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THE QUESTION OF THE SUBJECT BELONGING OF PLAUSIBLE REASONING

The study questions the subject belonging of plausible reasoning. Traditionally, logic is considered the discipline concerned with plausible reasoning, including analogy and induction. Nevertheless, heuristics, probability theory, and heuristic logic as a hybrid of logic and heuristics also claim to study plausible reasoning. The claims of the four disciplines can be explained by the fact that there are no commonly agreed definitions of the concepts of "probability", "logic", and "heuristics" amongst scholars, scientists, and philosophers, and thereby no well-defined research domains to which these disciplines (probability theory, logic, and heuristics, respectively) are applied, given the lack of unity among scholars, scientists, and philosophers both within and outside their own disciplines. The lack of unity among scholars, scientists, and philosophers can be explained by the diversity of approaches, movements, schools, traditions, and trends, the vast amounts of data, and all sorts of expansions, interventions, and differentiations of disciplines.
Keywords: *analogy, heuristics, induction, logic, plausible reasoning, probability theory.*

This paper is concerned with the question of the subject belonging of plausible reasoning. By the question of the subject belonging of plausible reasoning, I mean the problem of which discipline actually investigates plausible reasoning as its subject-matter. **Why this question is not groundless is the subject of this paper.**

Types (or forms) of plausible reasoning include, for example, induction and inference by analogy. Conventional textbooks on traditional formal logic in Ukraine traditionally treat induction and inference by analogy as logical forms of inference, reasoning or argumentation. For instance, the repeatedly reprinted logic textbook by Anatolii Konverskyi has a separate paragraph devoted to the so-called "non-deductive inferences", namely induction and analogy [Конверський 2004: 269–280]. Irina Khomenko refers to induction and reasoning by analogy in general as plausible reasoning [Хоменко 2004: 156–172]. If this is not about Ukrainian manuals and sourcebooks, then, for example, in the authoritative textbook by Ernst Nagel and Morris R. Cohen, which has been used for many decades to teach logic to students in American universities, an entire chapter is devoted to induction, and the same chapter includes a paragraph devoted to reasoning by analogy [Cohen & Morris 1934: 273–288]. In Steeven Shapados' "Dictionnaire philosophique et historique de la logique" the article on reasoning focuses heavily on plausible reasoning like abduction, analogy, and induction [Shapados 2017: 352–366]. Ansgar Beckermann points out that induction is valid non-deductive reasoning [Beckermann 2014: 181–187]. Kazimierz Trzęsicki discusses induction and analogy as types of inference [Trzęsicki 1996: 124–130, 156–160]. And as another example, induction and analogy should be thought of as types of indirect reasoning, according to Gajo Petrović's logic textbook

[Petrović 2011: 86–89].

My appeal to educational and reference material as examples is not random, for they, by virtue of their purpose of providing an exhaustive and systematic outline of the content of a subject, have the greatest influence on those who study a subject, and thus form in their minds a certain idea of the subject itself. Textbooks and dictionaries on logic explicitly state that abduction, analogy, and induction are the subject matter of logic, hence: all plausible reasoning is the subject-matter of logic. However, this position has been challenged by heuristics. In particular, for example, G. E. R. Lloyd views analogy as a type of heuristics [Lloyd 2015: 58–87]. Kaoru Takamatsu develops induction as a heuristic method [Takamatsu 2021]. Alan Hájek considers induction and analogy to be types of tools or rules of thumb for problem solving, judgment, and cognitively demanding activities in general in philosophical heuristics [Hájek 2016: 306–309; Hájek 2018: 364].

The most comprehensive approach to the question of the relationship between plausible reasoning and heuristics was taken by György Polya, author of How to Solve It (1945), a classic textbook on heuristics and problem-solving theory that has been reprinted many times and translated into dozens of languages, including Russian and Estonian. Polya proceeds from the following assumption about how a mathematician and a mathematics teacher work: “Mathematics has many aspects. To many students, I am afraid, mathematics appears as a set of rigid rules, some of which you should learn by heart before the final examinations, and all of which you may forget afterwards. To some instructors, mathematics appears as a system of rigorous proofs which, however, you should refrain from presenting in class, but instead present some more popular although inconclusive talk of which you are somewhat ashamed. To a mathematician, who is active in research, mathematics may appear sometimes as a guessing game: you have to guess a mathematical theorem before you prove it, you have to guess the idea of the proof before you carry through the details” [Polya 1968: 157–158]. Polya claims that mathematics teachers (and we can generalize here that teachers of other subjects do this as well) tend to present mathematics as a ready-made set of rigorous rules and rigorous proofs. I believe that textbooks and reference books on the subject contribute a lot to this, as they also provide ready-made sets of rules, proofs, and facts. Basically, teachers and educational literature “attack” the student's mind by anchoring certain ideas about the subject of study in the student's mind.

A mathematician does not have the challenge of teaching. A mathematician does research: before proving something, it is necessary to find or construct that something. According to Polya, this characterizes not only mathematicians, but scientists, scholars and philosophers in general (big quote below): “To a philosopher with a somewhat open mind all intelligent acquisition of knowledge should appear sometimes as a guessing game, I think. In science as in everyday life, when faced by a new situation, we start out with some guess. Our first guess may fall wide of the mark, but we try it and, according to the degree of success, we modify it more or less. Eventually, after several trials and several modifications, pushed by observations and led by analogy, we may arrive at a more satisfactory guess. The layman does not find it surprising that the naturalist works in this way. The knowledge of the naturalist may be better ordered with a view to selecting the appropriate analogies, his observations may be more purposeful and more careful, he may give more fancy names to his guesses and call them "tentative generalizations," but the naturalist adapts his mind to a new situation by guessing like the common man. And the layman is not surprised to hear that the naturalist is guessing like himself" [Polya 1968: 158]. For Polya, "the result of the mathematician's creative work is demonstrative reasoning, a proof, but the proof is discovered by plausible reasoning, by guessing" [Polya 1968: 158]. Practically speaking, D. Polya depicts plausible reasoning as a way of generating new mathematical conjectures, which I would characterize as educated or intelligent guessing, i.e., as "what we do when logic and information don't provide sufficient insight to answer a question completely" [O'Leary 2006: 74].

Polya refers to induction and analogy as plausible ways of reasoning. Additionally, he considers them to be means of heuristics, or more precisely, types of heuristic reasoning, which are "reasoning not regarded as final and strict but as provisional and plausible only, whose purpose is to discover the solution of the present problem" [Polya 2014: 113]. In other words: Polya asserts that plausible reasoning is equivalent to heuristic reasoning. As a result, plausible reasoning becomes the subject-matter of heuristics as a discipline.

One could say that there is a "conciliatory" version of the discipline that studies plausible reasoning as its subject, in the person of Emiliano Ippoliti's so-called "heuristic logic". For Ippoliti, "heuristic logic" (aka "logic of discovery") is "a set of rational procedures for scientific discovery and ampliative reasoning—specifically, the rules that govern how we generate hypotheses to solve problems" [Ippoliti 2018: 191]. Ippoliti's "heuristic logic" is based entirely on the plausibility, which "offers us a guide (not an algorithm) for the selection of the hypotheses in the form of an evaluation (not a calculus) of the reasons pro and contra a given hypothesis, and hence of the reasons for the passage from one specific proposition to another one during the search for a solution to a problem. So, this passage is not arbitrary" [Ippoliti 2018: 193]. According to Ippoliti, the arsenal of "heuristic logic" includes, among others, induction and analogy, which provide the building blocks for the construction and ampliation of knowledge [Ippoliti 2018: 200].

So, plausible reasoning can be the subject of three disciplines: logic, heuristics, and a kind of hybrid of logic and heuristics in the form of "heuristic logic" (or "logic of discovery"). However, probability theory can also claim plausible reasoning as its own subject-matter.

You can read the following from one of the developers of fast and frugal heuristics, Gerd Gigerenzer: "Logic, probability, and heuristics are three central ideas in the intellectual history of the mind. <…> Each of the three systems pictures the goals of human behavior in its own way. Logic focuses on truth preservation. <…> Probability theory depicts the mind as solving a broader set of goals, performing inductive rather than deductive inference, dealing with samples of information involving error rather than full information that is error-free, and making risky ‘‘bets’’ on the world rather than deducing true consequences from assumptions. <…> Models of heuristic cognition, in contrast, focus on situations in which people need to act fast (rarely a concern for logical models of mind), the probabilities or utilities are unknown, and multiple goals and ill-defined problems prevent logic or probability theory from finding the optimal solution. In this view, the mind resembles an adaptive toolbox with various heuristics tailored for specific classes of problems—much like the hammers and screwdrivers in a handyman’s toolbox” [Gigerenzer 2008: 20]. In this excerpt, Gigerenzer talks about probability theory as something that makes inductive inferences with erroneous information. From Gigerenzer's point of view, it can be assumed that probability theory is concerned with at least one type of plausible reasoning or inference (namely induction). In other words, some types of plausible reasoning can be subject to the study of probability theory.

Consideration of Gigerenzer's point of view above may help us to see one of the causes of the problem of the subject belonging of plausible reasoning. Gigerenzer emphasizes that “none of these three systems is always the best to use in any situation” [Gigerenzer 2008: 20]. This means that heuristics cannot be considered a second-best cognitive strategy after logic or probability [p. 20–21]. Rather, it should be considered that logic and probability theory, as well as heuristics, are part of the adaptive toolkit [Gigerenzer 2008: 21]. To put it another way, heuristics, probability, and logic are each a type of tool, a technological device, a targeted means of manipulating or creating/transforming an object.

If heuristics, probability, and logic are compared to tools, then, like tools, they must have a specific function and scope. For example, the function of a hammer is to strike, and the scope is a variety of tasks that require striking, such as blacksmithing, construction, locksmithing, pottery, games (such as croquet), and reflex diagnostics. The scope of use can be narrowed down to the area of solving certain problems (performing certain tasks). The aforementioned hammer solves certain problems (performs certain tasks) in blacksmithing, construction, locksmithing, pottery, games and reflex diagnostics because of its striking function. Something similar can be said about heuristics, probability and logic, namely that they solve certain problems (perform certain tasks) due to their functions: according to Gigerenzer, logic preserves the truth, probability theory draws inductive conclusions based on available information with errors, and heuristics acts in situations where there is insufficient information but it is necessary to act quickly (make decisions).

However, Gigerenzer's understanding of heuristics, probability, and logic has some “sticking points”. By the way, logic cannot simply be reduced to the preservation of truth, because logic is not always concerned with truth. Among the variety of logics, there is in particular the so-called “logic without truth”, a variant of deontic logic in which the concept of “consequence” is understood as primitive, i.e., one that does not start from the concepts of truth/falseness [Alchourron & Martino 1990]. Also, probability theory does not always rely on inductive arguments; as an alternative, a “deductive probability argument” is proposed [Chatalian 1952; Ducasse 1953]. Finally, heuristics are not always associated with fast solving of a task or problem under conditions of insufficient information; they are also associated with discovery and creativity. All of these examples above indicate that the distinction between heuristics, probability, and logic is probably not that simple – and I believe that this distinction is quite difficult to make because of the lack of a clear and precise understanding of what logic is, what heuristics is, and what probability is. Philosophers, scientists and scholars are unable to establish conventional definitions for heuristics, logic, and probability, because of the disunity of philosophers, scientists and scholars and the variety of different schools and traditions.

Significantly, Gigerenzer makes a clear distinction between heuristics, probability, and logic as intellectual tools. There are, by contrast, cases where a hammer is combined with another tool, such as an axe, a kind of hybrid: a hammer-axe. With such a tool, you can strike, chop and cut. There are also cases where an axe is used for striking, i.e., in the function of a hammer, for example to drive a nail. This means that under certain conditions, one tool is used as another tool. There are cases where a tool can be composed of elements of another tool. For example, an axe can be used as a handle for a solid mass of material that can be used for hammering. It is reasonable to assume that something similar can be said about heuristics, probability, and logic. Under certain conditions, there can be hybrids of heuristics, probability, and logic. Under certain conditions, heuristics, probability, and logic can perform each other's functions. Under certain conditions, they can consist of parts of each other. Good examples of this are the heuristic logic, the probabilistic logic, and the Bayesian heuristic.

Conclusions. The grounds for asking about the subject belonging of plausible reasoning is that there is no “monopoly” granted to any single discipline on the study of plausible reasoning. In this paper, I have exemplified four disciplines that study plausible reasoning, namely formal logic, heuristics, probability theory, and heuristic logic, which is actually a hybrid of logic and heuristics. This situation in humanities, science and philosophy can be explained by the fact that there are no generally accepted definitions of the terms of “probability”, “logic”, and “heuristics” among scholars, scientists and philosophers, and thus no well-defined fields of research assigned to these disciplines (probability theory, logic, and heuristics, respectively), because of the disunity of scholars, scientists and philosophers both within their own disciplines and externally. The latter can be explained by the plethora of approaches, movements, schools, traditions and trends, the enormous data sets, and all sorts of expansions, interventions and differentiations of disciplines. One possible answer to this question could be the development of a separate discipline with plausible reasoning as its main subject of study, on an interdisciplinary basis.

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ПИТАННЯ ПРО ПРЕДМЕТНУ ПРИНАЛЕЖНІСТЬ ПРАВДОПОДІБНИХ МІРКУВАНЬ

У дослідженні ставиться питання про предметну приналежність *правдоподібних міркувань. Традиційно логіка вважається дисципліною, що вивчає правдоподібні міркування, включаючи аналогію та індукцію. Проте евристика, теорія ймовірності та евристична логіка як гібрид логіки та евристики також претендують на вивчення правдоподібних міркувань. Претензії цих чотирьох дисциплін можна пояснити тим, що серед науковців та філософів немає загальноприйнятих визначень понять «ймовірність», «логіка» та «евристика», а отже, немає чітко визначених дослідницьких сфер, до яких ці дисципліни (теорія ймовірностей, логіка та евристика відповідно) застосовуються, з огляду на відсутність єдності серед науковців і філософів як у межах, так і поза межами їхніх власних дисциплін. Відсутність єдності серед науковців і філософів можна пояснити розмаїттям підходів, течій, шкіл, традицій і тенденцій, величезними обсягами даних, а також всілякими розширеннями, інтервенціями та диференціаціями самих дисциплін.*

Ключові слова: *аналогія, евристика, індукція, логіка, правдоподібні міркування, теорія ймовірностей.*

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