

# Characteristic features of relationships between intelligence and imagination in the synthesis of conceptualized forms of knowledge

Andrey Kuznetsov<sup>1, \*</sup>, Alexander Zhikharev<sup>1</sup>, Olga Kurganskaya<sup>2</sup>, and Alina Kuznetsova<sup>2</sup>

<sup>1</sup> Belgorod National Research University, 308015, Belgorod, Russia

<sup>2</sup> Belgorod State Institute for Arts and Culture, Belgorod, Russia

**Abstract.** The article presents the analysis of characteristic features of relationships between intelligence and imagination in the synthesis of conceptualized forms of knowledge. Two fundamental capacities of the subject that accomplish a constructive function in conceptualization of theoretical forms of knowledge are distinguished. The first one is the ability to synthesize categories and develop practical and relatively paradigmatically consistent methodologies, that is, the reflective ability of judgement that implies the development of a distinct structure comprising the previous findings as fundamental constructs. The second one is the ability to change the world view when dealing with “abnormal science” that implies the employment of philosophical and general scientific principles in their constructive function.

## 1 Introduction

In terms of cognition, rationality is an intellectual capacity that allows distinguishing the peculiarities of objective and subjective reality. In terms of practice, scientific rationality implies certain “programmed” actions on the part of the cognizing subject that are derived from intellectual principles and conditioned by the existent social norms and values given the rational nature of reality.

Conceptualization is a series of cognitive actions performed by the researcher and aimed at systematization of knowledge pursuant to the main take on the research object. Construction of conceptual diagrams (ideal models, abstract constructs) as the central element of the well-developed theory that frames its content and represents the reality under investigation is a classic example of the scientific knowledge conceptualization. According to its level, the distinction is made between empirical, theoretical and linguistic conceptualization, and according to its forms - between discursive and figurative conceptualization. Conceptual diagrams may be constructed of concepts, constituent parts of abstract constructs of various levels, as well as of the most common patterns of investigation of the sociocultural information incorporated in texts and artificial objective reality.

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\* Corresponding author: [kuzandr@mail.ru](mailto:kuzandr@mail.ru)

## 2 Basic concepts and definitions

The history of development of beliefs about methods of realization of the scientific worldview may be conventionally divided into three stages: *early stage* (physiophilosophical), *analytical* (the 20-30s of the 19<sup>th</sup> century – the mid-20<sup>th</sup> century) and *synthetical* (from the beginning of the 20<sup>th</sup> century). The drawback of the early stage concepts was that “thing, reality, sensuousness, is conceived only in the form of the object or of contemplation, but not as sensuous human activity, practice, not subjectively” [1:1]. However, the analytical stage already exhibited some tendencies towards synthesis albeit they were not characteristic of this stage. In the time of classical physics, development of unifying hypotheses was held in low regard among physicists. The majority of them preferred to conduct the real physical researches relying on the empirical regularities revealed in the course of multiple experiments in the field of experimental physics, rather than by general concepts. Logical reasoning was believed to be insufficient to conclude that a certain theory precisely depicted the real world. A. Einstein wrote, “Pure logical thinking cannot yield us any knowledge of the empirical world; all knowledge of reality starts from experience and ends in it. Propositions arrived at by purely logical means are completely empty as regards reality” [2:61-66]. As for the global unifying hypotheses that claimed to provide causal explanation of phenomena, they remained within the realm of personal interests of some researchers. The wider public took such hypotheses without enthusiasm [3:140], especially those that modelled the mathematic concepts. For example, French mathematician Poincaré claimed that only “logic is genuine and [it] can give us a proof” [4:167]. However, together with that he ambivalently added in his definition the involvement of experiment by saying that “intuition is the instrument of invention” [5:167]. By analysing intuition as a mathematical issue, Weyl warned against *focusing* attention merely on the set of things-in-themselves constructed by the subject in the process of idealization [6:64-66]. Feynman similarly cautioned that “mathematician provides nothing but the abstract proofs that can be used only if we assign the world with a set of axioms. Physicists, in contrast, should remember the value of their phrases” [7:55-56]. Apparently, these claims refer to the Kantian power of imagination [8]. According to this concept, our mind inherently sets a rule that allows the imagination to construct an object. Thus, as long as the concepts in a judgement are not connected a priori and may only be connected by the subject, categorical synthesis is to be determined by the structure of the transcendental subject.

Synthesis of scientific knowledge, accumulation of general knowledge about the subject is deemed to be the apotheosis of scientific cognition. M. Planck wrote, “Since ancient times, ever since human being began to study nature, he sought to reach the ultimate, supreme goal, that is to synthesize diverse physical phenomena into a single system or to describe them, if possible, with a sole formula” [9:23]. In this context, the issue of the synthesis of conceptualized forms of knowledge and physical world view, in particular, is concerned with the aspect of practicability. Hence, “there is nothing more delusive than to believe that it is possible to pursue science while leaving the issues of philosophy, epistemology and methodology aside” [10:242]. However, it does not ensue that practicability shall ensure the development of the relatively paradigmatically consistent methodologies.

To adequately describe the processes studied by contemporary physics, e.g., by quantum field theory, it is required to use the logically coherent types of “synthesis”. Meanwhile, the notion of “synthesis” in its strict methodological sense differs from a simple combination of principles in that it is essentially an integration of the primary principles into a certain *new* principle(s) that has a *new* physical meaning. Thus, the reflective capacity of judgement is viewed here as the development of a distinct structure

that comprises the previous findings as constructs of a new fundamental physical theory. Given the intuitive clarity of such a merger, “primary principles may often be generalized as well” [11], in other words, cognition turns out to be a highly integrative process. Certainly, cognition, in this case, does not start from scratch, from the establishment of principles, even though it is understood as an activity performed by the subject to create objects [12:42-45]. We inherently use all the knowledge accumulated as a result of human activity understood in the broadest sense. Interdependence of different areas of human activities explains the fact why “the increasing significance of methodological issues becomes a peculiar feature of the modern scientific development” [13:9]. While the main task for a scientist consists in acquisition of the true knowledge about an object, for a “methodologist it is the knowledge of linguistic reconstruction, organizing scientific knowledge gained by means of logic-gnoseological, Aristotelian or systemic structural methods and procedures, that constitutes the end product of his cognitive activity” [14:12]. Methodological character of the physical theory development was noted by E. Schrödinger in 1932 who highlighted its sematic-discursive (rather than formal mathematical) nature [15:182]. Development of relativistic-covariant quantum field theory by Tomonaga, Schwinger and Feynman created an impression that the issue was resolved without the use of the new physical principles. However, the analysis of paradoxes of this quantum field theory reveals how delusive such a “solution” was. That is why, in the late 1950s E. Wigner, O. Klein and W. Heisenberg persistently affirmed that the issues of synthesis of the physical principles remained still unresolved [16:257; 17:132-135; 18]. To name a few, W. Heisenberg imagined a quantum object prior to measuring as a kind of potentiality, tendency or possibility that might be quantified in terms of probability. Moreover, in his view, this probability qualifies as a “new type” of objective physical reality that in the Aristotelian tradition is to be located somewhere “midway between the massive reality of matter and intellectual reality of idea or symbol”.

Later, another view became widespread that limited the problem of synthesis to the synthesis of principles of general relativity and quantum field theory. However, presuming that the laws of the general relativity theory may be indefinitely extrapolated deep into the microworld, it then results in the assumption that at ultrasmall distances ( $l \sim 10^{-33}$  cm) the value of the gravitation interaction essentially increases and, therefore, constitutes a methodological antinomy: the general relativity theory turns out to be a particular case of another particular case of the special theory of relativity. In fact, even at small distances ( $l \sim 10^8$  cm) the gravitational interactions become so weak that here the special theory of relativity is to be applied. Consequently, in further investigations the concept of synthesis was seen as the synthesis of the principles of the special relativity theory and nonrelativistic quantum mechanics.

There are various types of synthesis of scientific knowledge. In the first place, any scientific theory synthesizes knowledge in a specific domain. Synthesis and generalization of knowledge also occurs when the area of research gets expanded. In addition, synthesis takes place in case of the comprehensive, interdisciplinary research of the subject due to infiltration of ideas and methods from some sciences into others.

### 3 Methods

The comprehensive research methodology is a special kind of methodology. It cannot be narrowed down to such well-known general scientific approaches as systemic-structural, probabilistic, statistical, modelling, etc., since they solely rely on one category (or its modifications) and have a one-sided character and, hence, cannot provide holistic information on the subject with due regard for all its relations and mediations. Specific nature of this type of methodology is determined by the mode of interaction between

sciences in the process of comprehensive research of the subject. This interaction implies “profound, fundamental, qualitative shifts in the structure of scientific knowledge itself, a complete revolution in the methodology of science, when the disciplinary structure of science that has been established over the centuries starts to collapse and a fundamentally new approach to the foundation of science itself engenders” [19:36].

The number of comprehensive studies grows with every passing year, they advance to the forefront and define the character of contemporary science. As predicted by V.I. Vernadskiy, the current stage of scientific development is characterized by increasing tendency to transition from mono-disciplinary to multidisciplinary research due to the fact that “the growth of scientific knowledge in the 20<sup>th</sup> century rapidly blurs the boundaries between individual sciences. We increasingly focus on specific problems, rather than on sciences. On the one hand, it allows to delve more deeply into the studied subject, while, on the other hand, it allows to study the subject more extensively, from different points of view” [20:124].

A. Polikarov notes that “synthesis may be defined in different ways, namely, as generalization of a certain theory (and its integration with the previous theory); as a combination of two theories, i.e. to form a more general (unified) theory or to generate a new theory; as extensive consolidation of the range of physical theories under one (umbrella) theory and, finally, as a process of merging physical theories with naturalistic ones” [21:176].

The highest-level synthesis involves synthesis of the system of subtheories about the object following a unified principle or a limited number of principles to build a universal general theory. A logical-theoretical procedure of abstraction plays an exceptionally important role in the process of such synthesis. The main point of abstraction is to formalize one point of view, make it a basic one [22]. Emergence of synthetical works is always associated with the introduction of new facts, methods and ideas into the physical cognition and always implies the expansion of the studied domain of reality.

## 4 Conclusion

An inherently synthetic stage of the physical cognition commenced at the beginning of the 20<sup>th</sup> century. Infiltration of methods from some sciences into others is indicative of emergence of synthetic trends in contemporary physics. Synthesis of physical knowledge is employed to address multiple, even seemingly specific physical problems and, hence, determines their general physical character.

The issue of leadership is usually associated with an uneven rate of development of different scientific disciplines due to which stormy points of growth arise from time to time and certain sciences become “leaders of knowledge”. As noted by academician B.M. Kedrov, the leaders may be either solitary or grouped [23:2,9]. Mechanical science was a solitary leader in the 17<sup>th</sup>-18<sup>th</sup> centuries. In the 19<sup>th</sup> century, the solitary leader was taken over by the grouped leader comprised of physics, chemistry and biology. From the middle of the 20<sup>th</sup> century, the grouped leader encompasses the following sciences alongside physics: macrochemistry and chemistry of high molecular compounds, bioorganic chemistry and molecular biology together with genetics, cybernetics, biocybernetics and bionics.

Under these circumstances, “the very cognitive strategy for learning natural phenomena and objects has changed and, consequently, an overall structure of natural sciences. Instead of isolated coexistence, now different sciences are increasingly more interrelated allowing for mutual penetration of concepts” [24:134]. Today, one domain of natural phenomena is no longer studied by one science as before, but by a whole cluster of interrelated disciplines.

In summary, based on the analysis of the methodological literature, we can distinguish two fundamental capacities of the subject that accomplish a constructive function in development of the scientific world view. The first one is a capacity to synthesize categories and develop practical and relatively paradigmatically consistent methodologies, i.e. the reflective capacity of judgement that implies the development of a distinct structure comprising the previous findings as constructs of the fundamental physical theory. The second one is a capacity to change the physical world view when dealing with the “abnormal science” that implies the employment of philosophical and general scientific principles in their constructive function.

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