capable of answering both the question about the identification of a certain object (as an object having a given name N connected to sensory category) and the question (F) about the identification of a form of this object belonging to that category.

For example, take an object of a certain form (code) that we agreed to call a square. It is important that the corresponding primary process of code creation determines and allocates a single object among the set of other objects, primarily as a pattern of the general form code and then as some "idea" (or name) of the object. The comparison of the output, which is given in N, with the content of cognitive memory provides an answer to the question: What is it? It is a square.

The answer to another question: Is this that certain object (for example, is it a square)? involves a counter process, going from a fixed in memory N name code

to an object that is outside and is represented by the interface F. This process is "ideal" in the sense that here there is a reverse generation from the "point" of fixing the name in memory. This counter-process is meeting in F with the process that goes from the outside to the interface F. If the results of the two processes coincide in F, the meeting confirms that the external input on the sense organ is exactly this object with the same (square) form. According to Mirakyan, for animals, unlike for humans, the last question is not actual. It does not make a big sense for them, since their ideal sphere is not well developed. The emergence of the question itself is associated with the need for an ideal choice of an object according to an already formed ideal representation of it. For man, this representation acts as an abstract substitute for the actual object of perception.

The other conclusion comes from the idea of a unified sensory process. Sensory categories are co-presented even they are produced individually and are separated. Co-presentation is a special term used in the approach, to stress the fact that sensory categories are structurally and procedurally related in the act of their generation. Perceptual processes as such include the coexistence of different alternatives providing the flexibility needed by any multifunctional perceptual and cognitive system (Artemenkov & Harris, 2005a). In practice, this assumes that the nature of perceptual cognition is complex and, for example, is quite different from common probability logic. According to the perceptual reality for any object, it is more reliable to have many defined and related features than just one feature (Artemenkov, 2019).

Thus, perceptual processes (unlike thinking processes) display that the object with many simultaneous features belonging to it is more valid and actual than an abstract object with just a few abstract or random features. The co-presentation principle in perception means that images and their characteristics are the products of the underlying formation of relations and the work of multiple mutual (unconscious and conscious) tendencies. Image features are all connected and united within the process of their creation and thus perceptual products have co-presented properties. This concept is one of the distinctive features which characterize the described transcendental paradigm.

8. Conclusion

As metaphysical TPA is poorly known to the English-speaking audience, the task of this article is both to explain its historical roots and to present the provisions of TPA in English, as well as several advances in the philosophical and psychological study of perception. The TPA was developed by Prof. A.I. Mirakyan at the Psychological Institute (Moscow, Russia) in the 1990s and continued to develop by his students there and at MSUPE. Altogether TPA important methodological and theoretical achievements arise from the need to dispense with the traditional PBP approach, in favor of a novel transcendental paradigm that emphasizes the critical role of the way of thinking used by scientists in the psychology of perception and cognition. TPA makes it possible to investigate new per-

ceptual and cognitive phenomena and to view old ones afresh. The TPA requires a radical change of the researcher's point of view from without to within the process under investigation, and in this respect, its philosophical origins can be traced back to Kant's transcendental approach. TPA seeks to discover and investigate the principles that give this process flexibility and the ability to create complex, coherent representations under different influences, irrespective of sensory modality or interface (Artemenkov & Harris, 2005a). On a phenomenological level, this is seen as a presence of different ways or sensorial disturbing subprocess, which variously works together and interfere.

It is essential that TPA holds out a novel methodological approach to the study of sensorial processes, regarded to imply special structurally generative and adiaphorous nature. To go beyond PBP Mirakyan turned to metaphysical notions of "nothing" and "something" and developed the transcendental approach, which is focusing on the axiomatics of general natural systemic principles. In contrast to epistemological and ontological paradigms based on heterogeneous subprocesses, TPA is based on anisotropic uniformity of forming relations and considers the process of direct perception as a form generation process. This is applied to all perceptual processes, regardless of their modality, and can recognize form creation as a time-consuming (inertial) process, taking place within an anisotropic structure-process system with a fixed discrimination capacity.

It is important to note that perceptual processes include the coexistence of different alternatives providing the flexibility needed by any multifunctional perceptual and cognitive system (Artemenkov & Harris, 2005a). They display that the object with many simultaneous features belonging to it is more valid and actual than an abstract object with just a few abstract or random features (Artemenkov, 2019). The coexistence principle in perception means that images and their characteristics are the products of the underlying formation of relations and the work of multiple mutual (unconscious and conscious) tendencies. Image features are all connected and united within the process of their creation and thus perceptual products have co-presented properties.

The two-stage qualitative model of perception, suggested within TPA, is based on the idea of structurally generative processing that can shed light upon the unified production of interrelated sensory categories with co-presented features. This qualitative model includes two interfaces connected to the forms and names of the perceived objects. The model explains various operations associated with object recognition, including the difference in capabilities between humans and animals.

The TPA also leads to a significant change in experimental practice. The focus of the approach on principles shifts the task of studying perception from characteristics and patterns of perceptual phenomena to studying the operations of hypothetical models based on certain metaphysical principles. Another important change is associated with the idea that the investigated processes are adia-

phorous in the sense that they generate new structures and forms regardless of any properties of the products used or produced by them. In this case, experimental studies should abandon the traditional ecological validity, because phenomena related to the studied internal mechanisms can only be detected outside the natural functional range of perception.

It has been proposed by A.I. Mirakyan and shown in recent experiments that symmetrical relations can lie inside a sensorial process and play a key role in structurally generative processes (Artemenkov, 2007a, 2009, 2020; Artemenkov & Shookova, 2017). The other A.I. Mirakyan's proposal suggests that the process for visual perception of the spatial extent of objects can be mediated only by temporal characteristics of the perceptual process and be obtained in the absence of a specialized spatial analyzer (Shookova & Artemenkov, 2017).

The direction of transcendental psychology of perception is interesting not only to the science of perception. In our opinion, it offers a way of solving the problem in the search and development of the fundamental principles of Cultural-Historical Psychology raised by L.S. Vygotsky (Yasnitsky et al., 2014). Part of the psyche presumably can handle adiaphorous structurally-generative processes that are realized outside their mediation by conceptual data of cognitive categories (Artemenkov, 2016).

However, it should be noted that the TPA established a rather abstract and at the same time limited axiomatics of the processes of form-generation. The basis of this axiomatics is made up of metaphysical concepts that are not easy to understand and concretize in more complicated working models. In this regard, with all the undoubted significance of the new paradigm of transcendental psychology, the tasks of disclosing, developing, and clarifying the corresponding principles and associated metaphysical constructs are staying quite acute.

Further investigations of structurally-generative processes seem likely to shed light on the mechanisms of brain function and to contribute strategically to new directions in philosophical psychology and neuroscience (including sensory substitution processes, the coupling of data into the human nervous system, and the theory of meaning in perception, etc.). In addition to stimulating progress in the understanding of perceptual processes in all modalities, the modeling of form-generating processes opens the way to a new technology of structurally-generative processes. Thus TPA could serve as a general theory of the synthesis of sensory experience and would be a useful tool for uncovering the proper fundamental psychological principles.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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