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SUBJECT-ORIENTED PROGRAM INVESTIGATING THE INTELLECTUAL SYSTEM OF WITNESSES OF UFO

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СУБ'ЄКТНО-ОРІЄНТОВАНА ПРОГРАМА ДОСЛІДЖЕННЯ ІНТЕЛЕКТУАЛЬНОЇ СИСТЕМИ СВІДКІВ НЛО

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Abstract: The article describes in detail the problems and methods of testing the subject's thinking (participant in the program of measurement "to-1.0-1.1 tests"), by highlighting logical and associative errors of the intelligent model by our measuring. The leading idea and impetus for the start of research was a common problem of the human factor or the interpretation of visual information (images, photographic and video materials, observed natural and social phenomena, etc.), which is transmitted by an eyewitness to the researcher-analyst and often cannot be considered reliable because of various reasons (human factors) or does not reach such a level of verification at all, then misinformation and distortion of facts accumulate. The urgency of the problem of information transfer without distortion between the subjects of society is undeniable. This phenomenon is faced by most analytical organizations that collect and compile data. The scientific novelty of further research will be highlighted in scientific materials. To date, the results of the research have confirmed that they cover the disciplines of logic, psychology, methodology, philosophy, so it is worth focusing on the format of novelty: a partial new combination of features and the inclusion of a new feature. Today, the results confirm the influence of the biased interpretation of visual objects on the logical errors of the subject.
Анотація: У статті детально описано проблеми та методи перевірки мислення суб'єкта (учасника програми вимірювання "to-1.0-1.1 tests"), шляхом виділення логічних та асоціативних помилок інтелектуальної моделі за нашими вимірюваннями. Провідною ідеєю та поштовхом до початку досліджень стала поширена проблема «людського фактора» або інтерпретації візуальної інформації (зображень, фото- та відеоматеріалів, спостережуваних природних та соціальних явищ тощо), яка передається очевидцем досліднику-аналітику та часто не може вважатися достовірною через різні причини (людський фактор) або взагалі не досягає такого рівня перевірки, тоді накопичується дезінформація та спотворення фактів. Актуальність проблеми передачі інформації без спотворень між суб'єктами суспільства є незаперечною. З цим явищем стикається більшість аналітичних організацій, які збирають та упорядковують дані. Наукова новизна подальших досліджень буде висвітлена в наукових матеріалах. На сьогодні результати дослідження підтвердили, що вони охоплюють дисципліни логіки, психології, методології, філософії, тому варто зосередитися на форматі новизни:

часткове нове поєднання ознак та включення нової ознаки. Сьогодні результати підтверджують вплив упередженої інтерпретації візуальних об'єктів на логічні помилки випробуваного.

Keywords:	**Ключові слова:**
Associativity	Асоціативність
Euler-Venn diagrams	Вимірювання "TO"
Human factor	Діаграми Ейлера-Венна
Judgments	Логічні помилки
Logical errors	Людський фактор
Subject-oriented expert system	Силогізм
Subjective factor number	Судження
Syllogism	Суб'єктно-орієнтована експертна система
"TO" measurements	Суб'єктивне число факторів

Introduction. The article describes the problems and methods of eyewitness thinking, in particular such types of logical errors as errors of the subject's judgments. We have summarized our research, which shows how many times an eyewitness exaggerates or distorts information by making typical judgmental errors known from the discipline of Logic of Judgments. Based on this, we determine our correction factor for these distortions – the number of subjective or human factors. We have developed an appendix to our eyewitness questionnaire that helps us identify a person for further collaboration with them. For more than ten years, some methodologies related to the purposeful study of the subject-oriented expert system have been researched by the first author (AIM), especially for the system-analytical department of SRCAA "Zond." The studied method was used in the research of AP (anomalous phenomena), and already a trial application of our method conducted due to the presented material with respondents, in which the second author (IMK) conducted research and collection of information (for our questionnaires) as an expert of the information and technical department (work with respondents of ISRC "EIBC"). IMK tested 26 people who say they were abducted by aliens: 7 were found to be lying; 8 suspected of various forms of mental disorders; 5 obvious ASC; and only 6 were selected that are still to be studied.). [5].

The data of the control group for further research were obtained based on courses on analytics of the project "IAE" ("Institute of Analytics and Expertise") with the assistance of local initiatives of public figures and project coordination by AIM (non-profit project, on public terms). Thus, the use of "TO" (an abbreviation of "to-1.0-1.1 tests") was implemented as an experimental technique in courses and trainings "IAE"; also, it is in one of the projects of ISRC "EIBC" and selectively in other organizations and at the expense of others wishing to take a trial part in measuring of "TO." Today, the subject-oriented expert system includes several measurement methodologies, analytical techniques, mathematical-statistical approaches and two versions of the "TO" measuring system developed by AIM. "TO" is an analytical measurement program in *Excel* and questionnaires on Google Forms [20]. At the beginning of the development of AIM’s methodology and measurement program, a conceptual approach or even a concept was needed. Since the expert system is ultimately a measurement program (computer analytical program [8]), before starting the technical part, we had to deal with the theory. Orientation to subjectivity means defining not only the concept of the subject; it also means a representative of society, the respondent, but the actual justification and isolation of the subjective factor. First, the very concept and criteria of cognitive psychology were analyzed to further focus on the intellectual model of the subject. Unlike any psychological model (cognitive), intellectual or intelligence model is much more effective in mathematical modeling and analysis, because it includes logic of judgments, semantic tables, logical errors. As you know, the word "cognitive" is used in psychology and means perception, attention, memory, skills. We don't research these parameters because we're not a psychology organization. We are an analytical organization. We also do not conduct a psychological test. We let our eyewitnesses fill out our questionnaire. To provide the empirical part of the research, it was necessary to obtain appropriate empirical material. In practice, the science of testing should help, and we have developed our research, pilot measurement program, which best reflects all the issues of conceptual research. The program of measurements "TO" also included a typical mathematical and statistical processing of data samples [6].

After years of research of empirical data on AIM's technique "TO", the decomposition of the result of the solved problems was carried out: a psychological approach gave way to a more pragmatic approach in research, assessment of the human intelligence system (Logic of judgments), namely identification of logical errors in judgments applied to the associative row (series, a set of objects being analyzed) by the respondent. In the following, an attempt is made to solve two problems as one, having studied only the natural intelligence system of the subject.

An associative approach involving certain cognitive parameters influences data sampling. It makes no sense to delve into all the problems at the same time: it is enough to determine the indicators of the subject's logic of judgments and to decompose the task into subtasks. To do this, we move on to the laws of formal logic because they are the connections of the internal structure of thoughts, which were historically formed in the practice's process of thinking based on objective properties and relations of the external world. We identified approaches to solving intellectual problems, which already include the criteria of the subject's existing experience.

Human logic is an intellectual model with a fuzzy structure, which is its difference from strict logic. But it can be applied to classical algorithms of logical operators used in artificial intelligence (AI) systems. We should not forget the fact that the principle of associations is the basis of connections, for example, in neurocomputers, but it uses a logical model as a formal system with many basic elements and many syntactic rules, including the semantics of the studied processes. Associative connections permeate all human thinking and there is no doubt that all mental phenomena are a very complex object of study that is difficult to formalize and model. Thus, the natural (subjective) intelligence model is the best for research. "TO" is not a simple measurement; it is a technique that builds such a model. "TO" examines subjective judgments (complex or simple) and logical errors: contradictions, oppositeness, compatibility of judgments and accompanying aspects which appear situationally such as errors of subordination. The presence of logical and semantic errors gives an understanding of whether it makes sense to investigate further the correlation of logical and unclear abstract thinking (errors determine the vector). The presentation format of the program "TO" contains syllogism-related tasks for the respondent and a special associative row (finite set of objects); it can be used both as a test and as a game technique that has been tested in practice.

Terms and notions. Logical square is a well-known method of testing the logical quality of the respondent's judgments (classical logic); an associative row is a set of elements related to each other by a certain common feature; moreover, if element *A* is associated with element *B* by an associated attribute, and element *B* is associated with element *C*, then it is not necessary that *A* is associated with *C*; judgments are a form of thinking that reflects the connection between an object and its attribute [1,7]; "TO associativity" is an internal concept of this study, reflecting the correlation between the respondent's choice of data subsets and the actual volume of a given set ($S = 30$); logical errors are errors in solving a logical task by the respondent, determined using the Logical square; "Complementarity of TO" is an internal concept of this study, reflects the results of solving logical tasks by the respondent in the form of volumes of subsets of empirical data (Euler circles); "Subject of TO" is a respondent, a participant in the questionnaire and further – the whole measurement of "TO"; subject(-s), predicate(-s) (*S*, *P*) are notions of formalized logic of judgments (subject-predicate approach); "point of support" is the concept of measuring "TO", the middle term of the syllogism-related task (*M*, is included in both premises (premise is a simple attributive judgment, part of a simple categorical syllogism-SCS), but is not included in the conclusion), that is, with which all S are compared (*S* is a smaller term in the lesser premise, called the subject of the conclusion) to obtain a conclusion-solution to the problem (in syllogism it is called a conclusion; i.e., a simple attributive judgment)). M in conclusion gives way to *S* and *P* (*P* is a predicate, and in SCS it is a larger term and predicate of conclusion). The syllogism-related task of "TO" consists of a simple categorical syllogism-SCS. And according to the rules of SCS, there must be a middle term, *M*, and, moreover, it must also be distributed in at least one of the two premises (larger or smaller). That is, the concept of "Supporting point" or an alternative to it – "equilibrium," which are intended for the classification and identification of the associative row of "TO"; in addition, is a mandatory component of the SCS rules. Terms rules: 1. Each syllogism must contain exactly three terms; 2. The middle term must be distributed in at least one of the premises; 3. A term not distributed in premise should not be distributed in the conclusion. Premises rules: 1. There must be at least one general premise (there is no output of two particulate); 2. If one of the premises is particulate, then the conclusion must also be particulate; 3. There must be at least one affirmative premises (no conclusion from two negative ones); 4. The number of negative premises should be equal to the number of negative conclusions.

As it was noted, not all respondents use the SCS rules, since when solving even one task of the TO program, someone does not make logical judgments at all, but simply chooses the answer options and that's it.

Concept (brief justification). The method focuses on the measurement process, not on testing as a method of measurement because an atypical method of "TO" is being developed. Along with the problems of the research concept itself, in the process of working with empirical data, key factors emerged that changed the vector from the analysis of psychology to the analysis of the intellectual system of the subject (the logic of judgments). Along with the linguistic phenomena that are often used today to manipulate social thought and the course of thinking (subjective-predicative neglect), the measurement of "TO" reveal the shortcomings of simple judgments due to the subject's rapid response to information; namely, neglect of conceptual apparatus (for example, the "average term" of the questionnaire "TO"). After all, the associative array is quite complex, and as a result, on the last questions, someone generally forgets what the tasks were and simply chooses answers that correspond to only one of the premises, which consists of either S or P, which gives rise to a probable logical-conceptual phenomenon. If we understand the global social problem of information perception, we can hypothesize that subjective-predicative neglect plus logical phenomena (absence P, M in judgment) are a possible sign of often distorted facts, unreliable information everywhere, and manipulation of society's thinking.

Problems of the respondent's thinking and solving the tasks of its measurement. Of a few disciplines that purposefully study this concept, the best model for measurement is the one that is best modeled (for example, thinking is studied by some sciences – philosophy, logic, physiology, genetics, cybernetics, psychology, etc.). An overview of different disciplines gives an understanding of the nature of thinking, its possibilities in the modern world of understanding various phenomena of a subjective nature. But again, it is for targeted measurement in practice, more effective methods have been tested. Cognitive studies are often perceived as superficial, subjective, unconfirmed if they do not meet standardization, normalization, and other proven techniques, without proper quantitative and qualitative analysis. In essence, the methods of mathematical and statistical analysis include methods of descriptive statistics (description of the characteristics of the phenomenon under study; distribution, features of communication, etc.); methods of statistical inference (establishing the statistical significance of data obtained during experiments); data transformation methods (data transformation to optimize their presentation and analysis) [2]. Based on the theoretical model and systematization of the results of qualitative and quantitative analysis of research, material carries out the interpretation (interpretation, explanation) of the results as a systematic procedure for explaining the studied phenomena [2].

But very often pilot or experimental programs do not always fall under the typical criteria of mathematical-statistical methods. To investigate for further standardization or normalization, for example, a new measurement system does not always justify the goals. And often diverts the amount of cumbersome work of analysis that falls on the researcher. Of course, provided that sufficient material and sample data are collected, it is quite appropriate to make a quantitative and qualitative analysis, but not all at once. In addition, the authors of research projects have repeatedly argued that mathematical criteria are not considered in psychology as the most productive, but it is unacceptable to ignore them.

The accuracy of the conclusions depends on their, which, however, can be refuted using other research methods. Depending on the degree of their reliability and sureness, there are other types of empirical data "L" -, "Q" -, "T" -data [2]. In this study, partially used "T" -data, due to the presence of an associative series, which affects the overall result of the respondent. These include data from objective measurement programs with a controlled experimental situation. Improving objectivity can be achieved through the following tactics applied to the tasks of the questionnaire in the measurement: 1. masking the true purpose of the study; 2. unexpected task statement, spontaneity; 3. uncertainty, the vagueness of measurement objectives (when checking the independence, persistence of the respondent); 4. distraction (offer distracting and basic tasks); 5. creating an emotional situation, including awkward (logical tasks and abstract associative series); 6. emotional content (atypical display of concepts, such as the concept of "point of support," or as in the second version of the measurement of "TO," an alternative condition of the tasks is proposed – "balance of objects"); 7. automated reactions (handwriting, manners, expressive movements, which were studied by the author's methods of measurement by IMK; 8) other types of indicators that were not used in this measurement of "TO." All these techniques are reflected when choosing the type of associative series or rows for measurement. In fact, this applies to the problems of thinking of the respondent or the natural intellectual system, which is characterized by greater "associativity" (associative connections permeate all human thinking) than any other system. That is, by improving the objectivity of the measurement, finding a semantic approach to the definition of subjective errors through the associative series (row), we can expect better indicators of formalized logic (logical tasks). IQ measurements are based on such principles. But most of them are standardized. Therefore, they are not suitable for other cases of experimental research (not situational), where, for example, it is necessary to determine the degree of influence of a subjective factor under certain conditions. They are designed to solve only a logical task, without showing what level of abstract thinking or "associativity" was applied to solve this problem. Instead, the measurement of "TO" is unique.

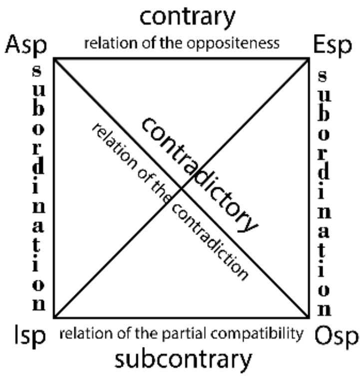


Fig.1. Typical LOGIC SQUARE of judgments

Another task is logical thinking, the transition from the initial states to their consequences according to the formalized laws of logic. The average person is rarely able to explain by what algorithms he makes logical constructions. But the techniques and algorithms by which logical thinking can be determined are, actually, well known. Implementation of formal requirements is important, otherwise, it is easy to make logical mistakes [3]. The laws of achieving truth are the subject of the study of the discipline of logic, and the problem of achieving truth by reasoning is a matter of logic alone. The specificity of the laws of formal logic is that they are the links of the internal structure of thought, which has historically been formed in the process of thinking based on objective properties and relations of the external world [2]. The subject of study of the discipline of formal logic are schemes, forms, and constructions of reasoning of subjects (Figure 1). Formalized laws of logic are best for determining the results of solving a complex intelligence problem, including logical delivery. And then with the help of the subtraction, you can determine the additional impact in the form of errors in solving these problems and other indicators such as associativity of "TO" (errors of the logical problem, and the scope of "associativity").

The problem of the influence of associative thinking was solved by setting an associative series (30 models of figures, the original set of data). The associative series affects a certain type of empirical data at the output. In combination with a logical problem (syllogism-related, categorical tasks), there is a determination of results, so we get several indicators of the intelligence system (type of judgments) of the respondent of "TO" and logic errors as a consequence of the associative series. Such a measurement may not be comfortable or clear to everyone.

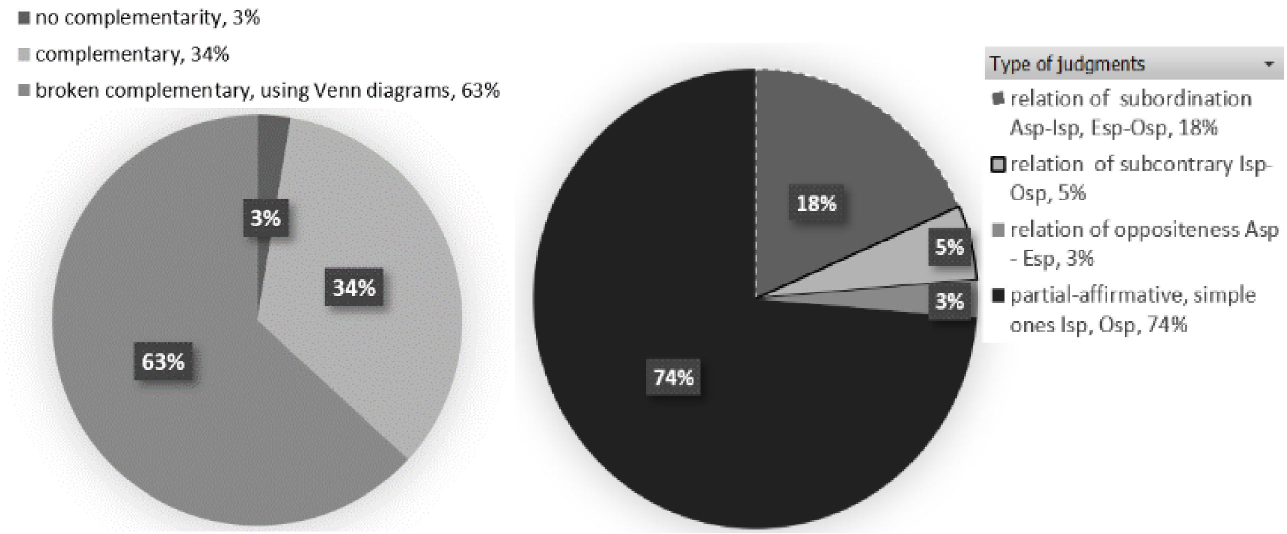


Fig.2-3. Statistics of the types of judgments obtained with the help of the new research test

But as soon as the "TO’s" respondent participates in it, almost immediately his intellect processes the problem and successfully solves the syllogism-related problem (simple categorical judgments) or is confused due to too high a level of abstraction, which is influenced only by the associative series (SCS (simple categorical syllogism-SCS) within one task rarely built by the respondent). Thus, appears the internal term-concept in the system of measurement "TO" is as the concept of "scope of associativity." During the research, it will be noticed that such a parameter is peculiar only to the natural intellectual system (subject-person-respondent), thanks to which it is possible to determine not only the influence of the associative series on logical errors but also to prevent the bot from measuring.

The purpose and objectives of the study. The aim is to study and determine the maximum number of criteria of the subjective factor. Not just typical concepts such as IQ (because AI is also characterized by such an indicator), or typical cognitive parameters of a person along with his EQ. The tasks of this study are solved at the expense of different disciplines at the intersection of sciences. To decompose the problem into sub-tasks of conceptual research, it is possible only by analyzing it from different methodologies and disciplines. It is important to single out the main task and set goals for the study. After separating the results, the parameters of the intelligent system are investigated. The next task is to display the model of the respondent's intelligence system (an abbreviation of semantic table of "TO," Figure 2a, Figure 2b, Figure 3). Next is to compare the scheme of modes, if any after solving a logical problem on typical models, and if there are none, then analyze the scheme of complementarity of "TO" subsets, the division of which was carried out by the respondent (Euler's circles). Since the excessive associativity of "TO" (the concept in "TO," is determined from empirical data) is a property only of the respondent, not a robot or other (AI), the actual subjective factor can be freely determined from the measurement of each respondent from data samples. The ultimate task is to create prognostic estimates of the dependence of the respondent's logical errors on the presence of an associative series and its type (images, photos, videos, and other information data), which will help to further investigate the subjective factor.

Thus, the study of the science of testing helped to determine the method of measuring the required indicators of subjectivity (research of intelligent tasks); from psychology, the type of empirical data on the complication of tasks is taken [2]; from formal logic, the theory of syllogisms and categorical and simple judgments with the model of the decision of a problem in the form of a Logical square (Figure 1), Euler-Venn diagrams is taken; in the analytical part of the evaluation of empirical data in addition to classical mathematical and statistical methods taken as the basis for counting sets (Venn sets, discrete and other special sections of mathematics). This is what it is obtained through the analysis of measurement data: errors of the Logical Square by determining the types of judgments used by the respondents, there are errors of contradiction, oppositeness, subordination; syllogism solution errors by using five tasks to the associative series of "TO" which are syllogistic, there are type of judgments and their figures; errors in solving the logical model of data sets by using an associative series. The term "complementarity of TO" is chosen to describe subsets. The combinations used by the respondent for the questionnaire and the location of subsets are displayed using Euler-Venn diagrams to check the logic of judgments (section calculation, *Excel*). Circle diagrams are not broken, divided, or repeated according to their properties. Each subset, or each task of the questionnaire, corresponds own circle diagram: there are only intersections, consolidation, complement circles, not divisions, gaps, etc. This is further generalized, "as a type of complementarity of TO" as an illogical division of circles "Impaired complementarity" (Figure 2a). Lack of "complementarity" is the absence of consolidation of circuit diagrams, subsets, which is evidence of the lack of analysis of tasks by the respondent (the subject of "TO's" measurement).

First about the subjective-objective. To identify the subjective factor, an objective approach from a variety of measurement techniques is conceptually required. "Objective" approach – the measurement is based on the effectiveness and features of the process (procedure) of solving the problem. This is mainly a measurement of intelligence (logical-formalized tasks, tests of special abilities). "Subjective" approach is the measurement made on the basis of data reported by the subject (respondent, various questionnaires). Measuring "TO" combines these two approaches.

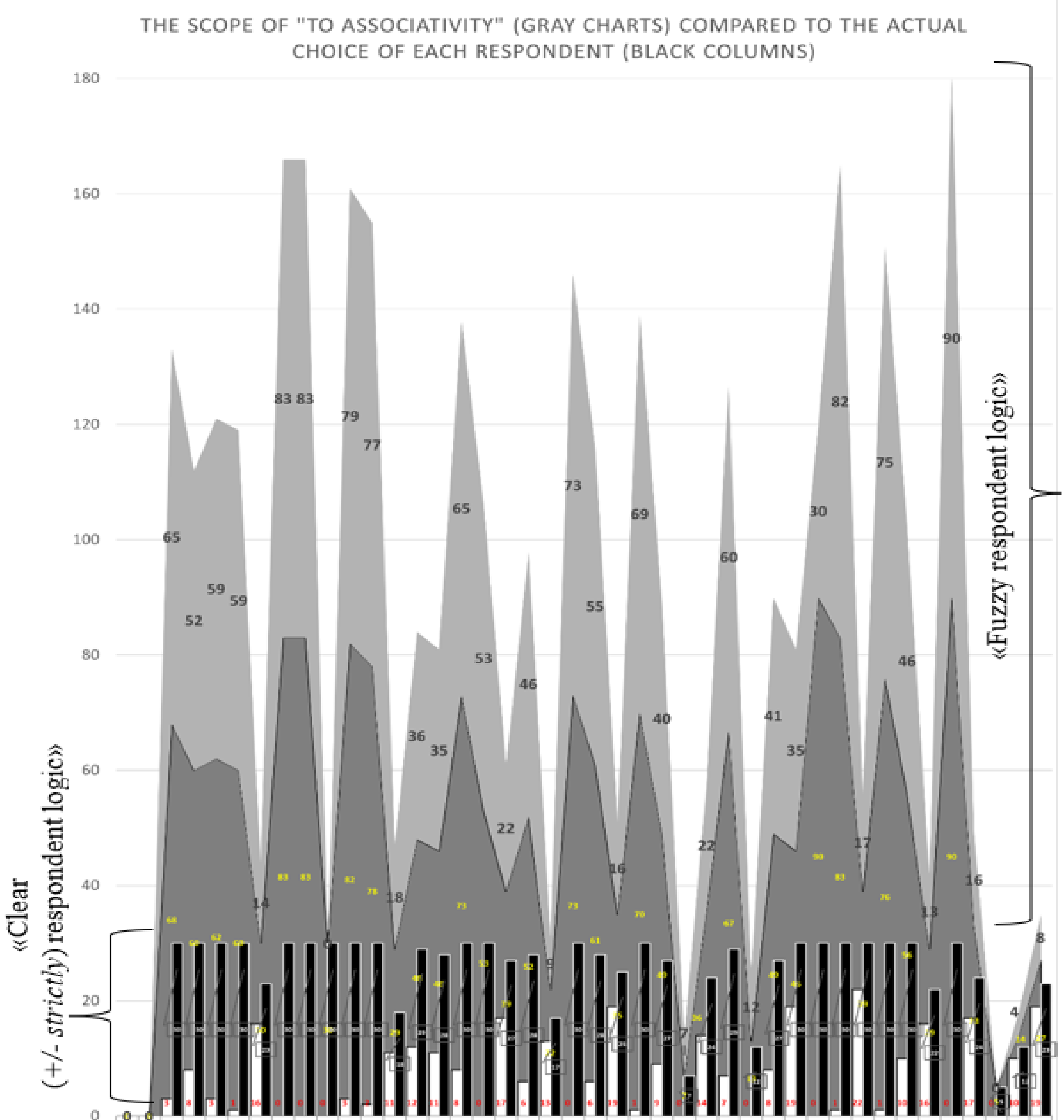
Methods and content of the study. In this study, the emphasis is on the measurement process, rather than on testing as a method of measurement, because an atypical method of "TO" is being developed. The program of measurements includes: the solution of the syllogism-related problem by the respondent (simple categorical judgments, the task of the "TO's" questionnaire); detection of logical errors (contradictions, oppositeness, subordination) using the method of Logical Square; determining the type of judgments and their figures (mode); determination of the "complementarity" of subsets of empirical data (only in "TO"), determination of the influence of the preset of the associative series of "TO" ("associativity," only in "TO").

Formal and logical laws. The particularity of logical laws is that they use certain tools that allow you to calculate the correctness of any reasoning, regardless of its content. And where obviousness, psychological expediency, intuitive relevance are bad helpers, "naked" formalism comes to the rescue. However, to understand what kind of formalization is appropriate, you need to understand what will give such an analytical approach. Given that in this method of measurement, there are typical logical problems, the methods of traditional logic (concepts, judgments, syllogisms, Logical square) may well be suitable for a simple analysis of a set of data. In addition to logical problems, the conceptual apparatus of the respondent is affected (the concept of "point of support" in "TO"), it is important to understand the role of the subject-conceptual analysis. It is part of a functional approach in the analysis of language statements, which makes it possible to more clearly determine the carriers of which logical forms are certain fragments of language, in fact, the concept. But it is worth remembering that in traditional logic, the central categories are concepts, judgments, inference as a form of thinking, then in modern logic the central categories are argument and a propositional function. The concepts of logic statements and the logic of predicates appear [7]. The following are the key categories without which it is not possible to analyze the attributive judgments (data) of the "TO" measurement. This is an abbreviation of statement of the theory that orients in which field the analytics was conducted.

Modern logic. Since traditional logic explores forms of thinking and considers them as a kind of familiarization, a reflection of reality, it is about concepts, judgments, inferences as forms of thinking. Modern logic, as the second stage of logic in the development of a single logical science, takes into consideration language, as the embodiment of thinking, or in other words, explores the semantic side of language. Therefore, in modern logic, they do not talk about concepts, judgments, inferences, but about terms, statements, their combinations, and relations. Modern logic uses the method of formalization in its purest form, excluding any means of natural language. This is the above written judgment in the language of formalism of modern logic: $\forall x(S(x) \supset P(x))$.

Subject-predicative formalism in traditional logic. According to the research conducted in the control group (Figure 3), the tasks set for the respondent in measuring "TO" are mostly solved by the logic of simple judgments, and traditional methods of calculating subsets are conveniently used even in the manual calculation of empirical data. From which the study actually began. Next, it is worth mentioning the attributive categories (*S, P, M*), which solve the whole logical problem of "TO." In accordance with "subject" and predicate of judgments we use *S* and *P* marking. The *S* is 30 figures, predicates (*P*) are categories into which the respondent distributes these figures ("real" belong to the concept of *M*, "unreal" is do not belong to the concept of *M*, "regular" with the concept of M, and then "static" or "dynamic," including or excluding the concept of *M*). According to SCS rules, the concept of *M* is a classic "middle term" of a syllogism. If the respondent-subject uses such a method of conclusion of judgments, if not, then we return to the logic of simple judgments. The concept of *M* is a term called by the actual measurement as the "point of support." What is most interesting, if the respondent does not use his conceptual apparatus for one reason or another to understand whether a given associative series corresponds to the concept, he will not be able to use the logic of judgments. Thus, it is possible to use the conceptual apparatus as a method, and it is possible only to use the method of judgments (simple, complex, inferences). Depending on their intelligence, respondents use these mechanisms of thinking in different ways. Tasks of "TO" are focused on judgments. But at the same time, simple trivial logic of concepts can also be used as an alternative. In traditional logic, *S* indicates what (or whom) is intended to characterize, describe in the judgment, and the predicate (*P*) represents the characteristic itself. (A predicate is that part of a judgment that reflects, captures, and attributes to the objects that represent *S* in the judgment). Judgment is a form of thinking (it is an idea in which the connection between objects and signs is affirmed or denied). Judgment is a form of thinking that reflects the connection between an object and its feature.

The logical structure of the judgment consists of the following parts: the object of thought, the sign of the object of thought, the relation of the object of thought, and its features. In the usual communicative process, concepts such as sentences, judgments, and statements are used as the same, identical. But when judgments are considered as one of the forms of thinking that explores traditional logic, then it is necessary to clearly distinguish between these concepts, to identify the specifics of each of the concepts. In the analysis of simple judgments by value, the whole set of simple judgments can be divided into two incompatible sets: true judgments and false judgments (special semantic tables we call the "truth-tables"). The procedure for identifying a value for a simple judgment is to establish conformity or no conformity between the judgment and what it is about. In the case of complex judgments, the emphasis is on the uniqueness of the procedure for establishing value for them. The value of a complex judgment depends on the values of simple judgments that make it up (not comparing the judgment with what is happening in reality, but the application of the "truth-table," where each simple judgment is compared with a set of values) [7]. The emphasis in the tasks of the questionnaire is on judgments, not on the concept of *M* ("point of support"), in order to determine as much as possible in the results of logical errors and not to understand the "conceptual apparatus" of the respondent. Since judgment is one of the forms of abstract thinking, its material embodiment, material realization is language, more specifically – a sentence [7]. The tasks of the questionnaire of "TO" mostly used sentences, not questions (direct instructions).



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
in combination			65	52	59	59	14	83	83	0	79	77	18	36	35	65	53	22	46	9	73
max			68	60	62	60	30	83	83	30	82	78	29	48	46	73	53	39	52	22	73
not used			3	8	3	1	16	0	0	0	3	2	11	12	11	8	0	17	6	13	0
actual sample			30	30	30	30	23	30	30	30	30	30	18	29	28	30	30	27	28	17	30

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
in combination	55	16	69	40	7	22	60	12	41	35	30	82	17	75	46	13	90	16	0	4	8
max	61	35	70	49	7	36	67	13	49	46	90	83	39	76	56	29	90	33	5	14	27
not used	6	19	1	9	0	14	7	0	8	19	0	1	22	1	10	16	0	17	0	10	19
actual sample	28	25	30	27	7	24	29	12	27	30	30	30	30	30	30	22	30	24	5	12	23

Fig.4. The scope of "TO Associativity"

Rules of judgments. Simple is a judgment in which no logical part is a separate judgment and therefore has no independent parts. For example, "A book is a source of information." If you subtract any part of this judgment ("book" or "source of information"), then taken separately, it will not be a judgment, and the original judgment, as a whole object will collapse. A complex judgment is one that consists of two or more simple judgments that are connected by logical conjunctions, and each of its correct parts will be a separate judgment. Let's focus on the analysis of simple judgments because everything complex consists of simple. By the nature of the sign, which is represented by the predicate (*P*) of the judgment, there are the following types: a) attributive; b) judgments with relations or judgments about relations; c) judgment of existence. *Categorical judgments* on the unified classification have acquired a standard statement: *Asp, Esp, Isp, Osp* (tops of the square). Mnemonic tool for the visual representation of logical relations between categorical judgments, which is called the Logical square (Figure 1). It is known that categorical judgments can be analyzed at the level of intensional and extensional (the concept of intentional and extensional was used by *R*. Carnap as explications, or clarifications, according to the concepts of content and volume). At the level of the intensional, categorical judgments inform about the belonging or non-belonging features of the subject of thought: *Asp – P is inherent in all S*; *Esp – P is not inherent in all S*; *Isp – P is inherent in some S*; *Osp – P is not inherent in some S.* At the level of extensional or volume, the terms *S* and *P* can be represented as definite sets. This means that for two terms *(S, P)* there are five possible types of relations, which are represented by the corresponding schemes of judgments. Each type of the given relations has own names: *I* is coincidence or equivalence; *II* is left-sided inclusion; *III* is partial coincidence; *IV* is right-hand inclusion; *V* is incompatibility. Each categorical judgment can be compared with specific types of relations *S* and *P*. Conditions of truth (*i*) or falseness (*x*) of any categorical judgment: *1) Asp – i↔{I, II}* the judgment of *Asp* is true if and only if there are types of relations *I, II*; 2) *Asp – x↔{III, IV, V}* – the judgment of *Asp is false if and only if there are types of relations III, IV, V;* 3) *Esp – i↔{V}*; 4) *Esp – x ↔ {I, II, III, IV}*; 5) *Isp – i↔{I, II, III, IV}*; 6) *Isp – x↔{V}*; 7) *Osp – i↔{III, IV, V}*; 8) *Osp – x↔{I, II}*. The relation between Euler circles (Euler diagrams) and Venn diagrams, and more precisely, the transition from one diagram to another – from Venn to Euler. Schemes are useful for understanding not only the evaluation criteria but also the main categories with which to conduct measurements of "TO": simple categorical judgments are attributive judgments. Since the tasks of the questionnaire give the opportunity to choose and to participate in this measurement or not, all respondents mainly use comparative categorical judgments (Figure 2a and Figure 2b).

Studies have shown that the main vectors of movement of judgments (thinking) on the Logical square (*AspEspIspOsp, AEIO*) in respondents who participated in the measurement of "TO" on the example of solving the first and second measurement tasks – are such thinking operations that practically brought to automatism in the majority. However, they are part of the analysis of the thought process – trivial things that we do not notice in ourselves when we analyze. Typical transformations of partial judgments when solving tasks of "TO" (*Osp – Isp*) look like this: *"Some S are not real" (Osp) = "Some S are non-real" (Isp)* is category of data subsets *N*; *"Some S are not non-real" (Osp) = "Some S are real" (Isp)* is category of subsets of data *R*, etc. with subsets of *Z, St, D.* Transformation of general judgments (rarely in "TO," *Esp – Asp*): *"No S is real" (Esp) = "All S is unreal" (Asp)* is category of data set *N*; or *"No S is non-real" (Esp) = "All S is real" (Asp)* is the category of the data set *R*: the third is not given, and the category of subsets *Z, St, D* is not formed, only all *N*, or all *R*, which excludes the entire volume *S = 30.* The vectors of the final compatible conclusions of the respondents' judgments are the conclusions in which there are only *S* (smaller premiss, subject SCS) and *P* (larger premiss, predicate), and the middle term *M* (the concept of "point of support") is absent (in the case of syllogism). Even if the syllogism is not used, the respondent solves a complex problem of five tasks with the help of simple judgments (categorical). Output schema for *S, P* (partially affirmative, *Isp*): *"Some R is Z," "Some R is St," "Some R is D"*; *"Some N is St," "Some N is D."* And also with the formation of relations of subordination in a subset (*Asp – Isp*): *"All Z is R (Isp)" – Z=R* (algebraic), etc.

The most typical relation is the probability of forming a mode figure (syllogism) under the condition of the existence of such a figure are examples of how many different combinations can be. Therefore, in the main table, the analysis of logical errors is made, according to the rules of traditional logic of incompatible comparable judgments (Figure 3). Figure 4 displaying the results of analytical processing of respondents' data, divided into groups – samples. The concept of associativity is an internal concept of research (see above). The black bars in the charts are all potential volume is the actual volume of subsets of the respondents' data. Gray areas reflect the number of the respondents' abstract thinking, interpretation of the associative series, which might not have been necessary, because there is a strict logic (black and white columns), which, without exception, as we see in the diagram, was used by each respondent.

Our diagrams show quantitative and qualitative indicators of subsets of data. These diagrams show the quantitative indicators of the subjects of the study (respondents), namely the distribution of the results of each respondent on one line. The diagram shows the distribution made by Euler-Venn diagrams (circles), essentially the same subsets, but with a plus or minus sign, respectively, which are included in the circles, and which are not included. It shows the volumes of all subsets for each respondent: here are those indicators that did not participate in the Euler-Venn diagrams (for example,

$Z=ø$). Also, we have the diagram which shows the results of the found logical errors in the respondents, due to the analysis by the method of the Logical square of incompatibility of judgments. In Figure 4, the black columns of the diagrams show the full potential volume is the actual volume of a subset of data respondents; gray areas are a clear view of the results of abstract thinking of the respondent, his interpretation of the associative series, which may not be necessary, because there is a strict logic (black and white columns), which without exception, as shown in the diagram, used each respondent. Since the concept of the respondent's interpretation of the visual object and abstract thinking have their meanings in everyday life, the very concept of "associativity in TO" is relatively free to put new meanings in this study. In the science of syllogism, in one way or another, the conditions for the truth of attributive statements are set. This is usually done using the so-called Euler circles (or Venn diagrams), which act as model schemes for the truth of attributive statements. As for inferences, they are determined from inferences by the Logical Square to direct and indirect inferences. The number of direct inferences in positive judgment includes the operation of *conversion*, or *obversion* (transformation) in negative judgment, and various types of contrapositions. Euler-Venn diagrams are used for a visual representation of logical operations, as a visual tool for working with sets. In these diagrams, all possible options for intersecting plurals are displayed. The number of intersections (areas) N is determined by the formula:

$$N = 2^n, \quad (1)$$

where n – is the number of sets. Venn diagrams are a graphical way of setting and analyzing logical and mathematical theories and their formulas. It is used in the analytics of combinations of different operations on sets (respectively, union, intersection, difference, symmetric difference, absolute complement as a kind of complementarity):

$$A \cup B=\{x|x \in A \text{ or } x \in B\};\ A \cap B=\{x|x \in A \text{ and } x \in B\};$$
$$A \cap B=\{x|x \in A \text{ and } x \in B\};\ A+B=\{x|or \in A, \text{ or } x \in B\}; \quad (2)$$

The search for errors by the Logical square is carried out by investigating certain pairs of sets, the combinations of which may have an intersection match. The inclusion-exclusion formula (or the principle of inclusion-exclusion) is a combinatorial formula that allows you to determine the cardinality of the union of a finite number of finite sets, which in the general case can intersect with each other. In the case of two sets A, B, the inclusion-exclusion formula: $|A \cup B|=|A|+|B|-|A \cap B|$. The sum $|A|+|B|$ the intersection $A \cap B$ elements are counted twice, and to compensate for this, we subtract $|A \cap B|$ from the right side of the formula. In the same way, with $n>2$ sets, finding the number of elements of the union $A_1UA_2U...UA_n$ consists in including everything, then eliminating the unnecessary required parameters. We also have the diagram which displays the relationship between original data samples, where a series of charts is set from the largest average of logical errors L (Logical square *AspEspIspOsp*) to the smallest ($L=3.5;\ L=0.2;\ L=0.1$). The previous conclusion of the influence of the respondent's "associativity" A_{to} on logical errors L_{AEIO}, directly shows that A_{max} is a harbinger of $L>0$. That is, the associative series of "TO" affects the number of logical errors. And, in fact, its very presence affects the indicators of A_{max}, A_{komb}. However, the A_{fact}, A_{not} indicators, respectively, the black and white columns of the diagrams, are actual figures of the associative series and not used in logical analysis, keep their trend, and are depicted as columns, not areas. Two other diagrams are also shown: with the least number of logical errors. For comparison, a diagram of the entire data set of a large sample of research subjects is presented. It is noticeable that the gray areas of the diagram (horizontal) with a minimum amount of logical errors are narrow, they are also minimal. This means that interpretations, illogical judgments, and abstract constructions of the respondents under the influence of the associative series are also minimal.

The white trend line in the diagrams separates the level of actual choice, which is almost the same for most respondents and does not differ much, because the actual volume of the associative range is always equal to $A_{fact}=30$ under ideal conditions, or is approaching this value (≤), according to statistics, "TO." Three graphs clearly show how much the associativity of Amax depends on the logical errors L_{min} and L_{max}. Without charts or graphs, it would be almost impossible to notice this in data tables at once. Thus, the high associativity and a large number of subset figures used by the respondent in combinations (A_{komb}) to solve the "TO" problem is likely to lead to many errors (*L*) resulting from the diagrams and the study. In the future, you can even predict, according to the average statistical indicators, for any respondent, the occurrence of logical errors, having only the initial data, the first results of solving the syllogism-related problem of "TO." In the entire array of research data, the Amin values are on average close to A_{fact}: $A_{fact} \leq A_{min}$. The actual volume of the set of the whole associative series does not decrease or increase by itself: $S=A_{fact}=30$.

Statistical results of respondents and introducing coefficients as corrections for logical and semantic errors of the subject. Models for compensation of errors of clear logic of the subject (respondent "TO") are in order to make sure that the coefficients are effective. The coefficient that compensates for the errors on the diagrams is always at the top (on the line graph, the upper broken line), and the maximum coefficient does not exceed the limit $y=1$: $Kmax=1$, and the minimum coefficient is not equal to zero (greater than zero) – $Kmin \neq 0$, $Kmin>0$. The value for respondents $Kresp=0$ shows that such a coefficient is not relevant and, is not introduced, because the errors are equal to zero. Corrections for errors of judgment (according to the Logical square) are tiny, and in the general array of others they are shown lower by columns on our diagrams. Because of this difference, the idea arose of introducing separate correction factors. The table with the results of respondents (in points) after passing the questionnaire (total marks), where there is a clear division into points of clear and non-clear logic of the respondent (upper broken line and lower, respectively). Statistical results of respondents in points, respectively, after passing the questionnaire (total marks) and after introducing coefficients of corrections for logical and semantic errors of the subject of measurement (real marks) can be seen on Figure 5.

The maximum number of *points* is *200*, the minimum is *0 points*. The average value of the score after passing the questionnaire is *128 points*. After introducing the correction coefficients for errors in passing the measurement, the average value is *98 points*.

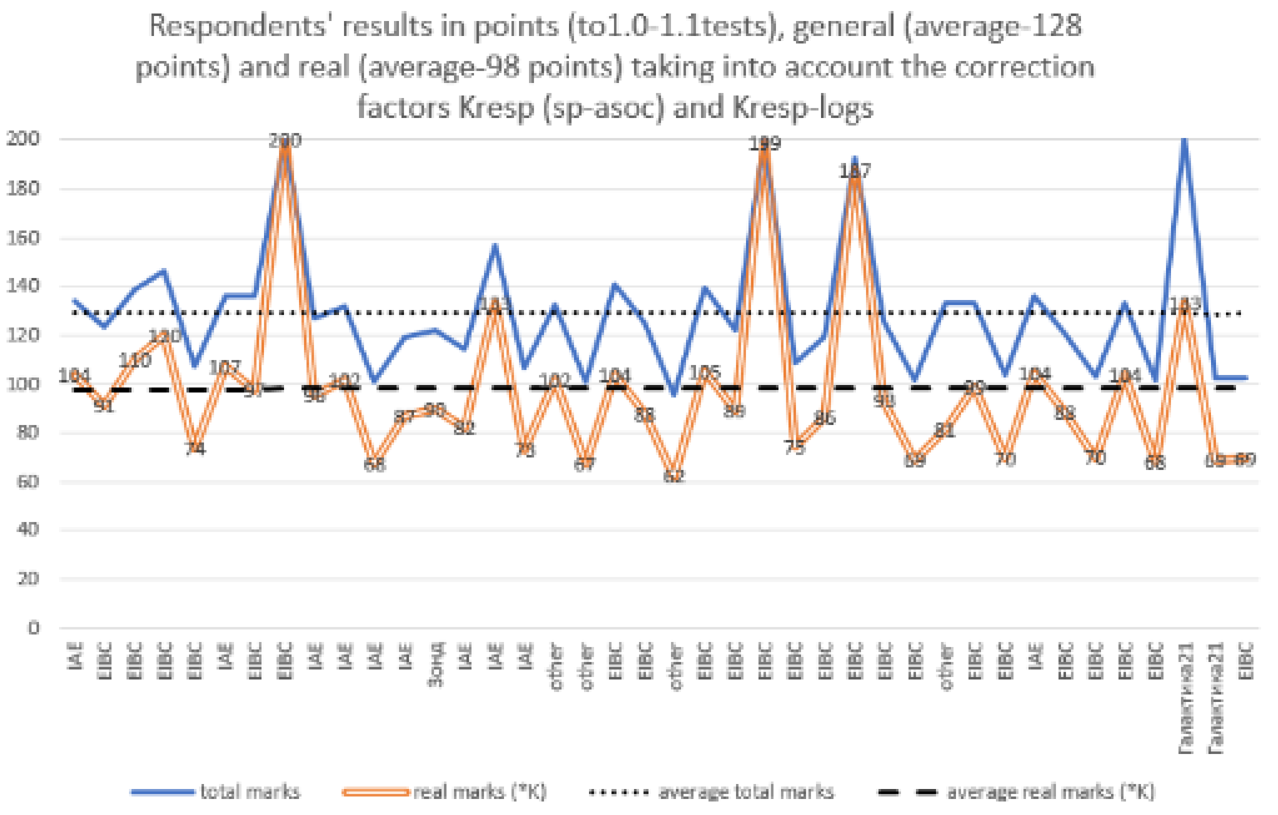


Fig.5. Respondents' results in points (to1.0-1.1tests)

On average, the coefficients affect *1.4 times* toward reducing the number of points. However, there are three types of coefficients, therefore, for different cases, one or another coefficient can be selectively considered. The average values of each type of coefficient, which was found by the analytical method. For example, the average coefficient $AK_{resp\text{-}logs}$ already considers the relative errors, which are found from the Logical square (logic of judgments) in recalculation on the volume of data subsets that it covered. The errors of judgments by the Logical square are distributed:

$$P_{logs}=P_{rn}+P_{zn}+P_{sd}\ , \qquad (3)$$

$$P_{rn} =1-((A_{fact}*2)/2S) \geq 0, \text{ where } A_{fact}=S. \qquad (4)$$

The same formulas, respectively, for P_{rn}, P_{zn} and P_{sd}, where the maximum volumes of subsets are $2S$. The coefficients $AK_{resp\text{-}sp}$ and $AK_{resp\text{-}assoc}$ are relative values from empirical data from the TO subsets. Moreover, $AK_{resp\text{-}assoc}$ is a deterministic indicator of the respondent's intelligence model (Figure 4), which is responsible for the areas of the subject's unclear logic, and in fact, is the characteristic of these areas. $AK_{resp\text{-}sp}$ is the average value of the coefficient found from the ratio between the volumes of subsets A_{fact} (data from areas of clear logic (Figure 4)) and A_{not} (unallocated S). Thus, the indicators of clear (0.71) and unclear logic (0.57) of the respondent are like average correcting coefficients. They can be considered in the received (total) scores of the respondent to find the real (real marks) of his scores and not to compare the respondents with each other, but with analytical indicators. The indicator of the logic of judgments (0.96) is not defined as a separate coefficient, because it is a relative value between sample subsets of data, the ratio of which is individually responsible for one or another type of judgment, namely: the ratio of oppositeness, contradiction, partial compatibility. Coefficients AK, which are equal to zero or one, show an impeccably completed measurement questionnaire of "TO," or because of "self-correction" of the respondent's data (unsatisfactory answers were compensated by the best, for example). Parametric methods for estimating and analyzing statistical hypotheses are an important step for the study of empirical data. When the first data samples are formed, you can further predict certain results, the actual absolute and relative values, as well as their averages. For data analysis, it often carried research out on sample sets, which determine the average error of a relative or average value, which allows to determine the essence of the derived value, its confidence limits (intervals). Determining the possible limits of fluctuations in repeated studies allows you to set the limits of the norm of indicators in the study. If the study of the same phenomenon in different samples leads to different results, each of them to some extent characterizes the phenomenon, but depending on random fluctuations, it differs from the result of the general population. In this case, it is necessary to assess the probability (significance) of the difference between these results using a parametric reliability factor (Student's criterion). Evaluating the reliability of research results helps to make the right conclusions with a guarantee against errors in interpreting the results. In the future, we can summarize the following algorithm and problems:-(areas of application) transfer of the results of the sample survey to the general population, determination of the materiality of the derived values, determination of the difference between the derived values;-(conditions that affect the reliability) the variety of features in the sample, the number of observations (n), the degree of probability of error prediction (%);-(methods of reliability assessment) determination of possible confidence limits of fluctuations of the got indicators, the ratio of the indicator to its average error in determining the reliability of the difference between the values. Determination of probable confidence limits of fluctuations of the received indicators (for average values and for relative values) [4]:

$$\bar{X}_{gen} = \bar{X}_{sam} \pm tm_x, \qquad P_{gen} = P_{sam} \pm tm_p, \qquad (5, 6)$$

where $\bar{X}_{gen}$, $\bar{X}_{sam}$ – are confidence intervals (limits) of the average value for the general totality and the sample, respectively; P_{sam}, P_{gen} – are confidence intervals (limits) of relative value for sample totality and general totality, respectively; m_x, m_p – are errors of average and relative values, respectively; t – Student's reliability criterion, which is used to assess the reliability of differences between indicators. <u>The ratio of the indicator to its average error (for average and relative values, respectively):</u>

$$m_x = \frac{\delta}{\sqrt{n}}\ , \qquad t = \frac{\bar{X}}{m_x}; \qquad m_p = \sqrt{\frac{P_q}{n}}\ , \qquad t = \frac{P}{m_p}, \tag{7, 8}$$

where σ – standard deviation; n – number of observation results; $q=1–P$ $(q=100–P, q=1000–P, q=10000–P, q=1000000–P)$. Standard (standard deviation) is the degree of deviation of all values of the feature from its mean, one of the most important methods to help determine how much a certain value changes: the larger the standard deviation, the wider the range of changes in the values of this value. Also, this method is one of the three known methods that allow you to decide based on the uncertainty factor (standard deviations, confidence intervals, and multiple regression analysis).

$$\sigma_s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}, \quad \sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{N}}, \tag{9}$$

where $\sum(x_i - \bar{x})^2$ – is a sum of the squares of all deviations of individual values (x_i) from their average size $(\bar{x})$; n – is a number of observation results. $(n-1)$ used in small samples, where a limited number of objects are randomly selected from the entire population for further study, N we use in the case of a continuous survey, when the data for each object of the population are considered. Determining the significance of differences between values (for average and relative values, respectively):

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{m_1^2 + m_2^2}}, \quad t = \frac{P_1 - P_2}{\sqrt{m_1^2 + m_2^2}} \tag{10, 11}$$

where $\overline{X_1} > \overline{X_2}$, $P_1 > P_2$. With numerous observations *(n>30)* the difference between the indicators is significant (essential, significant, non-random), if: $t \geq 2$ $(p<0,05)$, it corresponds to a probability of error-free prediction of 95.5% *if* $t>3$ $(p<0.01)$, it corresponds to a probability of error of 99.7%. If it is planned to transfer the conclusions got in the data sample to a similar population or the entire population, then the indicators (relative and average) require an assessment of probability (except for continuous studies). In addition, the analysis of the obtained data will show whether it will be possible to make prediction in the future or not. Evaluation of results we`ve in the following statement. The results are significant at $t>3$. Differences between indicators at $n>30$: unreliable at $t<2$ $(p>0,05)$, probable at $t>2$ $(p<0,05)$, probable at $t>3$ $(p<0,01)$. With a small sample $(n<30)$ t is estimated from the Student's table $(n` = n_1 + n_2 - 2,\ n' = (n_1 - 1) + (n_2 - 1))$. If $t_{fact} \geq t_{tab}$ – the difference between the indicators is probable. Probability of an unmistakable forecast and risk of error in the Table 1.

Table 1. Assessment of reliability and probability of error prediction

t	Probability of an unmistakable forecast (in fractions of a unit and in %, respectively)		Risk of error, (p) (in fractions of a unit and in %, respectively)		Reliability assessment
1	0,66	66	0,34	34	unreliable
2	0,95	**95**	**0,05**	5	reliably
3	0,99	**99**	**0,01**	1	reliably

Furthermore, about the confidence intervals of 95% and 99% in the degree of probability for the results (to1.0-1.1tests) in points (respondents) at $n>30$, where $t = 2$, $t = 3$. Initial data (tabular): $\sigma = \pm 4$ points at $\bar{X}_{total} = 128p.$ (average score of clear logic of the respondent before introducing correction factors) and $\sigma = \pm 5$ points at $\bar{X}_{real} = 98p.$ (average score of clear logic of the respondent after introducing correction factors), $t = 4.7$ $(t > 3$ $(p < 0.01)$, which corresponds to a probability of error-free prediction of 99.7% with numerous observations $(n>30))$. $\bar{X}_{gen} = \bar{X}_{total} \pm tm_x = 128 \pm 2*4$ points, with a probability of 95%, the average scores are in the range of 120–136p., $\bar{X}_{gen} = \bar{X}_{total} \pm tm_x = 128 \pm 3*5$ points, with a probability of 99%, the average scores are in the range of 116–140p. After adding the correction factors: $\bar{X}_{gen} = \bar{X}_{real} \pm tm_x = 98 \pm 2*4$ points, with a probability of 95%, the average scores are in the range of 88–108p., $\bar{X}_{gen} = \bar{X}_{real} \pm tm_x = 98 \pm 3*5$ points, with a probability of

99%, the average scores are in the range of 83–113p., show the degree of probability by which it can be argued that the scores are indeed within these limits. *We made the same calculations for all relative values to find the correction factors:*

$$A_{fact}/A_{max} = Ak_{resp\text{-}assoc} \text{ and } 1–A_n/A_{fact} = Ak_{sp};\ Ak'_{resp\text{-}logs} = \sum\left(\frac{A^{logs}_{komb}}{2S}\right) = \frac{A^{rn}_{komb}}{2S}+\frac{A^{zn}_{komb}}{2S}+\frac{A^{sd}_{komb}}{2S} \quad (12)$$

For errors in the judgments of the Logic square: $P_{logs}=P_{rn}+P_{zn}+P_{sd}=0$. Standard deviation for absolute values of errors of a Logical square of all data set (A^{logs}_{komb}): $\sigma_{rn}=\pm1{,}48$, $\sigma_{zn}=\pm1{,}72$, $\sigma_{sd}=\pm5{,}02$. Average value error: $m_{rn}=0{,}24$, $m_{zn}=0{,}28$, $m_{sd}=0{,}81$. And for relative ones ($Ak'_{resp\text{-}logs}$): $\sigma^{log}_{komb}=\pm0{,}09$; $m^{log}_{komb}=0{,}02$. Hence, the methods used to make decisions considering the uncertainty factor, as well as the influence of random value (researched standard deviations of averages and relative values, as well as confidence intervals of the results of respondents in points). In order to avoid inaccuracies, an already generalized indicator of all coefficients and a diagram of average indicators is proposed; *Kmin=0* was not considered in further analytical processing (*Kmin≠0, Kmin>0*). We can see this on Figure 6.

The number of subjective factors. The higher the coefficient in value, the less the human factor took place in the measurement "TO" ("to1.0-1.1 tests"). Although the average total coefficient is *0.75*. That is, the average score obtained by the average respondent, the subject of measurement TO, may decrease *1.4 times*. Thus, the subjective or human factor on average in the program "TO" affects *1.4 times*. But according to the above, this indicator depends on at least several factors: it is an associative series, and the complexity of syllogism-related questions, and the conceptual apparatus of the respondent, as well as a set of other intelligence parameters. In the respondent's case-subject-person there is an element of the human factor – that's when A_{max}, A_{komb} are not just judgments, but complex inferences, interpretations, with a violation of the logic of simple judgments and, accordingly, logical errors of judgments. Thus, the model of the intelligence system of the subject with the help of the logic of judgments becomes clear through diagrams and formal logic formulas [21].

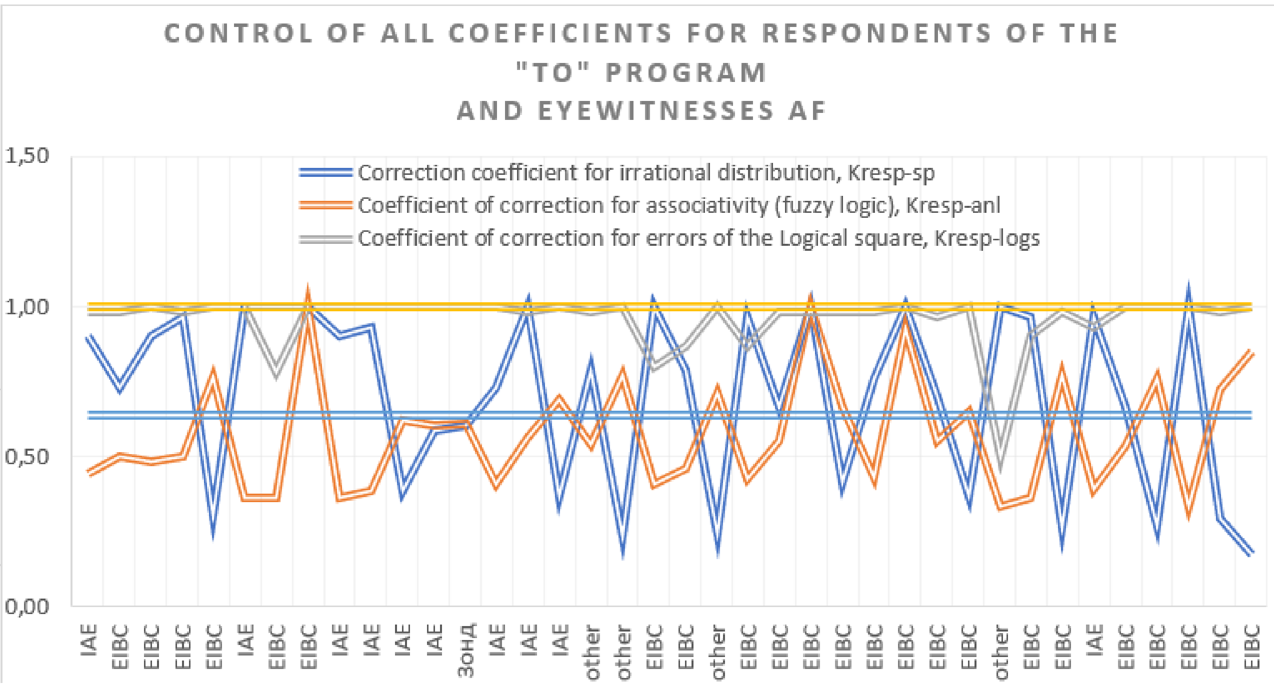


Fig.6. Control of all coefficients for respondents

Conclusions. The algorithm of any analysis involves the division into components of what is analyzed. In the case of the respondent-human subject, the human factor appears. It causes the appearance of A_{max}, A_{komb} which are not just judgments, but complex inferences, interpretations, with a violation of the logic of simple judgments and, accordingly, the logical errors of judgments. Thus, the model of the intelligence system of the subject with the help of the logic of judgments becomes clear through diagrams and formal-logical formulas. The main goal of the problem is experimentally investigated the determination of the rational logic and the ability to see what is "associativity TO" presented on our special resulting diagram – here rational logic is symmetrical to a new characteristic associativity. This diagram shows how obvious the issue of the influence of associativity is (individual interpretation, perception, experience, or the human factor). Single cases of convergence were received by those respondents in whom the number of logical errors is zero or minimal, and $A_{max} \approx A_{fact}$. Then the two curves on this diagram are combined. However, such a phenomenon is unfortunately not observed due to the presence of additional factors, namely the human factor, which is studied and determined under the experimental name "TO associativity." Convergence is no exception: it is a case of minimal human influence. Eyewitnesses, AP witnesses, who are among the respondents, are no exception. Such people are a clear example of the hidden associativity of memory and experience. The associative series is the only tool that guides the eyewitness through similar experiences and forces them to interpret, but only through the prism of logical constructions and judgments of the "to-1.0-1.1 tests" program or "TO." The program-method "TO" after analytical processing of the information carries out construction of the corresponding diagrams and an output of data on the respondent.

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