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## COGNITIVE-STYLE DETERMINATION OF THINKING

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### *Abstract*

The article considers the problem of cognitive-style determination of thinking characteristics. The cognitive-style organization of a person is a predictor of not only his behavior, manifests itself at all levels of organization of the personality Self-Concept, but also determines, first of all, the characteristics of the cognitive sphere. The aim of our study was to investigate the relationship of the cognitive-style organization of the personality and the characteristics of mental activity, in particular the manifestations of meta-intellectual operations in solving the problem in a visually effective way. The variables for the analysis were the person's belonging to one of the poles of the cognitive style (analyticity-syntheticity, impulsiveness-reflectivity), meta-intellectual actions (indicative, executive, and control) and operations (task adoption, detailed orientation, perceptual orientation plan, visualization, correlation with sample, compliance with sequence and orientation). An empirical study was conducted to test the hypothesis about the influence of cognitive-style organization on the nature of the manifestation of meta-intellectual actions and operations. The model for the study of meta-intellectual actions and operations in subjects with different cognitive styles was the Kohs Block Design Test. Cognitive styles were studied using the Gardner Free Sorting Test (analyticity-syntheticity, conceptual differentiation) and "The Matching Familiar Figures Test" (impulsivity-reflectivity). Mathematical processing of the research data was performed using the statistical software of MS-Excel, as well as the Statistica 6.0 program.

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**Keywords:** Cognitive styles, determination, meta-intellectual operations, thinking.



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## 1. Introduction

The problem of cognitive styles is of interest precisely as that potential area of psychological knowledge, where, perhaps, a variant of combining general psychological and differential psychological aspects of the study of human intelligence with access to an understanding of the personality nature will be found. Cognitive style is seen as global education, manifested in a similar way in cognition, behavior, communication, learning and professional activities. Cognitive styles are individually peculiar ways of processing information about your environment in the form of individual differences in perception, analysis, structuring, categorization, assessment of what is happening.

A comprehensive analysis of the problems of cognitive-style organization is given by Kholodnaya (2004). The author emphasizes the importance of the stylistic approach for modern theories of intelligence and personality. Numerous studies have shown that cognitive styles determine the content of both external information coming from the subject and interpersonal worlds, and internal information related to the self-awareness and self-concept of a person, their self-efficacy (Akhtamyanova, Fatykhova, & Nurieva, 2016; Kolga, 1986; Libin, 1999).

Cognitive style, reflecting various aspects of the functioning of the cognitive sphere, is a stable individual characteristic of the ways a person interacts with the information field. The closest attention was paid to such behavioral parameters as field-dependence-independence (Witkin & Goodenough, 1982), impulsivity-reflexivity (Kagan, 1986), analyticity-synthetics or conceptual differentiation (Gardner, Lohrenz, & Schoen, 1968) and others.

## 2. Problem Statement

The problem of the relationship between the cognitive-style organization and the characteristics of thinking was considered in sufficient detail in the works of Kholodnaya. She considers cognitive styles as metacognitive abilities. Justifying this provision, she writes that in the style studies the idea was first stated about the role of the structural organization of the individual mental (mental) experience of the subject as one of the determinants of individual differences in intellectual activity (Kholodnaya, 2004).

She makes a distinction between traditional intellectual abilities and cognitive styles: intellectual abilities are indicators of the formation of mental mechanisms responsible for the correctness (accuracy) and speed of the information processing process while cognitive styles are indicators of the formation of mental mechanisms responsible for managing the process of information processing. Shkuratova (2004), speaking about the relationship between cognitive-style organization and thinking, suggests that the main function of cognitive styles is to individually adjust the course of cognitive processes, with each cognitive style responsible for a specific aspect of the decision-making process.

Such understanding of intellectual abilities makes it possible to correlate them with meta-intellectual operations, which were justified in the works of Shadrikov (1996, 2007).

Shadrikov (2007) notes that thinking is usually understood as a system of “conscious operations aimed at solving problems by revealing objective connections and relationships” (p. 64). He further notes that in this approach to the definition of thinking, only one aspect is reflected – the operational one, but the functional aspect of the characteristics of thinking is completely absent. When determining the functional

mechanisms of thinking it is necessary to proceed from the fact that individual functional systems of the brain are associated, first of all, with solving problems. Then the properties of functional systems that allow solving the problem through the disclosure of essential connections and relationships can be defined as mental abilities.

According to Shadrikov (2007), the functional mechanisms of cognitive processes are specific functional physiological systems (sensations, perceptions, memory, thinking). The operating mechanisms are the system of acquired operations (cognitive actions related to the conditions of cognition). Intellectual operations are in the unity of functional and operational mechanisms.

Shadrikov (2007) defined mental abilities as the properties of functional systems that allow solving the problems through the disclosure of significant connections and relationships. Such understanding of abilities as the unity of three dimensions (the ability of the individual, subject of activity and personality) formed the basis of our study. It is a study of the operational mechanisms that manifest themselves in intellectual operations. In our case, these are meta-intellectual operations.

In the general psychological status, metaprocesses are processes of the "second order" of complexity in relation to the traditionally distinguished mental processes (primary processes). Metaprocesses are divided into metacognitive and metaregulative. In accordance with the structure of the psychological system of activity, one can distinguish such metaprocesses as goal setting, anticipation, decision making, forecasting, programming, planning, and control (Shadrikov, 2007).

However, the issue of cognitive-style determination of the functioning of meta-intellectual actions and operations in the scientific literature has not received its sufficient coverage. Therefore, this problem has become the subject of our study.

### **3. Research Questions**

Let us dwell on the characteristics of cognitive styles considered in our study.

The first style parameter "Analyticity-syntheticity" was highlighted by Gardner, Lohrenz, and Schoen (1968), and is associated with the concepts of "range of cognitive equivalence" and "sorting of objects" (p. 311). This parameter differentiates people according to what they are more focused on in the process of cognition: on distinction or on similarity, on specific in the observed phenomena or on the general. Analysts who distinguish many groups and focus on difference have a narrow range of cognitive equivalence; while synthetic subjects that distinguish few groups have a wide range of cognitive equivalence (that is, focus on similarities). These style characteristics are related to a special type of organization of individual cognitive experience, which involves the separation, isolation, and correlation of categorical levels of varying degrees of generalization in the process of constructing a mental picture of internal or external events (Kholodnaya, 2004), which, undoubtedly, affects the nature of solving various problems.

The second style parameter "Impulsivity-Reflectivity" was studied by Kagan. It has been revealed that these style parameters are considered to be predictors of the peculiarities of human solutions to problems containing alternatives. The "impulsivity-reflectivity" construct describes the tendency to reflect and question the criteria put forward as the basis for decision-making under the conditions of choosing from several likely alternatives, as well as the degree of uncertainty about which one will be more correct (Kagan,

1986). Impulsive subjects during the assignment make many mistakes, respond quickly and are characterized by a very small latent period, that is, the length of time between the first presentation and the first answer. In contrast, the reflective ones more actively evaluate the stimulus (for example, they more often refer to the reference example); more often they look at the available options, trying to collect more information on which their answers are based; pause, reflecting on the choice of alternatives, which leads them, in the end, to more correct answers (Ahtamyanova, Sitdikova, & Plehanova, 2019). The main difference between reflective and impulsive subjects is the difference in the nature of examining displayed objects in terms of the volume and thoroughness of the analysis of information that is collected before a decision is made.

Since the subject of our study is understanding the relationship of cognitive-style organization with meta-intellectual operations, let us dwell on the characteristics of the latter (Ahtamyanova & Sitdikova, 2018). Among the meta-intellectual operations there are: goal-setting as the formation of an activity goal that gives a system to all human actions; anticipation as building a forecast, acting in the form of a mental hypothesis; decision making as a transition from the informational stage to the executive stage; planning as an organizational process of creating and implementing your plan; control as a comparison of the result with the sample or with the intended plan (Ahtamyanova, Sitdikova, & Zaynullin, 2019). The abovementioned meta-intellectual operations can conditionally be combined into three groups: indicative, performing, and control.

#### **4. Purpose of the Study**

The purpose of the given study is to identify the relationship of cognitive styles (analyticity-syntheticity, impulsiveness-reflectivity) and the functional side of mental activity using the example of solving a mental problem in a visually effective way. The study tested the hypothesis about the relationship between belonging to a particular cognitive style and the features of the manifestation of meta-intellectual operations in terms of their functional structure and meaningful content.

#### **5. Research Methods**

The following methods were used to diagnose cognitive styles and characteristics of mental activity:

- The Gardner free sorting test, designed to identify the cognitive style of “Analyticity-syntheticity” (Kolga, 1986).
- The Matching Familiar Figures Test (MFFT), developed by Kagan (1986), used to diagnose the cognitive style of Impulsivity-Reflectivity.
- “Kohs Block Design Test”. The test is aimed at assessing the visually effective components of mental activity (practical intelligence (Naduvaev, 2007), and also makes it possible to evaluate the formation of meta-intelligent operations, such as task acceptance, orientation in the conditions of the problem, correlation with the sample, adherence to the sequence, actions and compliance with the orientation, control and quality of the control function (Salmina, 2006).

The study involved 151 students of the grades 7-10 of the municipal secondary educational institution Gymnasium №2, Buraevo vilage of the Republic of Bashkortostan.

Mathematical processing of the research data was performed using the statistical software package MS-Excel, as well as the Statistica 6.0 program. At first, the analysis of average values was carried out, then the analysis of differences in meta-intellectual operations between subjects tested, identified by belonging to one or another pole of the cognitive style, finally, a correlation analysis was carried out to identify differences in the ratio of meta-intellectual operations between subjects with different cognitive styles.

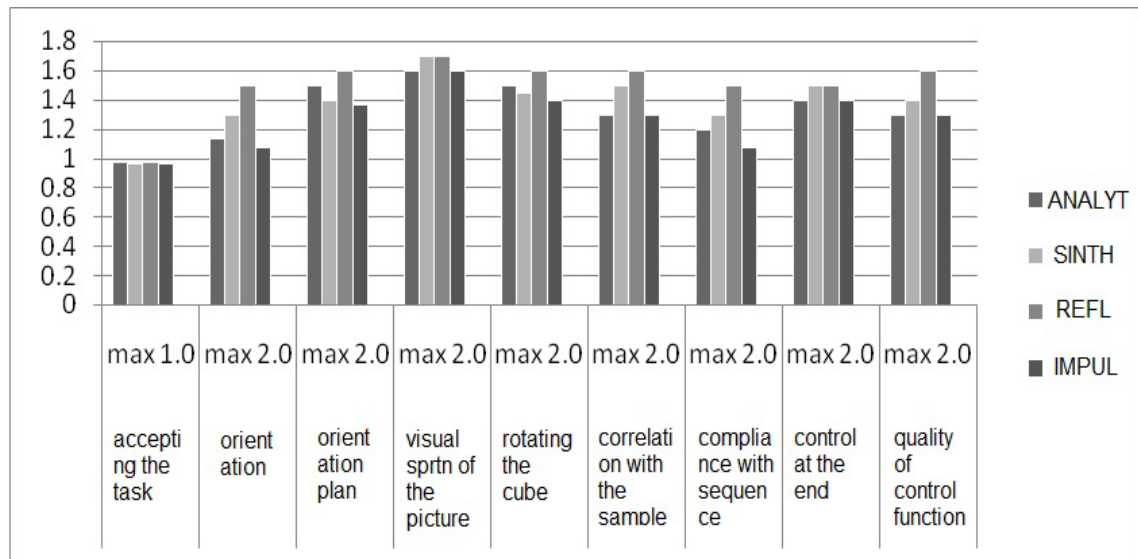
## 6. Findings

The distribution of subjects according to the degree of meta-intellectual operations depending on the cognitive style is presented in Table 01.

**Table 01.** The distribution of subjects according to the severity of meta-intellectual operations, depending on cognitive style

	Actions and meta-intelligent operations	Cognitive style pole			
		Analytical mind (n=63)	Synthesizing mind (n=88)	Reflective mind (n=56)	Impulsive mind (n=95)
	<b><i>Orientation actions</i></b>				
1	Accepting the task (1 point)	0.98	0.97	0.98	0.97
2	Extended Orientation (2 points)	1.4	1.3	1.5	1.08
3	Perceptive Orientation Plan (2 points)	1.5	1.4	1.6	1.4
	<b><i>Executive actions</i></b>				
4	Visual separation of the picture (2 points)	1.6	1.7	1.7	1.6
5	Rotating the cube in the required direction (2 points)	1.5	1.5	1.6	1.4
6	Correlation with the sample (2 points)	1.3	1.5	1.6	1.3
7	Compliance with the sequence, alignment with orientation (2 points)	1.2	1.3	1.5	1.1
	<b><i>Control actions</i></b>				
8	Control at the end (2 points)	1.4	1.5	1.5	1.3
9	Quality of control function (2 points)	1.3	1.4	1.6	1.3
Total (max 17 points)		12.2	12.6	13.6	11.5

You can get a clear understanding of the obtained data in Figure 01.



**Figure 01.** The degree of meta-intellectual operations in subjects depending on cognitive style

Let's consider the peculiarities of the orientation of the action in subjects with different cognitive styles.

1. As can be seen from Table 01 and Figure 01, the average indicators for the first parameter – "Accepting the task" – showed quite high results in all subgroups of subjects. This indicates that they basically accept the task, do not "slide off", and are not distracted.

2. By the nature of the orientation, reflective subjects come out in first place, they have it more reverted, carried out in blocks. Then come synthetic subjects, analysts and impulsive ones. They are characterized by a more step-by-step, detailed orientation.

3. The "orientation plan" appeared as follows: closer to using the perceptual orientation plan are reflective subjects and analysts. Impulsive and synthetic ones use the materialized orientation plan more, that is, they use the grid to solve the problem. The highest perceptual level was not identified

The executive part of the action is characterized by four meta-intellectual operations:

- "Visual separation of the picture" – analysts and impulsive subjects highlight elements of a pattern using a grid, and synthesizing and reflective subjects are more independent and use the grid less. Thus, visualization is more characteristic of subjects with synthesizing and reflective cognitive styles.

- "Rotating the cube in the right direction" – reflective and analytical subjects mostly deploy the cubes independently, and synthesizing while impulsive ones with the help of the tester.

- "Correlation with the sample" – reflective subjects, in comparison with synthesizing ones, do it more independently - without the outside help, while analytical and impulsive correlate mainly with the help of an adult.

- "Compliance with the sequence, alignment with orientation" – this indicator is higher among reflective subjects, synthesizing ones are in the second place, then go analytical and impulsive ones. The latter "slide off" more often and perform with the help of an adult.

Thus, the executive part of the action in all groups of subjects is manifested in different ways.

Let us consider the features of the control part of the action:

• “Control at the end” – independent comparison with the sample was revealed more among reflective and synthesizing subjects, while analytical and impulsive ones performed comparison mostly with adult indicating at it.

• “Quality of control function” – this indicator is higher for reflective subjects, then go the synthesizing minds, analytical and impulsive subjects correct errors only when an adult has indicated at them.

These data show that the action of control in all groups of subjects is also manifested in different ways.

In general, judging by the total indicators for all groups of subjects, reflective subjects (13.58 points) show the best results, then go synthesizing ones (12.57 points), analytical ones (12.18 points) and finally go the impulsive subjects (11.5 points).

In order to reveal how the studied meta-intellectual operations are interconnected among all groups of subjects, a correlation analysis was carried out. Its results are presented in tables 02, 03, 04, 05.

**Table 02.** Inter-correlation matrix for analytical subjects

	1	2	3	4	5	6	7	8	9
1	X	0.17	0.12	0.14	0.11	0.26	0.03	0.10	0.09
2		x	0.35**	0.12	0.21	0.36**	0.30	0.35**	0.50*
3			x	0.42*	0.15	0.30	0.09	0.37**	0.54*
4				x	0.08	0.30	0.17	0.12	0.35**
5					x	0.12	0.16	0.06	0.16
6						x	0.43*	0.42*	0.46*
7							x	0.25	0.40*
8								x	0.39**
9									x

Notes: \* – at  $p \leq 0.001$ ; \*\* – at  $p \leq 0.01$

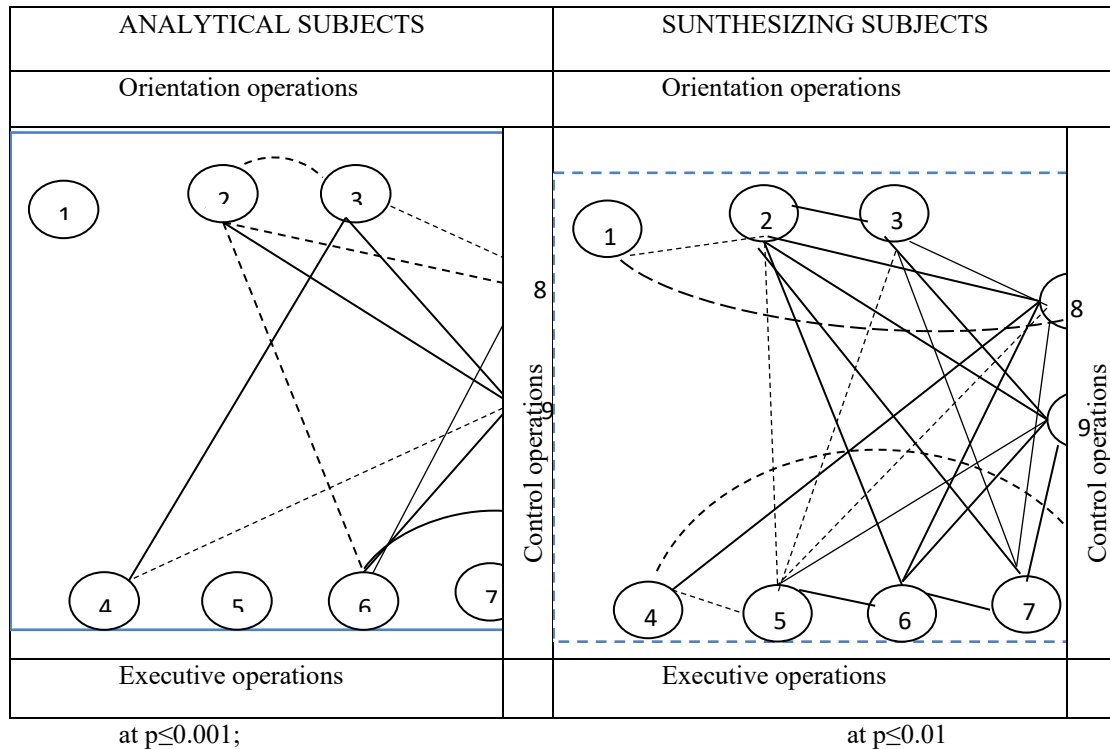
1. Accepting the task
2. Orientation
3. Orientation Plan
4. Visual separation of the picture
5. Rotating the cube in the required direction
6. Correlation with the sample
7. Compliance with the sequence, alignment with orientation
8. Control at the end
9. Quality of control function

**Table 03.** Inter-correlation matrix for synthesizing subjects (the notes are the same)

	1	2	3	4	5	6	7	8	9
1	X	0.33**	0.28**	0.13	0.23	0.15	0.24	0.15	0.02
2		x	0.59*	0.09	0.29**	0.41*	0.43*	0.35*	0.46*
3			x	0.24	0.31**	0.32**	0.37*	0.34*	0.48*
4				X	0.28**	0.15	0.15	0.42*	0.25
5					x	0.36*	0.24	0.30	0.40*
6						x	0.51*	0.40*	0.53*
7							x	0.40*	0.61*

8								x	0.28**
9									x

The graphical representation of the obtained correlation relationships is shown in Figure 02.



**Figure 02.** Correlation cluster: a graphical representation of the relationship of meta-intellectual operations among analytical and synthesizing subjects (the notes are the same)

The number of bonds between analytical and synthesizing subjects differs both in terms of significance and of structural components, as can be seen from the presented clusters. Thus, analytical subjects have a small number of connections between orientation, executive, and control actions. Synthesizing subjects have many of these connections and they are clearly expressed.

It is significant that such a parameter as “Accepting the task” does not have reliable and significant connections with any parameter for analytical subjects. For synthesizing subjects it is associated, at a reliable level, only with the parameters of the orientation block. Analytical subjects have the greatest number of connections (6) with the “Quality of control function”, which attracts such indicators as orientation and orientation plan, correlation with the sample, and visualization.

We can conclude that analytical subjects are focusing their attention not at the approximate (7 links) and executive parts of the action (6 links), but on the control functions (9 connections).

Synthesizing subjects have all structural components and all meta-intelligent operations interconnected. However, judging by the number of connections, the executive part dominates (17 connections versus 12 in the orientation and control parts).



And the number of connections in the indicator "Control at the end" is greater than in the indicator "Quality of control function." Consequently, synthesizing subjects are more focused on the executive part and on control at the end.

Let's consider the quality of correlation in impulsive and reflective subjects (tables 04, 05).

**Table 04.** Inter-correlation matrix for reflexive subjects (the notes are the same)

	1	2	3	4	5	6	7	8	9
1	x	0.27	0.12	0.21	0.13	0.32	0.10	0.12	0.15
2		x	0.61*	0.21	0.35**	0.57*	0.60*	0.59*	0.64*
3			x	0.33	0.43*	0.49*	0.38	0.71*	0.59*
4				x	0.35**	0.23	0.12	0.31	0.17
5					X	0.38**	0.38**	0.34**	0.50*
6						x	0.52*	0.52*	0.54*
7							x	0.53*	0.72*
8								x	0.57*
9									x

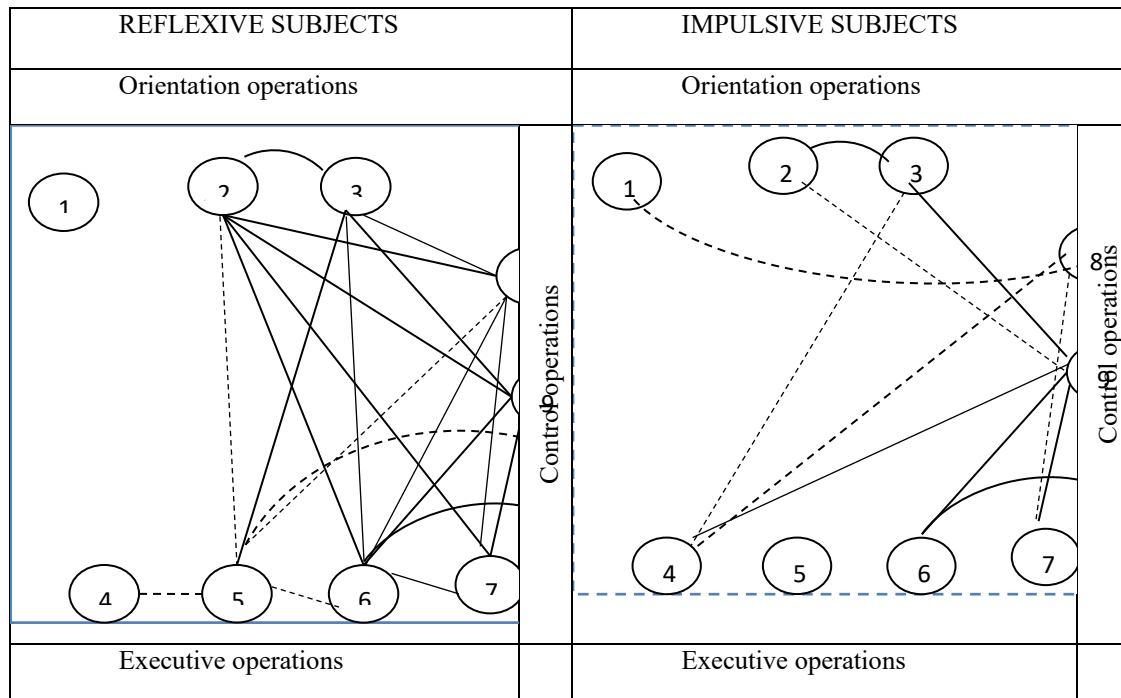
\*- at  $p \leq 0.001$ ; \*\*- at  $p \leq 0.01$

**Table 05.** Meta-intellectual inter-correlation matrix for impulsive subjects (the notes are the same)

	1	2	3	4	5	6	7	8	9
1	x	0.25**	0.29**	0.09	0.22	0.09	0.18	0.13	-0.03
2		X	0.38*	0.02	0.17	0.24	0.21	0.17	0.31**
3			x	0.27**	0.15	0.13	0.16	0.10	0.38*
4				x	0.12	0.20	0.15	0.27**	0.35*
5					x	0.16	0.09	0.12	0.17
6						x	0.42*	0.30**	0.42*
7							x	0.21	0.36*
8								x	0.12
9									x

\*- at  $p \leq 0.001$ ; \*\*- at  $p \leq 0.01$

The graphical representation of the obtained correlation relationships is shown in Figure 03.



at  $p \leq 0.001$ ;

at  $p \leq 0.01$

**Figure 03.** Correlation cluster: a graphical representation of the relationship of meta-intellectual operations among reflective and impulsive subjects (the notes are the same)

As can be seen from the presented clusters the number of connections in impulsive and reflective subjects also differs, both in terms of significance and structure. Thus, impulsive subjects have a small number of connections between the orientation (9), executive (8) and control actions (7). While the reflective subjects have a lot of connections and they are clearly expressed. It is significant that such a parameter as “Accepting the task” in reflective ones does not have reliable and significant connections with any parameter, while in impulsive ones it is associated at a reliable level only with the parameters of the orientation block. The largest number of connections (7) for reflective subjects belongs to the “Compliance with the sequence, alignment with orientation” indicator, which attracts other indicators of the orientation, executive and control part of meta-intellectual operations. We can conclude that subjects with a reflexive cognitive style focus on the executive part of the action (19 connections), then on the control (12 connections) and orientation (11 connections) parts of the action. “Correlation with the sample” indicator is dominant within the meta-intellectual operations themselves.

In impulsive subjects not all structural components and all meta-intellectual operations are interconnected. For example, such a meta-intellectual operation as “Rotating the cube”, which is a part of the executive unit, turned out to be unrelated to any indicator. The control unit is the leading one in impulsive subjects and its indicator such as “Quality of control function” is the dominant indicator.

The scope of this article does not allow to present a more detailed interpretation of the obtained correlation connections.

## 7. Conclusion

The findings suggest that there is a relationship between cognitive styles and meta-intellectual operations. Notably, the orientation block did not become dominant in any cognitive style. The executive unit by the number of correlation connections dominates among synthesizing and reflective subjects, and the control block dominates among analysts and impulsive subjects. Leading meta-intellectual operations were also highlighted. Basically, they belong to the group of executive and control actions: for “Correlation with the sample” – the referent is the cognitive style “Reflectivity”; for “Control at the end” – the referent is the cognitive style “Synthetics”; for “Quality of the control function” – the referents are the cognitive styles of “Analyticity” and “Impulsivity”.

Thus, the results of the study confirmed our hypothesis.

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