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# NETWORK MODELING OF THE INTELLECTUAL COMPETENCE STRUCTURE

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***Abstract***

**Background.** Adolescence is characterized by significant qualitative transformations in the physical, intellectual, personal, and spiritual spheres of an individual. This stage is notable for a marked improvement in problem-solving skills, driven by the development of conceptual thinking and metacognitive abilities in the context of intellectual growth. These advanced cognitive mechanisms are key to achieving intellectual competence and productivity.

**Purpose.** To determine the structure of the intellectual competence construct in late adolescence in terms of its conceptual, metacognitive, and intentional abilities.

**Materials and methods.** The article presents the results of an empirical study aimed at identifying the structure of intellectual competence in the context of manifestations of conceptual abilities, voluntary and involuntary metacognitive abilities, and intentional abilities in older adolescents. The study involved 90 students aged 14–16 from secondary schools in Moscow. Data from the following methods were used in the study: "Conceptual Synthesis" (by M.A. Kholodnaya, Y.I. Sipovskaya, 2023), "Method for Diagnosing the Degree of Reflexivity Development" (by A.V. Karpov, 2003), "Matching Familiar Figures Test" (by J. Kagan, 1966), "Mindset" (by Y.I. Sipovskaya, 2015) and "Interpretation" (by Y.I. Sipovskaya, 2016).

**Results.** Correlates of intellectual competence indicators in late adolescence were identified, demonstrating selective correlations with conceptual, metacognitive, and intentional abilities. The main elements of the intellec-

tual competence construct include skills related to creating new contexts, managing intellectual activity, and exhibiting specialized intellectual sensitivity. At the same time, indicators of involuntary intellectual control show a weaker association with intellectual competence. This suggests that the intellectual competence construct is heterogeneous, reflecting differences in the functional roles and cognitive complexity of its components.

**Keywords:** intelligence; intellectual competence; mental abilities; late adolescence

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Научная статья | Общая психология, психология личности, история психологии

# СЕТЕВОЕ МОДЕЛИРОВАНИЕ СТРУКТУРЫ ИНТЕЛЛЕКТУАЛЬНОЙ КОМПЕТЕНТНОСТИ

***Я.И. Сиповская***

***Аннотация***

**Обоснование.** Подростковый возраст характеризуется значительными качественными преобразованиями в физической, интеллектуальной, личностной и духовной сферах человека. Этот этап примечателен значительным улучшением навыков решения проблем, обусловленным развитием концептуального мышления и метакогнитивных способностей в контексте интеллектуального роста. Эти продвинутые мыслительные механизмы являются ключевыми для достижения интеллектуальной компетентности и продуктивности.

**Цель.** Определение структуры конструкта интеллектуальной компетентности в старшем подростковом возрасте в тернах его понятийных, метакогнитивных и интенциональных способностей.

**Материалы и методы.** В статье представлены результаты эмпирического исследования, направленного на выявление структуры интеллектуальной компетентности в контексте проявлений понятийных

способностей, произвольных и непроизвольных метакогнитивных способностей, а также интенциональных способностей у старших подростков. В исследовании приняли участие 90 учащихся в возрасте 14–16 лет из общеобразовательных школ г. Москвы. В исследовании использовались данные следующих методик: «Понятийный синтез» (Холодная М.А., Сиповская Я.И., 2022), «Метод диагностики степени развития рефлексивности» (Карпов А.В., 2016), «Тест сравнения похожих фигур» (Каган Дж., 1966), «Умонастроения» (Сиповская Я.И., 2015) и «Интерпретация» (Сиповская Я.И., 2016).

**Результаты.** Определены корреляты показателей интеллектуальной компетентности в старшем подростковом возрасте, которые демонстрируют избирательные корреляции с концептуальными, метакогнитивными и интенциональными способностями. Основные элементы конструкции интеллектуальной компетентности включают навыки, связанные с созданием новых контекстов, управлением интеллектуальной деятельностью и проявлением специализированной интеллектуальной чувствительности. В то же время показатели непроизвольного интеллектуального контроля имеют более слабую связь с интеллектуальной компетентностью. Это позволяет утверждать, что конструкция интеллектуальной компетентности является неоднородной, что отражает различия в функциональной роли и когнитивной сложности ее компонентов.

**Ключевые слова:** интеллект; интеллектуальная компетентность; ментальные способности, старший подростковый возраст

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## Introduction

Modern policies in the field of social and educational management guide the labor market and employment towards the formation of so-called flexible and mobile metaskills [2], i.e., competencies. These competencies, in turn, are manifestations of tacit knowledge. According to

V.I. Arshinov's views, tacit knowledge is knowledge about action, knowledge realized in the action of a person as a thinking, feeling, sensing, and experiencing being [5]. This knowledge is based on experience and, at the same time, contributes to the enrichment of this experience, expanding opportunities for new activities for the individual. Tacit knowledge, according to L.B. Sultanova's views, is a means of achieving set goals, a kind of tool acquired during the practical activity [30]. However, during this activity, when applying their knowledge in practice, this tool is improved, "adjusted" to specific circumstances, ultimately leading to more productive work in this particular field of activity [25; 57; 58]. Thus, there is a mutual influence between tacit knowledge and experience – experience leads to the emergence and development of tacit knowledge, and tacit knowledge, in turn, expands the possibilities for spreading personal experience across various spheres, thereby contributing to its enrichment.

As shown in the studies of S. Scribner, conducted among sorting workers at a factory producing and bottling milk, workers did not have formal mathematical education, but when bottling milk, they could accurately determine when to stop the flow of milk to fill a specific volume of the bottle [59; 60]. The experiments by S.J. Chechi and J.K. Laiker with Brazilian children who were forced by economic reasons to work as street vendors showed that these children had acquired and mastered complex mathematical skills for calculations [46; 47]. Studies by R.J Sternberg [62; 63] and experiments by O.K. Tikhomirov with chess players of various categories [31] also demonstrated the importance of gaining experience for more productive activity in a specific field, which, however, does not necessarily mean success in any other unrelated activity. Another piece of evidence is the research by W.M. William and R.J. Sternberg, which showed that the less experience an individual has in a specific activity, the lower the corresponding scores for tacit knowledge [65]. The results underline the role of experience, through which tacit knowledge is traced, in practical activity.

According to M. Polanyi's views, outlined in his work "Personal Knowledge," tacit knowledge forms the basis of all knowledge, including

scientific knowledge, and manifests itself in various cognitive acts [24]. It appears as a deep layer, on which, in turn, explicit, implicit knowledge, brought into the focus of consciousness, rises. L.B. Sultanova writes that tacit knowledge represents assumptions we rely on but which we leave out in reasoning [30]. Tacit knowledge ensures an adequate understanding of reality, but it cannot be consciously reconstructed. L.B. Sultanova believes that tacit knowledge is preconditioned, exists in an implicit form, as it seems unproblematic and obvious, self-evident, and serves as a tool and condition for cognition (which almost always remains unnoticed, focusing on the final result or the object of action itself). Despite its foundational position, tacit knowledge is subject to change, and its boundaries constantly expand along with the expanding sphere of activity of each individual, which, in turn, determines the personal nature of tacit knowledge. Since tacit knowledge is acquired during the process of gaining personal experience, it has practical value only for the individual possessing it.

Speaking about the importance of personal experience, it is necessary to mention R.J. Sternberg's viewpoint, who wrote that tacit knowledge is knowledge reflecting the practical ability to learn from experience, rather than from social learning, and apply it to achieve personal goals [62; 63]. Such knowledge is essential for adapting to the environment, shaping this environment, and selecting it. Here, the process of reflection is already involved, and for its proper course, a stable basis is needed, which tacit knowledge provides. The understanding and problem-solving depend on procedural skills and schematically organized knowledge, controlled at an unconscious level. This knowledge provides a more complete picture of the surrounding environment than knowledge obtained in formal education processes [64]. The goal of an action is usually achieved by following norms and rules unknown to the person performing the action, as noted by M. Polanyi. As T. Kuhn writes in his work "The Structure of Scientific Revolutions," tacit knowledge requires reflection, analysis, and pre-existing interpretation, and sometimes, in addition, the intervention of an external authority [20]. This knowledge is the result of experience; it is transmitted through education or training.

Thus, the educational task points to the direction of training – the ability to use knowledge and accumulated experience in various (new) situations while forming and developing the ability to combine them depending on the changing conditions of the situation [27].

Thus, several areas of further intellectual development are addressed, primarily the need to form a conceptual apparatus [19; 35; 37; 38; 39; 42]. These abilities allow students to understand and analyze the world more deeply, developing an understanding of abstract concepts, logical and analytical thinking, the ability to make conclusions and generalizations, etc. Three types of conceptual abilities are highlighted: 1) semantic – forming semantic networks and operating with the content of verbal signs; 2) categorical – using categories of different degrees of generalization and identifying relevant categorical features of an object of thought; and 3) conceptual, related to generating new mental content [34]. Each of the identified types of conceptual abilities has its own criteria and functional load. For example, identifying hidden (latent) features and patterns falls under the category of conceptual abilities, while vocabulary (features of the individual's mental lexicon) falls under semantic abilities. However, categorical abilities are essential for implementing a function such as actualizing a variable set of categories concerning any object by individualizing the content of categories. According to M.A. Kholodnaya, such types of conceptual abilities have structures of nested constructs, where the basic ones are semantic abilities, which, through the process of categorization (categorical abilities), reach the level of conceptual abilities [ibid.]. This process is bidirectional, both bottom-up and top-down, as L.M. Vekker pointed out [10]. Thus, enriching semantic experience, i.e., the alphabet of ways to encode incoming semantic information, expanding and complicating the semantic fields of concepts can improve the differentiation of species and genus signs in the content of a concept and, accordingly, form new areas of mental experience. Meanwhile, already enriched and differentiated new mental contents, in a way, top-down, change the boundaries of categories and expand semantic fields.

However, if we return to the problem of the permissive capabilities of tacit, hard-to-verbalize knowledge, it is worth noting another feature

– the resource and regulating function, namely, the regulation of intellectual activity to achieve outstanding results, without which students will not be able to effectively apply their knowledge in real life and successfully tackle tasks [4]+, i.e., metacognitive abilities. This type of ability is a form of intellectual self-regulation, mental structures that determine sensitivity to the direction of problem-solving in situations of uncertainty and information deficit [7; 14; 30; 35]. A.V. Litvinov and T.V. Ivolina study the "diagnostic potential of metacognition, allowing predicting the development of an individual's intellectual activity, their learning motivation, and self-regulation in the process of mastering new knowledge" [21, p. 59]. The authors point out that metacognitions are characterized by systemicity, divided into two components: the ability to learn and the ability to manage this process. The authors also note that: "Metacognitive regulation is the monitoring of one's cognitive activity, including the stages of planning the cognitive process, realizing one's ability to carry it out, its implementation, evaluation of the effectiveness of monitoring processes and chosen cognitive strategies" [ibid., p. 67]. Therefore, the authors point out, on the one hand, the heterogeneity of the metacognitive abilities construct, and on the other, the connection between metacognitive abilities and cognitive processes. Similar ideas are held by A.V. Karpov [14], who indicates that the ability to learn and the degree of individual formation of metacognitive processes and personality traits are interdependent. In their collective monograph, the authors appeal to the fact that "the metacognitive sphere of personality is usually not explicit and is not revealed in terms of its belonging to specifically systemic-type formations," emphasizing the tacit nature of metacognitive abilities [15, p. 780].

M.A. Kholodnaya defines metacognitive experience through a high degree of involuntary intellectual control with high reflectivity, which is compressed [37]. According to M.A. Kholodnaya, metacognitive abilities imply metacognitive awareness and planning, as well as an open cognitive position as a personality trait [ibid.]. It should be noted that in this respect, a transition to other psychological constructs occurs in terms of personality traits, such as cognitive styles, which are also involuntary,

unconscious, or automated constructs.

In this regard, it is worth mentioning other manifestations of tacit knowledge related to the productivity of activity, i.e., intentional abilities, which determine the degree of formation of personal knowledge in the form of individual preferences, beliefs, and specific intellectual intuitions [18; 23; 52; 53; 56]. These, like other manifestations of tacit knowledge underlying outstanding achievements in any field of activity, be it creativity or scientific work, are difficult to verbalize, and professionals cannot accurately describe them. Intellectual intentions initiate, direct, and regulate cognitive activity at an unconscious, compressed, indescribable level. These components are related to "professional intuition" or "professional sense," characterized by a unique individuality and even inimitability. They are marked by a pronounced selectivity in the process of perception and understanding of what is happening and the heterogeneity of information processing strategies. M.A. Kholodnaya divides them into moods (confidence that the problem should be solved in a strictly defined direction, although the reasons for this selectivity cannot be named, relying on what one "feels") and beliefs – individual epistemological positions [34; 36]. I.A. Belyaev also notes the general subject-semantic direction, stating that intention is "…one of the possible specific variations of the current direction of an individual's worldview orientation towards certain concrete and abstract objects and processes, the real-situational configuration of its motivational-semantic content" [7, p. 31]. Other authors, such as N.D. Pavlova and T.A. Grebenshchikova, define intentions as intentions that manifest themselves, for example, in textual activity [22]. They can be expressed openly, highlighting their motivating character aimed at achieving specific goals, such as speech forms of communication used by a child to "inform" others about their desires [32]. However, this approach does not reveal the deeper, inexpressible verbal characteristics of intentional abilities in the context of activity productivity.

Thus, considering the problem of forming and developing intellectual abilities in the educational system at a basic, deep level, one can conclude that it is necessary to take into account a metasystem of selectively included

components, which may represent intellectual competence, determining the possibility of achieving high results in a particular type of subject-oriented activity associated with high productivity. This epistemological approach, on the one hand, due to its systematic nature, allows students to realize their full intellectual potential and become successful and productive members of society. On the other hand, the construct of competence appeals to real practical activity, i.e., subject-specific knowledge [17; 35; 36; 56]. Meanwhile, the development of intellectual activity is an important task for the educational system. At the same time, it is important to emphasize the adaptability of the educational system to the needs of modern society and the labor market. Thus, the introduction of educational standards for basic general education, implemented by the Ministry of Education and Science of the Russian Federation on December 17, 2010, is aimed at developing "universal educational actions" (UEA) among schoolchildren, with special attention given to the interdisciplinary educational activity [33]. This activity includes not only knowledge but also the ability to quickly analyze and solve problems, work in teams, cognitive needs, flexibility, critical thinking, and the creative approach to problem-solving [30; 44; 53] and specific motivation [37; 48; 49; 63]. Achieving these UEA requires the formation of flexible and adaptive knowledge and skills that will enable effective decision-making within specific subject areas – this is where intellectual competence (general academic abilities, logical thinking, and problem-solving skills) plays a key role. Consequently, studying the mechanisms of intellectual achievements in real-life conditions shows the need to study the complex of individual mental resources, namely conceptual, metacognitive, and intentional abilities [16].

It should be noted that studying the manifestations of intellectual competence in older adolescents (14-16 years old) is of particular interest due to the special sensitivity of this developmental stage in a person's life. This stage marks a critical point, signifying the transition from one phase of mental growth to another. It is during this period that the final maturation of conceptual thinking occurs, which contributes to the qualitative improvement of intellectual resources. According to L.M. Vekker, the ability to conceptualize is a prerequisite for higher intellectual

actions [10]. Moreover, through conceptualization, individuals assign resource value to external (objective, natural, and social) and internal (intrapersonal) objects, imbuing them with personal meaning and practical value for achieving goals, maintaining activity, and stimulating development [36]. Furthermore, it is precisely the developed conceptual abilities that can explain the unique regulatory role in information and energy processes – first in the primary "vertical" system (cortico-reticular regulation) and additionally in the "horizontal" system (cortico-bilateral regulation, characterized by the simultaneous and coordinated work of both hemispheres of the brain) [10]. Accordingly, conceptual abilities play an important role in intellectual and physiological regulation. Returning to the processes of initiation and regulation of intellectual competence, it should be pointed out that metacognitive abilities encompass both voluntary and involuntary processes. These regulatory mental functions distinguish natural (human) intelligence from artificial intelligence [1; 9; 11; 12; 13]. In our previous studies, regulatory thinking – defined as the regulation of one's intellectual activity – was used as an indicator of metacognitive abilities [27; 28; 29]. F. Beuk and T. Basadur argue: "Based on the theory of regulatory congruence, we find that engagement in the task mediates a positive effect of orientation towards advancement on creative potential. Our findings are consistent regardless of whether fluency, flexibility, or originality is used as a measure of creative potential" [43, p. 199].

Thus, in this study, the following were examined:

1. Manifestations of intellectual competence;
2. Voluntary and involuntary metacognitive abilities;
3. Intentional abilities, such as intellectual confidence and attitudes;
4. Conceptual abilities.

Theoretical hypothesis: the indicators of intellectual competence are associated with conceptual, voluntary and involuntary metacognitive, and intentional abilities. Research hypothesis: there is a connection between the degree of formation of intellectual competence indicators and the development of conceptual abilities, intentional abilities, and metacognitive abilities in middle school students aged 14–16 years.

Objective: to reveal the structure of intellectual competence in older adolescents in terms of conceptual, metacognitive, and intentional abilities.

Task: to determine the structure of the construct of intellectual competence through the lens of conceptual abilities, voluntary and involuntary metacognitive abilities, and intentional abilities.

Thus, the subject of this research is the structure of intellectual competence, and the object is middle school students aged 14–16 years with developed intellectual competence.

**Materials and methods**

The study was conducted between 2019 and 2023, based on the examination of the degree of development of mental experience in older adolescents. The materials of the study, which illustrate the development of mental experience in the form of conceptual, metacognitive, and intentional abilities as components of intellectual competence in older adolescents, were the results of diagnosing these constructs.

The participants of the study formed a sample consisting of 90 ninth-grade students (54 girls and 36 boys) from secondary schools in Moscow, namely Secondary School No. 709 and Secondary School No. 2044. The participants' age ranged from 14 to 16 years, with a median age of 15 years [50].

The following research methods were used: "Conceptual Synthesis" [34], Methodology for Diagnosing the Degree of Development of Reflexivity [14], The Matching Familiar Figures Test (MFFT) [54], "Mood States" [27], and "Interpretation" [28].

"Conceptual Synthesis" [34] assesses the development of generative abilities, particularly the ability to create new mental constructs. Indicator: the level of development of conceptual abilities (the ability to generate mental spaces based on personal experience).

The Methodology for Diagnosing the Degree of Development of Reflexivity [14] evaluates the degree of reflexivity as a metacognitive personality trait. The reflexivity diagnostic tool (A.V. Karpov's questionnaire, reflection test) measures the level of voluntary reflection in an individual. Indicator: Voluntary metacognitive abilities.

The Matching Familiar Figures Test (MFFT) [54] assesses the cognitive style of impulsivity/reflexivity, which reflects individual differences in decision-making speed and is associated with involuntary regulation of intellectual activity. Indicators of impulsivity/reflexivity:

1. Time delay of the first response (duration);
2. Total number of errors.

The "Mood States" method [27] evaluates an individual's attitudes, defined as the "feeling of direction" in their activity, experienced as "a sense of progress towards a specific goal..." (quoted from [6, p. 153]). The overall assessment combines two aspects: the intensity of attitudes (the number of predictions) and confidence in attitudes (subjective certainty about the accuracy of decisions). Indicators:

1. Intensity of attitudes;
2. Confidence in attitudes.

The "Interpretation" method [28] is used to assess intellectual competence and involves writing an essay based on a moral dilemma described by A.I. Podolsky and O.A. Karabanova (quoted from [6, pp. 57-61]). It evaluates how individuals structure their personal experience, reflecting their ability and willingness to effectively process information through a cognitive-personal approach [6; 41].

The qualitative features of the essays are considered indicators of intellectual competence, as writing an essay is an important component of academic performance. The analysis also includes the classification of sentence types used in the essays, highlighting factual, argumentative, systematizing, interrogative, interpretative, emotionally-evaluative-informative, and emotionally-evaluative-personal sentences. Indicators:

- Intellectual competence (complexity of the generated text or mental narrative);
- Factual type of narration;
- Argumentative type of narration;
- Interrogative type of narration;
- Interpretative type of narration;
- Emotionally-evaluative-informative narration;
- Emotionally-evaluative-personal narration.

## Results and discussions

Since the distribution of several variables significantly deviated from normality, non-parametric statistical methods were used for data analysis, specifically Spearman's correlation analysis. The results of its application regarding conceptual, intentional, and metacognitive abilities, as well as indicators of intellectual competence, are presented in Table 1.

*Table 1.*

**Correlation of indicators of intellectual competence and indicators of conceptual, metacognitive and intentional abilities**

| Indicators | Conceptual abilities | Voluntary metacognitive abilities | Involuntary metacognitive abilities - time | Involuntary metacognitive abilities - errors | Mindset |
|---|---|---|---|---|---|
| Interpretation | 0.31 | 0.37 | -0.10 | -0.08 | 0.31 |
| Factual type narratives | 0.16 | 0.08 | 0.03 | -0.02 | 0.15 |
| Argument type narratives | 0.35 | 0.24 | -0.25 | -0.27 | 0.27 |
| Systematic type narratives | 0.10 | 0.02 | 0.10 | -0.04 | 0.09 |
| Question type narratives | 0.42 | 0.19 | 0.12 | -0.13 | 0.30 |
| Interpretive type narratives | 0.41 | 0.26 | 0.01 | -0.20 | 0.42 |
| Emotional-evaluative informative type narratives | 0.29 | 0.14 | 0.12 | -0.18 | 0.35 |
| Emotional-evaluative personal type narratives | 0.48 | 0.30 | -0.09 | -0.19 | 0.44 |

The results presented in Table 1 indicate that the overall indicator of intellectual competence significantly correlates with conceptual abilities ($Rs = 0.31$; $p \leq 0.01$), the level of reflexivity ($Rs = 0.37$; $p \leq 0.001$), and the degree of development of intentional abilities (in particular, the ability to rely on one's own beliefs when searching for answers in the absence of necessary knowledge; $Rs = 0.31$; $p \leq 0.01$). However, no significant correlation was found between intellectual competence and indicators of cognitive speed and accuracy (involuntary metacognitive

abilities). Accordingly, in the senior adolescent age, the development of intellectual competence is associated with voluntary metacognitive abilities, which echoes L.S. Vygotsky's assertion of the predominance of voluntary control and general regulation of behavior during the peak development of conceptual thinking in adolescence, while involuntary intellectual control occupies a secondary role [cited in 38, p. 14]. In this age, the voluntary component of metacognitive abilities actively forms and develops, replacing the involuntary one, and, as a result, intellectual competence includes control over goal setting, choice of methods, monitoring progress, and assessing results.

Thus, intellectual competence is associated with conceptual, voluntary metacognitive, and intentional (belief-related) abilities.

The types of sentences are selectively related to conceptual and intentional abilities. Conceptual abilities correlate with question-based, interpretive, argumentative, and emotionally evaluative-personal sentences. Intentional abilities correlate with question-based, interpretive, emotionally evaluative, substantial, and emotionally evaluative-personal sentences.

Interestingly, argumentative and interpretive sentence types show correlations with involuntary metacognitive abilities, such as cognitive speed and error frequency ($Rs = –0.25$; $p \leq 0.05$; $Rs = –0.27$; $p \leq 0.05$; $Rs = –0.20$; $p \leq 0.05$, respectively). These results suggest that a more developed mechanism of involuntary intellectual control is associated with a higher frequency of using cognitively loaded constructs, such as interpretive sentences when constructing explanations.

The moral dilemma allows for multiple solutions, none of which can be unequivocally evaluated as right or wrong. Therefore, instead of seeking the right or wrong solution, individuals rely on other mental resources, such as intentional abilities, which correspond to the use of question-based ($Rs = 0.30$; $p \leq 0.01$), emotionally evaluative ($Rs = 0.35$; $p \leq 0.01$), and emotionally evaluative-personal ($Rs = 0.44$; $p \leq 0.001$) sentence types.

Intentional abilities are similar to conceptual abilities in their functional roles: both serve as tools for mobilizing an individual's emotional experience.

Thus, the contribution of both conceptual abilities [27; 38] and intentional abilities to the productivity of intellectual activity in terms of intellectual competence is confirmed. The heterogeneity of the structure of this connection can be explained by the differences in the functional load of each ability, as well as the varying cognitive and emotional complexity of sentences of different types. This reflects the selective mobilization of resources depending on the requirements of specific mental tasks.

A significant relationship between attitudes and beliefs ($Rs = 0.46$; $p = 0.001$; $df = 90$) – two indicators of intentional abilities – along with their correlations with conceptual abilities ($Rs = 0.6$; $p = 0.001$; $df = 90$ for attitudes and $Rs = 0.3$; $p = 0.01$; $df = 90$ for beliefs), indicates a synergy between conceptual and intentional abilities. This is consistent with the assumption that these abilities likely form a tandem of descriptors of intellectual competence. However, the data from the correlation analysis are insufficient to draw such an unequivocal conclusion.

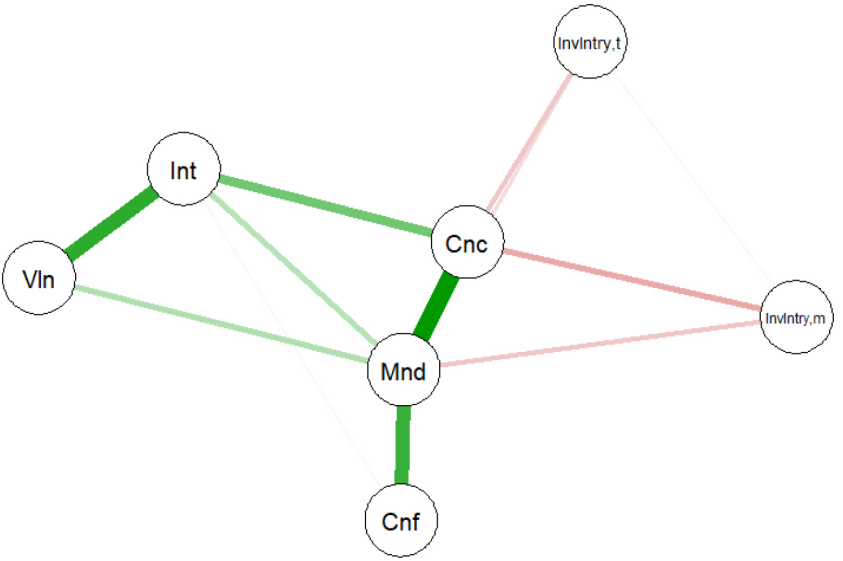
For further study of the structure of the intellectual competence construct, network analysis was used, applied to reduce the dimensionality of variables while preserving significant interrelationships in a comprehensive data analysis [4; 45; 51]. This type of modeling is a powerful tool for analyzing complex multidimensional random measurements [3; 8], where the properties of the whole cannot be derived solely from the properties of individual components [55].

The results of the network analysis of the intellectual competence construct, studied in the context of conceptual, metacognitive, intentional, and categorical abilities, are presented in this study in the form of Graph 1.

Based on the data presented in Graph 1, it can be concluded that the core of intellectual competence is formed by abilities that contribute to the generation of new contexts, voluntary regulation of intellectual activity, and increased intellectual sensitivity, while the indicators of involuntary intellectual control occupy a peripheral position.

The network structure of the intellectual competence construct emphasizes the key role of metacognitive abilities (such as reflexivity), conceptual abilities, and intentional abilities, particularly in the aspect of

attitudes and beliefs. The influence of involuntary metacognitive abilities (such as cognitive pace) was primarily observed in the detailed analysis of interpretive texts, revealing connections with emotionally evaluative-personal and substantial sentence types.




**Graph 1.** Network model of intellectual competence

**Notes:** Int – indicators of intellectual competence; Vln – indicators of arbitrary (voluntary) metacognitive abilities; Mnd – indicators of intensity of mindset; Cnf – indicators of certainty of mindset; Cnc – indicators of conceptual abilities; Invlntry,t – indicators of of impulsivity / reflexivity – latent time of the first response (amount); Invlntry,m – indicators of impulsivity / reflexivity – the total number of errors.

Thus, the results suggest that conceptual thinking reaches sufficient maturity to provide significant improvement of intellectual resources by late adolescence. At this stage of development, the mental space reaches its maximum potential, despite the inherent variability of established connections and relationships.

Therefore, it can be concluded that the construct of intellectual competence is heterogeneous. The observed differentiation in the structure of intellectual competence is determined by the functional load and cognitive complexity of its constituent components.

The results indicate the complexity of the conceptual composition of intellectual competence in senior adolescents.

The results of this empirical study emphasize the multilayered nature of the formation of intellectual competence in senior adolescents, illustrating the uneven contribution of conceptual experience, voluntary and involuntary intellectual control, as well as intentional abilities to intellectual productivity. Various correlations were found, depending on the type of functional load.

Thus, intellectual competence, functioning as a metasubjectivity that determines the productivity of intellectual activity, is characterized by the necessity to regulate task setting, choose appropriate methods, control the process of achieving results, and compare expected outcomes with actual ones. In the present study, this control was manifested at a voluntary level, complemented by a more implicit and involuntary intentional control, in contrast to involuntary metacognitive control, whose contribution was not proven.

Similar results were obtained by M.A. Kholodnaya and Y.I. Sipovskaya, who found correlations between the indicators of two methods, i.e.,"Conceptual synthesis" and "Comparison of similar drawings". Their results showed that higher indicators of conceptual abilities corresponded to faster decision-making and fewer errors, i.e., senior students with developed conceptual abilities predominantly belonged to the "quick/accurate" cognitive style subgroup.

The authors also conducted a factor analysis of the components of intellectual competence in terms of indicators of conceptual, metacognitive, and intentional abilities. The complexity of the text interpreting the moral dilemma was included in one factor with voluntary metacognitive abilities (level of reflexivity) and intentional abilities (intensity of attitudes). Another factor, which includes high factor loadings for conceptual abilities, involuntary metacognitive abilities (particularly, the accuracy of perceptual scanning under multiple-choice conditions), and intentional abilities (intensity of attitudes), suggests that the key aspect of conceptual abilities is the integration of involuntary intellectual control when processing information and reliance on personal intuition. This

conclusion is especially important, as it highlights the connection between the highest level of conceptual experience and involuntary mechanisms regulating intellectual activity.

Several studies have explored the role of intuition in various forms of conceptual cognitive activity. These studies focused on individual differences in intuitive information processing, which relied on a "sense of meaning" when interpreting stimuli and real events [50; 61]. The results of these studies led to the conclusion that participants with a strong "sense of correctness" (the ability to rely on intuition as an indicator of a high degree of developed intentional abilities) demonstrated more pronounced positive emotions.

To determine the skills that best predict the complexity of texts interpreting moral dilemmas, the authors conducted stepwise discriminant analysis, which allowed them to conclude that three types of abilities – conceptual, metacognitive (reflexivity), and intentional – predict manifestations of intellectual competence in senior adolescents. These results emphasize the importance of engaging and interacting with these three different levels of abilities when performing complex intellectual activities related to making moral judgments in conditions of information deficit and reliance on facts.

Similar results emphasizing the central role of conceptual abilities were obtained in studies of intellectual competence in adults [39; 40]. In these studies by O.V. Shcherbakova and D.N. Makarova, participants were required to go beyond established corporate rules and work in conditions of insufficient information, and their conceptual abilities were assessed. The authors concluded: "Conceptual abilities, which underlie the ability to identify non-obvious connections between objects and phenomena and form highly generalized connections between categories into holistic and meaningful conceptual concepts, explain 42% of the variance in case-solving success" [40, p. 68], while correlation analysis did not reveal any connection between case-solving success and the level of psychometric intelligence.

Furthermore, participants who successfully solved both tasks not only demonstrated a high level of conceptual abilities but also exhibit-

ed cognitive-personal characteristics such as: flexible application of formal rules, guided by the internal logic of the real problem; intellectual reflection, critical evaluation; open cognitive position and tolerance for uncertainty; independence in reasoning [ibid.].

The results of this study emphasize the key role of conceptual abilities and the importance of regulating intellectual activity as indicators of voluntary metacognitive abilities, as well as intentional abilities.

**Conclusion**

A high level of intellectual competence correlates with the development of conceptual, intentional, and metacognitive abilities in students aged 14–16 years.

Intellectual competence is defined as a systemically organized metastucture, the components of which are manifestations of conceptual, voluntary, and involuntary metacognitive and intentional abilities.

The construct of intellectual competence is heterogeneous due to the differentiated functional load and cognitive complexity of its components: the foundation consists of voluntary metacognitive, intentional, and conceptual (conceptual) abilities.

The use and interaction of conceptual, metacognitive (reflexivity), and intentional abilities as three different levels of abilities when performing complex intellectual activity under information deficit and in the absence of reliance on knowledge serve as predictors of manifestations of intellectual competence in late adolescence.

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