

7th icCSBs 2018
**The Annual International Conference on Cognitive - Social,
and Behavioural Sciences**

**CONCEPTS, CONCEPTUAL ABILITIES, INTELLIGENCE AND
CREATIVITY**

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Abstract

The main issue of this empirical research was to discover the correlation of creativity indicators, conceptual structures, intelligence of students with different levels of conceptual abilities (semantic, categorical and generative abilities). For the purpose of this study, a complex design including assessment of conceptual structures ('concepts'), different techniques of assessment of creativity (TTCT), intelligence (SPM) and conceptual abilities was used. Participants of the experiment were four hundred eight Russian students of nine humanitarian departments (71.7% female and 28.3% male) aged 18–23 (mean 19.3 ± 1.05). The results show a close relationship of conceptual abilities with indicators of psychometric intelligence, conceptual structures ('concepts') and creativity, but the measure of the intensity of intelligence, conceptual structures ('concepts') and creativity varies depending on the degree of formation of conceptual abilities: the higher is the level of conceptual abilities, the higher is the level of creativity, conceptual structures ('concepts') and intelligence. The finding of this research may be useful for solving the problem of human mental resources increasing through the development of conceptual thinking.

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Keywords: Conceptual (Semantic, Categorical, Generative) abilities, Conceptual Structures (Concepts), Intelligence, Creativity.



1. Introduction

The problem of correlation between creativity and psychometric intelligence is one of the controversial in modern psychology. Some studies claim that intelligence and creativity are factors independent of each other (Ponomaryov, 1999; Eysenck, 1985; Gruber, 1982; Guilford, 1967), in other (e.g., in theory intellectual thresholds of Torrance (1992)) it is noted that the ratio of intelligence and creativity varies depending on the level of intellectual development (IQ \leq 115-120 intelligence and creativity form a single factor).

A highly controversial situation has developed in the psychology of abilities: on the one hand, a number of studies noted the key role of conceptual thinking in the intellectual development of personality (Vygotsky, 1982; Vekker, 1976; Yasyukova, 2005; Harvey, Hunt, Schroder, 1961; Li, 1996; Sattler, 1988 and others.), on the other hand, conceptual abilities are not actually presented in modern models of intellectual abilities (in particular, in the catalogue of intellectual abilities within the framework of the intellectual abilities in the SNA theory Cattell, Horne, and Carroll among more than 80 abilities are described only five conceptual ones).

The theory of certain mental structures (multidimensional representative cognitive structures in long-term memory) that underlie human psychological development including the development of intelligence, competence and creativity (Vekker, 1981; Kholodnaya, 2002; Chuprikova, 2007; Volkova, 2013) attracts a lot of attention nowadays. Furthermore, there is a great number of studies devoted to the peculiarities of the organization and formation of mental structures ("cognitive maps" (Tolman, 1948), "representation" (Chuprikova, 2007), "mental experience", "concept" (Kholodnaya, 2012) "core structure" (Sergienko, 2005).

A brief analysis of the literature sources shows that a key role in the distinguishing the relationship between intelligence and creativity and can play conceptual abilities. Before proceeding to the description of the results, it is necessary to identify the main constructs used in the study. Traditionally, general abilities include intelligence, creativity and learning.

Based on research Druzhinin (1998), considering the psyche as a single system, processing information, intelligence can be defined as the ability to apply knowledge, creativity as the ability to transform knowledge and learning as the ability to acquire knowledge. In various studies, conceptual abilities are presented as "semantic and symbolic intelligence" (JP Guilford), "the ability to do abstract thinking" (J. Sattler), "conceptual intelligence" (Li), "generative thinking" (Ward, Sifons), "conceptual thinking" (Vygotsky; Vekker).

Following types of conceptual abilities are distinguished:

- 1) semantic abilities (assimilation, storage and actualization of the content of verbal signs);
- 2) categorical abilities (voluntary and involuntary) (selection and operation with categorical signs of different degrees of generalization);
- 3) generative abilities (generation of new mental contents).

In recent years, some studies began to appear in the field of intelligence psychology, which raises questions about the internal structure of the conceptual structures (Chuprikova, 2011; Volkova, 2016; Volkova, Ten, 2014). Nevertheless, it is essential to distinguish the study of the cognitive structure of the concept as a mental formation "inside" conceptual experience of the individual subject (field of

psychological research) from studying the content of the concept as a unit objectively existing cultural and historical knowledge (the sphere of cognitive linguistics research).

From a psychological point of view, concepts are ‘substratum’ of all mentioned types of conceptual abilities, a high level of formation of which is the basis of human intelligence (Vekker, 1981). Therefore, the semantics of the concept as a mental formation is not identical to the semantics of the word as a linguistic phenomenon and the more semantic concepts as a logical phenomenon. At the same time there were some studies that reveal new and interesting facts about the nature of conceptual abilities: the phenomenon of "creative categorization» (Ranjan, Srinivasan, 2010), representation in the structure of categories and concepts of subjective elements, in particular, bodily and sensory-emotional experience (Barsalou, 1999; Lakoff, 2011), the phenomenon of generative thinking (Ward & Sifons, 1997), etc.

Volkova (2011) defines the concept as a model of mental reflection, the highest level of organization of mental structures that defines the creative productivity. Her research has shown that the emergence of new ideas is associated with the formation of a detailed level of concepts.

Highly differentiated and integrated conceptual structures, corresponding to the object of professional activity, are essential basis for the manifestation of creativity in a particular field of professional activity. These structures are a systemic factor that integrates the properties of the creative person (Volkova, 2016).

2. Problem Statement

One of the key directions in the study of human nature is the search for an answer to the question of the mechanisms of reasonableness as the basis for effective cognitive activity and constructive social life of people.

Many researchers have recognized the special role of conceptual abilities in the structure of intelligence, considering the ability to conceptual reflection as the highest stage of intellectual development, providing the possibility of conscious (arbitrary) regulation of activity. A prominent Russian scientist Vygotsky (1982) that conceptual abilities enable people to understand communication, relationship, interdependence hidden behind the surface of the visible phenomena, and therefore, to comprehend the laws that govern reality.

In addition, conceptual structures (‘concepts’) are a means of streamlining the perceived world using a “grid” of categorical and logical relations, i.e., it is an intellectual tool that helps to cope with the chaos of empirical impressions and to organize effective behaviour. Further, conceptual experience is a prerequisite for the socialization of individual intelligence, which creates conditions for a subtler understanding of other people and situations of social interaction. Finally, conceptual abilities are the basis of self-knowledge (knowledge of inner reality, the world of one's own experiences).

Thus, conceptual abilities (features of the organization of individual conceptual experience) provide an opportunity for a qualitatively new form of awareness (understanding) of what is happening — the objective world, other people, and oneself.

3. Research Questions

How do conceptual abilities change with creativity, conceptual structures ('concepts') and intelligence?

4. Purpose of the Study

The purpose of this empirical research is to study the relationship between psychometric intelligence, conceptual structures ('concepts') and creativity in different levels of conceptual abilities.

5. Research Methods

5.1. Participants

Four hundred eight respondents of nine different humanitarian departments («Psychology Department» (N = 97), «Primary Education Department» (N = 110), «Speech Therapy Department» (N = 22) «Defectology Department» (N = 15), «Foreign Languages Department» (N = 47), «History and Social Studies Department» (N = 32), «Management Department» (N = 23), «Social Services Department» (N = 11), «Land Registry Department» (N = 51)) from Kostroma, Moscow, Penza, Perm and Taganrog aged 18 to 24 years (19.32 ± 1.48) took part in our research, among them were 79.2% female students.

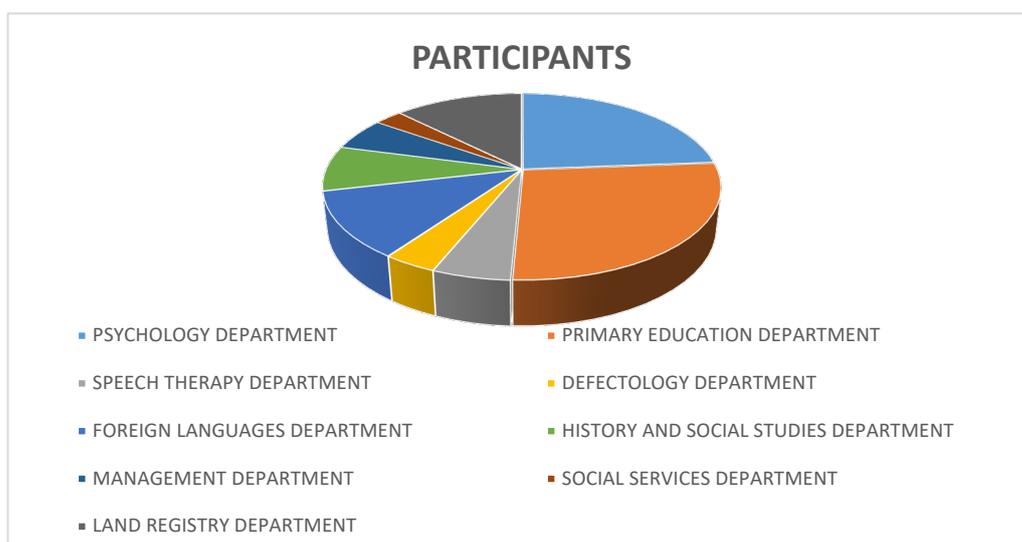


Figure 01. Participants of the study by department

5.2. Methods

A complex design was used in our research including assessment of concept organization (modification of "Integral Conceptual Structures" technique), conceptual abilities ("Conceptual abilities" technique), creativity (Torrance technique (both TTCT-Figural and TTCT-Verbal)) and Raven's intelligence test (SPM / RPM).

5.2.1. Methods of assessment of conceptual structure organization

The modified version of the “Integral Conceptual Structures” technique enabled to explicate three features of concepts (e.g., abstract concepts “Potential” and “Resources”) such semantic features (“Directed associative” technique), visual features (“Visual Portrait of a Notion” technique) and sensory-emotional features (“Semantic differential technique modified by Kholodnaya, (2002; 2012). The standardized z-scores indices (the indices of the objectiveness, the indices of generalisation of topical image and indices of generalized figurative translation number of selections in the column “weak-medium” of semantic differential) were summarized to get the indices “level of conceptual structures”.

5.2.2. Methods of assessment of conceptual abilities

To assess different aspects of conceptual abilities such techniques as “Generalization of three words”, “Free sorting words”, “Conceptual Synthesis” were used.

- “*Generalization of three words*” (Kholodnaya, 2012) technique was used to estimate generative abilities (ability to generalize the concepts based on their essential characteristics). The participant is given 10 triads of words (e.g., newspaper – lighthouse – fire; soap bubble – vase – suitcase; etc.). The words in each triad differ in their semantic fields. According to the instructions, the participant should think about what ‘connects’ the words in each triad and name this common feature, if possible – in one word.

- “*Free sorting words*” (Kholodnaya, 2012) technique was used to estimate involuntary categorical abilities – the participant was asked to spread thirty-five cards with words denoting the different aspects of the category of “Time” into groups in the most convenient, logical and natural way, from their point of view.

- “*Conceptual Synthesis*” (Abraham, Okoniewski, Leman, 1987; Kholodnaya, 2012) technique was used to estimate voluntary categorical abilities - the ability to ‘create’ connections between concepts based on three unconnected words. The participant was asked using three words (e.g., shell-paper clip-thermometer) to make the maximum possible number of combinations in the form of meaningful sentences.

5.2.3. Method of assessment of creativity

- The Russian *TTCT* (Tunick, 1998) is an adaptation of the American version (Ball & Torrance, 1992) of *Torrance Test of Creative Thinking* (TTCT, Ball & Torrance, 1992). It was used to estimate both verbal and nonverbal creativity. It consists of a Verbal (TTCT-Verbal) and Non Verbal creativity (TTCT-Figural) test battery.

5.2.4. Method of assessment of intelligence

- *Raven’s Intelligence Test* (SPM / RPM) is widely known for being well-validated measure of fluid reasoning ability. It was used to estimate level of psychometric IQ (Carpenter, Just, & Shell, 1990). The SPM contains 60 nonverbal items (Raven, Court, Raven, 1992). Each item consists of a 3 × 3 matrix with a missing piece to be filled in by selecting an answer from six/ eight alternative pieces.

5.3. Statistical data processing was carried out based on the IBM SPSS software package

Statistics 22.0. It included descriptive analysis (mean, standard deviation), comparative analysis (Student t-test), analysis of variance (ANOVA), hierarchical cluster analysis with preliminary factor analysis (Ward Method).

5.4. Procedures of the empirical study

To determine the conjugation of indicators of conceptual abilities with intelligence, conceptual structures ('concepts') and creativity, the hierarchical cluster analysis with preliminary factor analysis (Ward Method) was conducted. It revealed three homogeneous subgroups of respondents with high, low indicators of conceptual abilities and the intermediate subgroup.

Table 01. The results of clustering variables on conceptual abilities

Conceptual abilities	Cluster		
	Cluster 1 N=190	Cluster 2 N=74	Cluster 3 N=143
<i>Generative abilities</i> ("Generalization of three words" technique)	5,28± 1,94	10,43±2,15	5,38±1,4
<i>Voluntary Categorical abilities</i> ("Conceptual Synthesis" technique)	5,96±2,35	9,01±3,23	11,5±1,76
<i>Involuntary Categorical abilities</i> ("Free sorting words" technique)	0,52±0,23	0,66±0,24	0,59±0,25
Subgroups	«low level of conceptual abilities»	«high level of conceptual abilities»	«intermediate subgroup»

As can be seen from table 1, cluster 1 is characterized by minimal indicators of all three types of conceptual abilities, cluster 2 - high indicators of all three types of conceptual abilities. Cluster 3 combined respondents with relatively low generative abilities and involuntary categorical abilities, but high voluntary categorical abilities. These one-way ANOVA (ANOVA) across the sample indicated a significant difference between the values of all three clusters ($p < 0,05$).

To examine a difference in subgroups of the Conceptual abilities between IQ, creativity and conceptual structures independent sample t-tests were conducted.

Table 02. Comparative data analysis and data of intelligence, concepts and creativity in students with low and high indices of conceptual abilities

Indicators	Average values		Student t-criterion
	Subgroup 1 (low level of conceptual abilities)	Subgroup 2 (high level of conceptual abilities)	
IQ	48,64±7,86	51,7±4,52	-3,943***
Creativity	49,09±12,133	56,1±13,21	-2,162***
Conceptual structures ('concepts')	-0,28±6,36	1,43±5,5	-3,957*

$p^* \leq 0,05$; $p^{**} \leq 0,01$; $p^{***} \leq 0,001$

As it can be seen from table. 3, respondents with a high level of conceptual abilities (both generative and categorical abilities) demonstrated not only high IQ but also conceptual structures and creativity.

Table 03. Comparative data analysis and data of intelligence, concepts and creativity in students with high indices of conceptual abilities and intermediate

Indicators	Average values		Student t-criterion
	Subgroup 3 ('intermediate')	Subgroup 2 (high level of conceptual abilities)	
IQ	49,67±7,4	51,7±4,52	-2,506*
Creativity	50,60±10,12	56,1±13,21	-3,133**
Conceptual structures ('concepts')	-0,5±5,73	1,43±5,5	-2,420*

p*≤0,05; p**≤0,01; p***≤0,001

According to the data presented in table 3, respondents with relatively low both categorical and generative abilities, but high semantic abilities have significantly lower levels of IQ, conceptual structures ('concepts') and creativity.

There is no significant difference in terms of IQ, conceptual structures ('concepts') and creativity in the subgroup with a low level of conceptual abilities and an intermediate subgroup.

It is possible to assume about the special role of conceptual abilities in relation to their impact on the level of psychometric intelligence, conceptual structures ('concepts') and creativity, given the fact that in subgroup 2 ('intermediate') indicators semantic abilities (11.5 points) is much higher than in other subgroups (11.5 points). Thus, the degree of expression of intelligence, conceptual structures ('concepts') and creativity varies depending on the level of formation of semantic abilities.

6. Findings

The results of a comparative analysis of the ratio of IQ, conceptual structures (concepts), creativity and conceptual abilities indicate that:

- at a high level of conceptual abilities respondents demonstrate not only high level of IQ and conceptual structures (concepts) but also creativity;
- at the average level of conceptual abilities respondents demonstrate average indicators of IQ, creativity, conceptual structures (concepts) and creativity;
- at a low level of conceptual abilities — low indices of IQ, conceptual structures (concepts) and creativity.

Thus, the high level of formation of conceptual abilities implies higher indices of IQ, conceptual structures (concepts) and creativity.

7. Conclusion

The data of comparative analysis between the indicators of intelligence, conceptual structures (concepts) and creativity at different levels of conceptual abilities allows us to assume the existence of not

only the upper but also the lower "conceptual threshold", by analogy with the intellectual threshold of E.P. Torrance.

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