

Prerequisites of Regulatory Scientific Models in Education and Social Practice: Transcendental Approach to Conjunction Fallacy

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Abstract—The importance of analyzing and considering the prerequisites and assumptions of the regulatory scientific models used in education and social practice is shown. In contemporary cross-cultural communication and education, the human heuristic decision making is often mistakenly evaluated by means of certain standard regulatory scientific models and conceptions. The transcendental psychology approach to perception makes it possible to substantiate co-representation probability models which are compliant with human perceptual psychology and heuristic judgment under uncertainty. Thus, the tendency to consider human estimations of joint probability as the conjunction fallacy may be regarded as a form of scientific illusion.

Keywords—*regulatory model, heuristics, transcendental psychology, perception, co-representation, probability, conjunction fallacy, scientific illusion*

I. INTRODUCTION

In the modern world, scientific concepts and representations play an important role in the social practice and life activity of people. Scientific knowledge and models act as international educational standards and are of great importance in intercultural communication and education. In fact, they often objectify intercultural truths, which are associated with the creation of universal explanatory models that allow one to predict phenomena and experimental results, conduct comparative studies, and as a result integrate the intercultural social and educational environment. At the same time, scientific development is connected both with the search for new models and the rethinking of existing knowledge. This process is determined both by the lack of satisfaction with the current state of affairs and the attractiveness of other theoretical developments. New designs are often sought in other scientific fields, in other cultural traditions and in other times.

Regulatory models, which are the foundation of many theoretical concepts and beliefs, are often not explicitly defined at the level of awareness and can serve as the basis for various cognitive illusions. Related ideas are finalized in textbooks and transmitted through training, on the basis of direct influence, communication, and even missionary pursuit. At the same time, education is a rather conservative

element in different cultures and has been following many such rules and regulations for a long time. Thus, the disclosure and understanding of these conservative tendencies is a subject of particular interest.

Normative knowledge is often embodied in relatively simple, in particular, mathematical theories and models. Mathematical knowledge is universal and can often be implemented in various sciences and areas of practice. This knowledge is especially widely used in education. In this regard, mathematical models are becoming even more normative. For example, the joint probability model is often used to calculate random chances and has actually become the norm for assessing various causal situations that have a particular uncertainty of their occurrence. This model is widely used in modern education and is considered as a universal explanatory tool for determining the chances of joint random events almost regardless of the complexity of their nature.

At the same time, in general, the heuristic solutions of people in real conditions do not correspond to the probability theory model, which is often regarded as erroneous behavior [8]. However, in principle, it is reasonable to assume that a simple theoretical model developed for physical random phenomena cannot be unconditionally used as a normative model for assessing the behavior of complex systems and, in particular, of a person under conditions of uncertainty. In other words, in reality, the joint probability model is not suitable for assessing human decision making. Based on the paradigm of transcendental psychology of perception [6], a psychologically sound mathematical model of the joint probability of related events is proposed and considered.

II. HEURISTICS AND CONJUNCTION FALLACY

Initially, the theory of probability and its models were developed to consider casual events that, being joint or incompatible, are obviously not related to each other. The random events associated with many independent phenomena of the physical world serve as a real basis for developing clear rules for calculating probabilities. At the same time, due to the relative simplicity of the initial model, the rules for calculating probabilities are fairly easily transferred to phenomena in very different systems,

and their results begin to serve as norms determining the correctness of the resulting behavior in specific circumstances.

In particular, following the research of Tversky and Kahneman [9,10], human decision making under uncertainty is often mediated by intuitive heuristics. Heuristics as intuitive judgments occupy a position between the automatic operations of perception and the deliberate operations of reasoning. They deal with the concepts as well as with the percepts, can be evoked by language and are not bound by specific scientific natural laws.

Studies have shown [8] that relying on heuristics (related to the representativeness or availability of events) when making decisions, people are most likely mistaken, because the fact that something is more representative does not make it more likely. In practice, the combination of events may be more representative than one of them, and this contradicts the basic probability determined according to the standard rule for calculating the chances of independent accidental events in probability theory. The representativeness and availability heuristics [10] therefore can result with a so-called "conjunction fallacy" and make a conjunction appear more probable than one of its constituents. This violates the most basic law of probability - the conjunction rule: The probability of a conjunction cannot exceed the probabilities of its constituents.

Thus, conjunction fallacy is regarded as a false belief that two events have greater chance of co-occurring than either event by itself. This phenomenon was demonstrated in a variety of contexts including estimation of word frequency, personality judgment, medical prognosis, decision under risk, suspicion of criminal acts, and political forecasting [8].

For example, in the well-known Bank Teller Study [10] subject receives description of the situation with Linda: 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations. The question is: which of the following alternatives is more probable?

A) Linda is a bank teller. B) Linda is a bank teller and active in the feminist movement.

Most participants picked B and have fallen prey to the conjunction fallacy. It is not possible for two events to be more probable than one of the events by itself.

The systematic character of violations of the conjunction rule makes it absolutely unclear - why does such inadequate behavior takes place and occur so frequently [5]? The common answer to this question is contrasting heuristics and intuitive inferences to specific mental logical operations and specific scientific gains as the laws of probability. These laws are then used as objective measure of the perceptual and cognitive processes without special analysis of the initial premises and the correctness of their use in a particular situation. The fallacy as such

emerges when researchers fix the difference in the results of the experimental psychological process and regular model process within presumably the same conditions. On closer examination it is possible to notice that context situations for perceptual intuitive solutions and logical mental operations are very different and have very distinct nature. Thus, simple comparative judgment model is hardly applicable in this case [5].

Learning the theory of probability leads to the fact that people begin to follow its rules in a variety of conditions, i.e. specially trained people may behave according to the rules of probability. But, apparently, the mistakes of intuitive heuristic solutions have their own truth. Science itself relies on numerous intuitive grounds and heuristic operations (discrimination, identification, association and so on). It is also known that being distinct from the scientific discourse heuristics are existed since the beginning of time and people relied on them long before scientific laws have been discovered. Depending upon intuitive judgments, often presented in the form of specific legends and myths, people during a long road of their historic development have been in many ways quite successful in their life activity both in relations to physical nature and interrelationship.

III. CONJUNCTION FALLACY AND SCIENTIFIC DISCOURSE

Another argument against the notion of conjunction fallacy is associated with the scientific discourse, which uses a positivistic way of thinking when scientists make abstract truth more concrete or real, turning it into a law of objective reality, and then tying specific events or phenomena to it. Then everything that corresponds to the law is usually goes without saying, and that which does not correspond is an error and requires an explanation. 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.

For example, the historical formulation of the problem of constancy of visual perception, following R. Descartes, is usually solved on the basis of considering the light projection of images of objects on the retina of the eye. According to the laws of optics, the magnitude of the projection decreases with the distance of the object of perception from the subject, which explains the phenomenon of the non-constant nature of the perception of the visual size of an object located at different distances from the 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 eidola, a kind of emanation from external

objects that constantly expire from them, being their thin copies, from the influence of which is deduced sensation and thought. 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. In particular, 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 transcendental psychology approach [6] both initial ideas are inadequate to finding the mechanisms of perception. Constant and non-constant phenomena equally require explanation not based on any products of perception, regarded as form creation process.

IV. THE BENEFITS OF THE TRANSCENDENTAL PSYCHOLOGY APPROACH

Transcendental psychology approach was developed by A.I. Mirakyan (1929-1995) and his followers. It focuses upon the direct-sensory processes and the principles that support the flexibility needed to create complex, coherent representations under different stimulus conditions. The central idea is that the generative perceptual processes are different from emergent psychological processes dealing with perceptual images and may be based on universal formation of relations. The basic transcendental principles of perception are proposed, which can be applied to all perceptual processes regardless of their modality [6].

In particular, the methodology of transcendental psychology provides a new outlook which makes it possible to see well known phenomena afresh and allows predictions of certain experimental results before the start of the experiment. For example, let us look on “A puzzle about Perception” in the book of Nelson Goodman “Ways of Worldmaking” [7]. The Author there is trying to interpret P.A. Kolars’ experiments concerning the “seeing of motion or change that is not there”. The simplest and best-known phenomenon of apparent motion occurs when a spot is exposed very briefly against a contrasting background, followed after an interval of 10 to 45 milliseconds by exposure of a like spot a short distance away. Kolars decided to use figures of various shapes instead of spots and study their transformation into each other in the process of apparent motion. The task of an investigator is to find “the relevant measure of similarity to be used in determining the limits of dissimilarity for smooth apparent change” [7].

Apparent motion phenomenon is interesting because it demonstrates the visual transformation of some figures or shapes of objects into the others. If some of the shapes have specially-tailored conditions of this transformation then it is possible to tell what shape features are underlying the perception processes. It can be seen that in such reasoning a product-based way of thinking is presupposed. It is assumed that the properties of the shape of objects can serve as an explanation or a measure of the perception process in which they are formed. In principle, this strong assumption is the usual unconscious foundation of the entire edifice of the traditional experimental research of constructive or information processes.

If perception is a form creation process, then the measure of the proximity of two these processes cannot consist in the very properties of the forms as their products. The formulation of the Kolars’ experiment in this way is not correct, and from the standpoint of the transcendental psychology of perception, the negative result of the experiment obtained by him can be predicted in advance. This example shows the critical importance of analyzing paradigm bases and methodological aspects that need to be identified before research begins, and also shown and explained in the process of teaching scientific methods.

V. HUMAN PERCEPTION AND MODELS OF JOINT PROBABILITY EVENTS

The transcendental psychology of perception states that perceptual processes include co existence of different alternatives providing the flexibility needed by any multifunctional perceptual and cognitive system [6]. This assumes that the nature of perceptual cognition is more complex and 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. Thus, perceptual processes (unlike thinking processes) display that the object with many simultaneous and related features belonging to it is in fact more valid and actual than abstract object with just a few abstract or random features.

The co-representation principle in perception means that images and their characteristics are the products of underlying formation of relations and the work of multiple mutual (unconscious and conscious) tendencies. Thus, image features are all connected and united within the process of their creation and have all the time connection to the person to whom they are presented. The co-representation idea may help to obtain an appropriate probabilistic model suitable for explaining human behavior in the face of uncertainty.

Instead of throwing lots in the form of tossing a coin, consider throwing a locket that can unfold, is like a coin on the outside and contains nothing inside. It gives 4 incompatible states (A-head, B-tail, A&B, Nothing) with possible roughly equal chances. It is easy to see that in this model conjunction event of opened locket-coin has equal chances with any of separate coin like states: $P(A) = P(B) =$

$P(A\&B)$. Here P is probability of the events in parentheses.

It is clear that calculation of chances depends on a whole space of elementary events as well as on favorable set of events. They are in their turn determined by logical and other operations which are often implicitly feasible on the sets. If we consider also the logical conjunction ($A\&B$) and disjunction ($A\vee B$) operations on A and B events, then probability of just one event A or B still equals $\frac{1}{4}$ and probability of two A and B events may correspond to $A\vee B$ situation and so will be equal $\frac{3}{4}$. That is 3 times higher than $P(A)$. The disjunction of A and B events corresponds to perceptual reality of objects in the sense that if two features are thing specific then each of them is also specific to this object. More over in other case the existence of just one A or B event will be in principle impossible.

Thus, in psychological perceptual model of events' probability perfectly reasonable is to suppose that A and B event are more probable than separate A or B events. In the standard probability model, the events are separate independent random events, while in presented psychological model the events have common origin or common representation medium. The two models serve different spheres of reality. The standard model comes from the lack of knowledge about objective situation, while psychological perceptual model presupposes a certain understanding of the situation starting from the self of a person. Tossing of a coin then assumes that only one possibility of two (head and tail) is possible each time while we know that two sides are simultaneously presented on a coin. To consider the chances of A and $A\&B$ events in this case is not correct. These events do not belong to the same set of elementary events.

As we see here the knowledge about A and B events include multiple meaning and the number of events connected with logical operations may be increased too. We have both ambiguity of conjunction and disjunction operations and multiple events in disjunction operation. This results in expansion of the number of favorable events for A and B association and so provides in this case for higher estimation of chances. It may be noted that this ambiguity is not specific just for psychological situation and is observed in quantum physics, where it leads to difficulties in quantum measurements [1].

More complex model of throwing the rhombicuboctahedron die may be even more demonstrative in regard to the rate of conjunction probability. The rhombicuboctahedron is an Archimedean solid with eight triangular and eighteen square faces. There are 24 identical vertices, with one triangle and three squares meeting at each. The rhombicuboctahedron can be seen as an expanded cube (or an expanded octahedron) and as such includes six square sides of an original cube from which it is generated.

In throwing the rhombicuboctahedron die the chances to see from one direction a certain $A\&B$ combination of two facets originated from primary cubic die are in general up

to three times higher than chances to receive just one facet of this die [3,4]. These modeling results clearly shows that $P(A\&B) > P(A)$ and they agree with human decisions made in numerous experiments [8] and with results shown in our works including cross-cultural psychological research for joint probability judgments of co-represented events [3-5].

VI. CONCLUSION

Heuristics and regulatory scientific judgments can be considered essential invariants of intercultural communication, which are formed in the process of education and contributed significantly to the ordinary psychological processes in different cultures, as well as the way of scientific thinking in psychology and other sciences. In particular, the now-familiar scientific concepts are often used as standards and criteria in evaluating the truth of human psychology. It is noted that this is not always adequate to reality and can lead to a kind of scientific errors and illusions, which are persistent, due to the generally recognized the importance and significance of scientific knowledge.

Thus, regulatory scientific models used for evaluation of human behavior are not impeccable and when real human reasoning or performance and normative competence (rational computation) diverge, often there is something wrong with the norms used, and not with the reasoning [5]. In regard to conjunction fallacy it is not of course the case that probability theory is wrong. Rather human behavior is more complex and the model used for its evaluation is too rigid.

The transcendental psychology approach makes it possible to substantiate other probability models which are compliant with the human judgment under uncertainty [3,4]. According to the concepts of transcendental psychology [6] the properties of perception as a basis of the representativeness heuristic ideas are to a large extent conditioned by the co-represented properties of the process of perception. This corresponds to mathematical models, which theoretical implications are consistent with the results of cross-cultural and other experiments [3,4].

The resulting probability values shown in these experiments are largely determined by situational preferences. Without the presence of a special mathematical context different subjects naturally conceptualize the word "probability" in a multi-valued way. Therefore, the tendency to consider special pure mathematical representation of the probability does not play a big role in decision-making. The model of reasoning according to the rules of probability theory, of course, may be presented among the above trends. However, this kind of thinking is not a priority because it refers to a specific group of phenomena of reality, and is unlikely to be evolutionarily significant. In part, it becomes socially relevant in modern education, yet this process is not widespread.

The developed mathematical models of co-represented

events demonstrate that the probability of joined events may well exceed the probability of certain separate casual events. Then the issue of verification of heuristic behavior using standard probability theory model has a different solution and the conjunction fallacy problem is removed. It can be argued that the conjunction fallacy is not an error of the people being tested. It is rather stereotyped researchers' error, taking a basic scientific theory and regulatory model as the norm, where its application is not completely justified.

The considered alternative mathematical models are more valid psychologically and may be useful for better assessment of the heuristics (used for making judgments about the probability of events under uncertainty) and evaluation of human psychology by means of setting appropriate scientific standards, which are commonly used in communication and learning processes. When standard scientific conceptions differ fundamentally from common human behavior it is reasonable to check the limits of scientific models which are used as a matter of right and valid norms. It means that for instance scientific probability norms of contemporary cross-cultural communication and education processes have to be adjusted to fit complex reality of human psyche [2].

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