

V Congress of Russian Psychological Society

Structural Analysis of Junior Schoolchildren' Intellectual Abilities

Vladimir D. Shadrikov*

Faculty of Psychology, National Research University of Higher School of Economics, 46B Volgogradskiy Prospekt, Moscow 109316, Russia

Abstract

This paper aims to undertake a structural analysis of intellectual sphere of junior schoolchildren that is conditioned by the synthesis of intellectual abilities and some personality traits in a whole structure. For experiment the complex of indices (intellectual abilities and personality traits) has been identified to study the intellectual development in schoolers. To draw a whole picture the single intercorrelations of a single intellectual ability and personality traits have been systematized to integral structures of intellectual activity. In keeping with this aim some abilities and traits that are systematizing within the structure of schoolchild's intellectual activity have been defined.

© 2013 The Authors. Published by Elsevier Ltd.

Selection and/or peer-review under responsibility of Russian Psychological Society

Keywords: Intellectual ability, Intellectual development, Learning activity, Junior schoolchild, Personality traits, Structure, Structural analysis.

1. Introduction

In studying schoolchildren' abilities it should be taken into account that the efficacy of learning activity is conditioned by the synthesis of intellectual abilities in a whole structure, structurally functional organization of a psyche rather than by the level of a single ability development. Some personality traits such as motivation and empathy can be included in having been formed functional structures.

2. Method

To prove the given propositions we have conducted the study of students' intellectual abilities in three metropolitan comprehensive secondary schools.

The complex of indices (intellectual abilities and personality traits) has been identified to study the intellectual development in schools. They are the indices of attention, memory, thinking, imagination and personality traits

* Corresponding author. Tel.: +74957096568; fax: +74991782277.

E-mail address: shadrikov@hse.ru

(achievement motive, learning motives and empathy). To measure the given indices the relevant tests have been chosen (Table 1).

Table 1. Techniques and indices used to diagnosis the schoolchildren' abilities and personality traits

Index	Technique
<i>Attention indices</i>	
The productivity of volitional attention	Bourdon test
<i>Mnemic abilities indices</i>	
Short-term memory span	Memorizing (10 words)
Short-term indirect memory span	Memorizing (pair of words)
Short-term indirect meaningful memory span	
Indirect memory span	Pictogram
<i>Thinking ability indices</i>	
The level of verbal and logical thinking	Verbal and logical thinking test
The level of nonverbal spatial thinking	Raven Progressive Matrices
The level of reflexive generalization	Test "Postman"
The level of search planning	Test "Bishop-castle"
<i>Imagination ability indices</i>	
The level of nonverbal imagination originality	Test "Complete Figures"
Nonverbal imagination flexibility	
<i>Personality traits indices</i>	
Motivation to avoid failure	Rean test
Success achievement motivation	
Success achievement motivation	Assessment scale of a need for achievement
Qualitative analysis of learning activity motives	The technique of learning activity investigation
The level of empathy	Test "Empathy level"

2.1. Participants

In the study the junior schoolchildren of the third (n=181) and four (n=151) grades of Moscow schools took part. The total sample is 332 participants from eight to ten years old.

3. Results

Data was conducted using SPSS 11.5 and Statistica 6.1. The descriptive statistics, comparative and criterion analysis of means, correlation analysis have been used in data processing.

Table 2 illustrates the means of the level of intellectual abilities and personality traits development in junior schoolchildren of the third and fourth grades. Examining the data we could consider that from the third grade to the fourth grade in junior schoolchildren some of intellectual abilities are developed. They are the productivity of volitional attention, the short-term and meaningful memory spans, the verbal and logical thinking (awareness and thinking by analogy), the level of reflexive generalization, the level of nonverbal imagination originality and nonverbal imagination flexibility.

Table 2. The means of intellectual ability development and personality traits

Index	The third grade (M)	The fourth grade (M)	Difference in means between the third and fourth grades	P
The productivity of volitional attention (PVA)	110	132,2	22,2	0,001
Short-term memory span (StMS)	6,5	6,8	0,3	0,001
Short-term indirect memory span (StIMS)	12	12,6	0,6	0,636
Short-term indirect meaningful memory span (StIMMS)	6,4	9,2	2,8	0,001
Indirect memory span (IMS)	8,2	8,7	0,5	0,384
The level of verbal and logical thinking:				
Awareness (A)	9,3	2,4	0,001	7,9
Classification (C)	8,5	0,7	0,068	7,8
the level of generalization (G)	7,2	0,6	0,757	6,6
thinking by analogy (TA)	7,1	2,7	0,007	4,4
The level of nonverbal spatial thinking (NST)	113,9	103,7	- 10,2	0,001
The level of reflexive generalization (RG)	1,4	2	0,6	0,001
The level of search planning (SP)	3,6	3,6	0	0,717
The level of nonverbal imagination originality (NIO)	3,5	3,9	0,4	0,001
Nonverbal imagination flexibility (NIF)				
Success achievement motivation and motivation to avoid failure (SAM&MF)	14,5	13,5	- 1	0,015
The level of success achievement motivation (SAM)	11,9	11,6	- 0,3	0,321
The level of empathy (E)	57	56,5	- 0,5	0,692

Basing on the empirical data we counted the interdependence of some indices. The matrix of intercorrelations is presented in Table 3.

The initial data analysis has shown the intercorrelations between some junior schoolchildren' intellectual abilities and personality traits that are represented on 5% and 1% level of significance ($p < 0,05$ and $p < 0,01$). A big amount of significant intercorrelations is the share of different intellectual abilities. Here there are relationships between the indices of the same intellectual abilities as well as different abilities – attention, memory, intellect and imagination. As for personality traits, they demonstrate small majority of relationships with intellectual abilities and do not show the significant intercorrelations.

A large number of significant intercorrelations show that the schoolchildren' intellectual sphere as a system formation. Consequently we could assert that on the level of single intellectual abilities the schoolchildren' learning activity has definite structure and individual specificity associated with it. It should be stated that the structure of intellectual activity on the level of intellectual abilities would be individually specified by aims and conditions of schoolchild's learning activity. Therefore in any educational systems the structure of schoolchild' learning activity can be considerably differentiated.

The identified significant intercorrelations that have been examined in pairs are less informative from structural analysis. To draw a whole picture the single intercorrelations should be systematized to integral structures of intellectual activity. In keeping with this aim we have attempted to identify the abilities and traits that are systematizing within the structure of schoolchild's intellectual activity. So we have analysed the weighting coefficient of each intellectual ability and personality traits in accordance with a correction factor that is the level of intercorrelation significance between different indices. The coefficient 2 goes to intercorrelation that is significant on $p < 0,01$ and the coefficient 1 goes to intercorrelation that is significant on $p < 0,05$. Thus, the assigned weighting coefficient to each identified index reproduces the qualitative and quantitative characteristics of its intercorrelations between other indices. The more the weighting coefficient of intercorrelations is, the more close relationships the considered component has within the analysed structure (Table 4).

The data analysis defines the basic characteristics that contribute more to the examining structure. They have great number of significant intercorrelations between other components within the structure and play an integrating role. So, the highest level of development of these characteristics in schoolchild learning activity is a base for other structural component development and for identification of compensatory functional relationships between them.

Table 4. The weighting coefficient of structural components of schoolchild intellectual activity

Index	<i>P</i>		Σ	Pr	
	2	1			
The productivity of volitional attention (PVA)	3	4	10	6,5	
Short-term memory span (StMS)	4	5	13	3	
Short-term indirect memory span (StIMS)	4	3	11	4,5	
Short-term indirect meaningful memory span (StIMMS)	8	2	18	1	
Indirect memory span (IMS)	0	0	0	-	
The level of verbal and logical thinking:	Awareness (A)	4	3	11	4,5
	Classification ©	4	1	9	8
	the level of generalization (G)	4	2	10	6,5

thinking by analogy (TA)	7	2	16	2
The level of nonverbal spatial thinking (NST)	2	2	6	10,5
The level of reflexive generalization (RG)	2	2	6	10,5
The level of search planning (SP)	0	0	0	-
The level of nonverbal imagination originality (NIO)	2	4	8	9
Nonverbal imagination flexibility (NIF)				
Success achievement motivation and motivation to avoid failure (SAM&MF)	0	1	1	13,5
The level of success achievement motivation (SAM)	0	1	1	13,5
The level of empathy (E)	0	2	2	12
C4, C3, C2, C1	44	34	78	
$\Sigma 4, \Sigma 3, \Sigma 2, \Sigma 1$	88	34	122	
Basic characteristics				Meaningful memory span

P – Level of correlation significance; Σ - weighting coefficient; Pr – rank; C_i – number of i -level significant relationships; Σ_i - weighting coefficient with correction factors.

Finally, it should be noted that the system of schoolchildren' intellectual abilities has quite high level of integration (122) and this fact enables us to conclude that the intellectual sphere of schoolchildren is actually the holistic, structured formation and it develops systemically in relation to all components.

4. Discussion

The data analysis has shown the meaningful memory span to be one of the basic components within the structure of junior schoolchildren' intellectual abilities. This index has had a lot of intercorrelations with other structural components of learning activity and consequently has had a high weighting coefficient. So, on the level of operational mechanisms the meaningful memorising plays an integrating role in organizing the learning activity of junior schoolchildren by incorporating in different memory processes as well as in different intellectual processes.

As systemising components within the structure of junior schoolchildren' intellectual abilities thinking by analogy (TA) and short-term memory span (StMS) should be marked out that are on the second and third place in the rank structure. The development of thinking by analogy is typical for learning because the learning process is based on repetition and reproduction of actions algorithm that is represented by a teacher. The same findings are presented in some our researches [1], [2]. It could be suggested that the need for much repetition given and demonstrated algorithms leads to intensive development of meaningful memorisation, since to reproduce definite actions in doing the task is initially necessary to be aware of them and memorise. In this case the solving of the task that has analogy with previously done task would be associated with maximum effectiveness. The short-term memory span (StMS) might also be developed intensively in the process of meaningful information processing during meaningful memorizing and reproducing the given strategies and algorithms by drawing an analogy. This assumption is proved by the significant intercorrelations ($p < 0,01$) between such indices as: short-term memory span (StMS) and meaningful memory span, short-term memory span and thinking by analogy (TA)

So, three basic structure-forming components within the structure of junior schoolchildren' intellectual activity are closely intercorrelated and are developed as a single system factor that is determined by aims and conditions of learning activity.

As for the development of mnemonic abilities it should be noted that if the span of meaningful memory (the memorized comprehended elements) is put on weighting coefficient by intercorrelations, the goal-directed long-term memory span is not put on any weighting coefficient by intercorrelations. Here we have to underline that the above said concerns relatively long indirect memorizing. The short-term memorizing that is short information keeping in memory for current task solving also develops in relationships with other abilities and includes their operational mechanisms (particularly perception and thinking, and other indices of memory estimation). However

in the goal-directed long-term memory that presupposes different operational systems, which make the memorizing more intellectual, do not have any relationships with intellectual processes.

So memorizing in junior schoolchildren develops spontaneously and this development is based on prompt understanding, remembering and reproducing definite information or thinking by analogy. They do not use any memorizing techniques or operations and do not demonstrate any mnemonic strategies. Their main goal is to comprehend the given to them mechanism of task-solving, and to reproduce it by memory. As a result the mechanism of indirect (intellectualized) memorizing does not have any relationships with other intellectual processes (out of learning activity) and is less developed.

Such index as the level of search planning (SP) does not represent any relationships with intellectual abilities and personality traits. Taking into account that this index is less developed in junior students it could be said that the search planning stays aside of integral development of intellectual sphere of junior students.

Finally, we must conclude that the structural analysis of the intellectual activity of junior schoolchildren clearly demonstrates the system regularities of their intellectual sphere development. The abilities that have close relationships with intellectual processes are progressively developed. The components that have not any significant relationships with intellectual processes demonstrate the lowest level of development. The primary development of any components and identification of their relationships are determined by aims and conditions of junior schoolchildren' learning activity.

Acknowledgements

The study was supported by the Basic Research Program at the National Research University Higher School of Economics (HSE) in 2013.

References

- [1] Shadrikov V.D. *Mental development of human being*. Moscow: Aspekt Press; 2007. (in Russian)
- [2] Shadrikov V.D. *System genesis issues of professional activity*. Moscow: Nauka; 1982. (in Russian)