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EXTERNAL MOTIVATIONAL ATTITUDES INFLUENCE ON CONVERGENT TASKS SOLUTION BY YOUNGER SCHOOLCHILDREN

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Abstract

The article features an empirical study results of solving convergent tasks success by younger schoolchildren in the context of various external motivational attitudes. The study was conducted at Moscow primary school “School No. 1561” in 2016-2018. The final sample of the study included 239 second-graders, aged 8 and 9 (102 girls and 137 boys). To assess overall level of children's cognitive abilities, Raven's Progressive Matrices (RPM) were used as well as other tools: “Ladder of promptings” (modified method of N.V. Elfimova) – to assess motivational characteristics; a questionnaire by M. Seligman for children's attributive style (modification by N. A. Baturin and D. A. Tsirin); questionnaire of implicit theories by C. Dweck (modified). As part of the experiment, two blocks of convergent tasks were formed. The first block is focused on logical reasoning, the second – on spatial reasoning. It was revealed that primary schoolchildren show the highest level of success in solving convergent tasks if the attitude is to avoid failures. At the same time, younger schoolchildren, solving logical type tasks, demonstrate the greatest success exclusively if the attitude aims at avoiding failure. While solving spatial type tasks, their results increase in conditions of both an attitude to achieve success and to avoid failures. The differences found substantiate the conclusion that primary school girls are more sensitive to changes in the external motivational attitudes than boys of the same age.

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1. Introduction

Academic achievements of primary schoolchildren, as well as success of their solution to convergent tasks, are closely related to motivational component of educational activity, and features of motivational-personal characteristics of the subject included in this process.

Psychological research convincingly shows that motivational variables, which include individual's goals and motives, their ability to self-regulation and perseverance, prevailing form of response to failure, attribution of success and failure, ideas about limit and possibility of changing one's own abilities, are extremely important for understanding of what underlies person's academic achievements. Relevance of studying the problem of motivational component of convergent tasks success is also directly related to current education standards. According to them, the teacher in their interaction with children should adhere to the subject-subject position. This, in particular, means that participating in educational process in the space of educational interaction, the teacher must lean and contribute in every possible way to development of productive forms of children's motivation. These include cognition motivation, achievement and self-development, collectively embodied in child's internal motivation. However, the reality is that until now one of the main methods of stimulating children's educational and cognitive activity are marks and competition.

2. Problem Statement

Despite active desire of many scientists to introduce more divergent tasks (tasks that have one condition and many correct answers) into primary school educational process, convergent tasks remain the basis of curricula at all levels of education. Convergent tasks prevail in notebooks and manuals for the preschool level, and they are found in secondary school and higher education. This prompts an in-depth study of influencing convergent tasks success by varying external motivational attitudes. At the same time, it seems especially important to focus the research on primary school age. For primary schoolchildren convergent tasks are of particular importance, because they lay foundation for verbal and logical reasoning formation.

An empirical study was conducted at Moscow State Budgetary Educational Establishment «School No. 1561». The sample consisted of 239 second-graders, aged 8 and 9 – 102 girls and 137 boys.

To assess overall level of children's cognitive abilities, Raven's Progressive Matrices (RPM) were used as well as other tools: “Ladder of promptings” (modified method of N.V. Elfimova) – to assess motivational characteristics; a questionnaire by M. Seligman for children's attributive style (modification by N. A. Baturin and D. A. Tsirin); questionnaire of implicit theories by C. Dweck (modified).

3. Research Questions

In order for a child to succeed in educational activities, not only the level of development of his cognitive sphere is significant, but also a number of non-cognitive parameters. At the same time, teachers', parents' and often students' ideas that success in educational activity is explained by special abilities, talent, development of reasoning, memory and other cognitive factors continue to prevail (Lubart et al., 2016). As the main research questions we consider the following: is it possible, due to

modification of only one parameter external to task-solving activity, to influence success of convergent tasks solution by younger schoolchildren? The parameter was an external motivational attitude to achieve success and avoid failure, created through oral instruction. In addition, we were interested in whether primary school girls and boys' reaction to these external influences will differ (Rodán et al., 2019).

4. Purpose of the Study

The paper aims at analyzing possibility to change convergent tasks solution success by primary schoolchildren by use of various external motivational attitudes.

5. Research Methods

The purpose determined the use of the research methods to follow: analysis of psychological and pedagogical literature, psychodiagnostic method, experiment, methods of mathematical data processing.

6. Findings

Not only cognitive factors, but also factors of non-cognitive order have a significant impact on person's productivity in task-solving process. The latter traditionally include persistence, self-regulation, determination and self-confidence (Aristova et al., 2018; Druzhinin, 2001; Gajda, et al., 2017; Matyushkin, 2017; Savenkova, 2017; Ushakov, 2003). A separate block is set by studies showing that task solution is determined by motivation of a person who solves it, in particular, their external motivational attitude (Gordeeva & Shepeleva, 2011; Irvine, 2018; Tuominen et al., 2020) is extremely important. Modern studies highlight that a child's success both in task solving and in educational activity in general is determined not only by how developed their cognitive abilities are. Often person's motivation comes to the fore, which activates brain activity (Gordeeva & Shepeleva, 2011). In situations of children's educational activity motivational factors often exceed the role of intelligence in the effectiveness of their impact (Damrongpanit, 2019; Duckworth et al., 2019; Duckworth & Seligman, 2005; Seligman, 2017).

6.1. Organization and research methodology

We assumed that various external motivational attitudes, created experimentally with the help of oral instruction received by younger schoolchildren can change productivity of convergent tasks, fixed both by the total number of answers and by the number of tasks solved per unit time (Gavrilova, 2019; Savenkov, 2019). In our study, we rely on convergent tasks, that, in psychology, are tasks with one condition and one correct answer. Converged thinking, activated at the same time, is defined as unidirectional, sequential, logical. Unambiguity of answers received in convergent tasks makes it possible to evaluate success or failure of a task solution as fully as possible.

In our study, we used convergent tasks from notebooks for the cognitive development of younger schoolchildren by Savenkov (2019). Based on these tasks, we formed two blocks of convergent tasks. The first block consisted of tasks aimed at nonverbal logical reasoning. They were associated with patterns and analogies identification, establishment of logical connections and sequences, that is, with common

logical skills (Fetisova, 2009; Savenkov, 2019). The second block was represented by tasks aimed at spatial reasoning, coupled with spatial visualization and mental rotation related to spatial abilities of “small scale” (Jansen, 2009; Voyer & Jansen, 2017). Each block included four tasks.

Prior to experimental study, we implemented a preliminary experiment. Its results allowed us to adjust the general plan and methodology of the study, correlate them with the tasks of experimental work, as well as determine level of each task complexity and assign an appropriate score for its solution. The experimental study consisted of three consecutive series with an interval of about a month between them. Each series was based on one of three external motivational attitudes.

As part of the first series, a neutral motivational attitude was created. Second-graders were asked to solve the sets of tasks that the experimenter proposed. The need for a solution was explained to children by the fact that the experimenter, together with colleagues, is now preparing a collection of tasks for children of precisely their age. But before publishing, there was a need to check whether it is well-composed – whether the tasks included are too easy or, on the contrary, difficult. This work did not imply external awards or punishments: primary schoolchildren were informed that no mark would be put for solved or unsolved tasks. Thus, children solved them voluntarily, relying on their own cognitive motivation and desire to help an adult. This series was also considered by us as a checking means in relation to the next two.

The second series of the experiment was set around an external motivational attitude, focused on achieving success. The younger students were informed that the headmaster of their educational park highly assessed the tasks that the children had solved a month before. Therefore, he asked the experimenter to prepare similar tasks in order to determine which of the children solves them best. Thus, children were invited to take part in the competition between second-grade students of their educational park. Compared with the first series, there were some external changes in the behavior of second-graders. In particular, they showed great focus on the task-solving process, turned to the experimenter and their form teacher for help, and used auxiliary tools, such as a ruler. In addition, to solve tasks in the second series, younger students spent on average more time than with a neutral motivational attitude. This allows to assume growing importance of task solving in relation to the first series.

While implementing the third series of the experiment, an external motivational attitude was included and aimed at avoiding failures. The experimenter's instruction was set around the idea that children who do not solve a new batch of tasks will be given an F (unsatisfactory mark) in mathematics. The second-graders' form teacher was present in the classroom when the instruction was given and confirmed the information thus making the situation looking official. After checking the works, all the schoolchildren were informed that they had completed the tasks and no one was given an F. Also, as with the introduction of an external motivational attitude to achieve success, second-graders, trying to avoid failure, showed signs of tasks solving importance. They used drafts and pencils, which made it possible to change the answer to the task several times. Some schoolchildren, in addition to rulers, used compasses. The number of primary schoolchildren who continued to solve tasks after a call for a break increased.

The first experiment series showed that in neutral conditions, younger schoolchildren in relation to the maximum possible number of points gain an average of 40.8%. It should be noted that at a statistically significant level the children solved nonverbal logical reasoning oriented tasks better than tasks of a spatial type. Differences were checked with Wilcoxon T-test ($Z = -10.506$, $p = 0.000$). A comparison of

tasks solving results by girls and boys (Mann-Whitney U-test) showed that they solve logical type tasks at the same success level ($U = 6548, Z = -0.850, p = 0.395$), but in solving spatial tasks there are statistically significant differences. It turned out that boys do such tasks much better than girls ($U = 5908, Z = -2.069, p = 0.039$).

At the second stage of the study, the results of tasks solving have changed. With the introduction of an external motivational attitude to achieve success, the total number of points scored from the maximum possible number increased to 41.9%. Moreover, the greatest growth was shown in solving spatial tasks: in comparison with a neutral motivational attitude, the number of points scored by primary schoolchildren increased from 30.6% to 35.1% with respect to the maximum possible number. The general success ratio of tasks solving, in which children better solve non-verbal logical rather than spatial tasks, was preserved at a statistically significant level ($Z = -7.882, p = 0,000$). The analysis of gender differences showed that in the context of a motivational attitude, girls and boys do at the same level tasks of both a logical type ($U = 6598, Z = -0.753, p = 0.451$) and tasks aimed at spatial abilities ($U = 6703, Z = -0.546, p = 0.585$).

The introduction of an external motivational attitude focused on avoiding failures brought the largest increase in the number of points relative to the two previous settings, and amounted to 44.2% of the maximum number of points. Statistically significant differences were also found between completing logical and spatial type tasks ($Z = -8.339, p = 0,000$). This allows us to conclude that, regardless of the conditions set by an external motivational attitude, younger students are more successful in solving nonverbal logical tasks as compared with tasks for volumetric-spatial reasoning. No gender differences were found within the framework of the attitude to avoid failures, neither with respect to non-verbal logical tasks ($U = 6936, Z = -0.098, p = 0.922$), nor to space-spatial ones ($U = 6583, Z = -0.783, p = 0.434$).

The generalized results of completing logical and spatial type tasks with the introduction of each of the three external motivational attitudes are presented in Table 1, as a percentage of the points that the children scored and the maximum possible number.

Table 01. Results of solving convergent problems of logical and spatial blocks with the introduction of different external motivational attitudes (%)

	Logical Type Tasks	Spatial Type Tasks	Total
Neutral attitude	50,9	30,6	40,8
Attitude to achieve success	48,6	35,1	41,9
Attitude to avoid failures	51,1	37,5	44,2

Using the Friedman criterion χ^2 , we determined the presence of statistically significant differences in the success of solving logical and spatial type tasks, as well as their total indicators when various external motivational attitudes were introduced. The results are presented in Table 2.

Table 02. Differences in solving tasks of logical and spatial type, as well as in their total results

Categories compared	the Friedman criterion χ^2	P
Logical type tasks	10,269	0,006*
Spatial type tasks	45,530	0,000*
Summary Results	20,456	0,000*

NB: * $p < 0,01$

At the next stage of data analysis and processing using the Wilcoxon T-test we determined under which of the three external motivational attitudes conditions primary schoolchildren solve which type of tasks at a higher level of success. The Wilcoxon T-test is standardly used to compare data from two samples. In accordance with the objectives of our study, we compared the three samples in pairs, so we adjusted the level of statistical significance ($p = 0.017$). The results are presented in Table 3.

Table 03. Differences in the success of solving tasks of a logical and spatial type, as well as summary indicators for pairs of motivational attitudes

Task type (pair of motivational attitudes)	Z	P
LTT (NA & AAS)	-2,088	0,037
STT (NA & AAS)	-4,049	0,000**
CF (NA & AAS)	-1,124	0,261
LTT (NA & AAF)	-0,166	0,868
STT (NA & AAF)	-5,880	0,000**
CF (NA & AAF)	-3,815	0,000**
LTT (AAS & AAF)	-2,466	0,014*
STT (AAS & AAF)	-2,404	0,016*
CF (AAS & AAF)	-3,253	0,001**

NB: * $p < 0,017$; ** $p < 0,01$

LTT – logical type task; STT – spatial type task; CF– consolidated figures; NA– neutral attitude; AAS – attitude to achieve success, AAF – attitude to avoid failures

As the data analysis showed, primary schoolchildren more successfully solve nonverbal logical reasoning tasks, while being in a attitude that is designed to avoid failure. The differences shown are true both in comparison with neutral conditions, and with the conditions set by the attitude towards success.

With "small scale" spatial capabilities tasks the situation is different. It was revealed that, unlike the previous type of tasks, primary schoolers demonstrate higher efficiency in tasks solving in the conditions of motivational attitude towards success compared to a neutral attitude. At the same time, children continued to demonstrate the greatest success in solving spatial tasks in a motivational attitude aimed at avoiding failure. This is true when compared with the results obtained using both a neutral attitude and a success attitude.

In the case of summary success indicators for solving both types of convergent tasks, the situation is similar to that identified and described above with logical type tasks. We found out that younger schoolchildren reliably solve more successfully convergent tasks of both types under conditions of attitudes aimed at avoiding failure, both with respect to neutral attitudes and attitudes towards success.

To determine under the conditions of which of the three external motivational attitudes which type of tasks is solved at a higher level of success separately by boys and girls, we used the Wilcoxon T-test ($p = 0.017$). The results are presented in Table 4.

Table 04. Differences between boys and girls in the success of solving logical and spatial types tasks, as well as in the total indicators of solving convergent tasks in pairs of motivational attitudes

Task type (pair of motivational attitudes)	Boys		Girls	
	Z	P	Z	P
LTT (NA & AAS)	-1,530	0,126	-1,426	0,154
STT (NA & AAS)	-2,302	0,021	-3,418	0,001**
CF (NA & AAS)	-0,459	0,646	-1,220	0,222
LTT (NA & AAF)	-0,200	0,842	-0,029	0,977
STT (NA & AAF)	-3,677	0,000**	-4,591	0,000**
CF (NA & AAF)	-2,176	0,030	-3,309	0,001**
LTT (AAS & AAF)	-1,760	0,078	-1,539	0,124
STT (AAS & AAF)	-1,721	0,085	-1,740	0,082
CF (AAS & AAF)	-2,097	0,036	-2,097	0,013*

NB: * $p < 0,017$; ** $p < 0,01$

LTT – logical type task; STT – spatial type task; CF– consolidated figures; NA– neutral attitude; AAS – attitude to achieve success, AAF – attitude to avoid failures

It was found out that among girls there is an increase in the success of spatial type tasks when comparing a neutral attitude and an attitude towards success ($Z = -3.418$, $p = 0.001$). In addition, girls, being in a setting that is designed to avoid failure, show better results in solving convergent tasks in general. This is true for both the neutral attitude ($Z = -3.309$, $p = 0.001$) and the attitude toward success ($Z = -2.097$, $p = 0.013$).

7. Conclusion

In the course of our study, we verified the hypotheses that we formulated at the beginning. So, we have found that the primary success level in solving convergent tasks is shown by primary school children in the context of attitude to avoid failures. At the same time, younger schoolchildren, solving logical type tasks, demonstrate the greatest success exclusively in the context of the attitude to avoid failure. And when solving spatial type tasks, their results increase in conditions of both an attitude to achieve success and an attitude to avoid failures. However, in the second case, the success of solving tasks is higher.

Younger schoolchildren complete logical type tasks better than spatial ones, regardless of the conditions set by an external motivational attitude.

The differences found substantiate the conclusion that primary school girls are more sensitive to changes in the external motivational attitude than boys of the same age. With logical type tasks girls demonstrate the same success as boys. However, when analyzing the results of solving spatial type tasks, we found significant gender differences, which seem quite interesting to us. In psychology, there is a lot of data on the existence of gender differences in development of spatial abilities, including “small-scale” abilities (Aristova et al., 2018). The results of solving spatial type tasks by younger schoolchildren in a neutral attitude correspond to these provisions. But when external motivational attitude changes, leveling of gender differences is observed. We attribute this to the fact that with an increase in the situation significance of task solving by changing external motivational attitude, girls begin to solve spatial tasks at

a higher level. This idea is consistent with sociocognitive theory of motivation developed by Dweck (2017).

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