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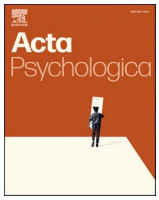

Learning motivation tendencies among preschoolers: Impact of executive functions and gender differences

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ABSTRACT

The current study aimed to validate the Russian version of the Child Behaviour Motivation Scale (CBeMO), examine gender differences in motivational tendencies, and explore the impact of executive functions on learning motivation tendencies among children. The sample consisted of 434 typically developing 5–6 years old children. The confirmatory factor analysis showed that according to the evaluation criteria, the model is poorly fitted to the data. However, internal consistency analysis confirmed acceptable levels of reliability and unidimensionality of the CBeMO scales. The identified internal structure of CBeMO indicates an overlap between CBeMO items related to task avoidance and social dependence on the Russian sample. The study revealed differences between girls and boys in all three CBeMO scales. Concerning executive functioning, it was revealed that motor persistence skills and working memory have an impact on the learning motivation tendencies among children, when controlling for group size, age, gender and non-verbal intelligence.

1. Introduction

Research to understand how to improve children's academic performance has already shown the importance of such indicators as emotionally comfortable atmosphere, teacher's skills in creating a good sense of community, and the choice of the pedagogical tools used to build thinking and language skills and concept formation in children (Blankson et al., 2017; Ferrier et al., 2014; Gloeckler et al., 2014; Hatfield et al., 2013). Today, teaching is increasingly focused on children's own motivation and self-regulation skills since they contribute to children's engagement in learning activities (Saeed & Zyngier, 2012; Wigfield et al., 2015). They are associated with higher academic achievement (Habgood & Ainsworth, 2011), enjoyment of problem solving and goal achievement (Blair & Razza, 2007; Pintrich & Schunk, 2002), metacognitive skill development (Sawyer, 2017), and collaboration skills (Butler & Walton, 2013). The contribution of executive functions to further child development is already fairly well understood, but there is still a paucity of research revealing the role of motivation in this process.

Studies indicate that the characteristics of children's learning motivation and attitude toward learning have a significant impact on their later academic performance and achievement (Hyson, 2008; McClelland et al., 2000; Vitiello et al., 2011). In addition, learning motivation is related to social behaviors necessary for successful learning: learning is facilitated when children behave in class in socially expected ways, such as following teacher directions, cooperating with peers, and demonstrating self-regulation skills when performing difficult tasks under the guidance of an adult (Coolahan et al., 2000). However, the absence of a validated toolkit has long prevented the assessment of learning motivation in preschool and elementary school-aged children for research and practical purposes. Today, the study of this factor has become possible due to the availability of qualitative diagnostic tools, one of which is the Child Behaviour Motivation Scale (CBeMO) (Lepola et al., 2007; Center for Learning Research, University of Turku). The first goal of this study was to examine the validity of a Russian version of CBeMO adapted to assess learning motivation among Russian preschool children, and to address the underlying structure of the questionnaire based on the Russian sample. The second goal was to investigate whether a child's learning motivation is associated with executive functions such as inhibitory control, verbal and visual working memory, cognitive flexibility, and motor persistence.

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1.1. Motivation

Motivation is an internal individual psychological factor (Brody et al., 2020) defined in this paper as "the process whereby goal-directed activities are instigated and sustained", following Pintrich and Schunk (Pintrich & Schunk, 2002, p.5). This definition contains main aspects of motivation: it is a process; implies a focus on a goal; has a beginning; lasts over time; and is directed toward achieving that goal (Cook & Artino, 2016). Many theories have been developed to understand the nature of human motivation. The multiplicity of theories creates confusion because most of them overlap conceptually. Indeed, "learning engagement," "mastery motivation," "academic motivation," "motivation to learn," "behavioral learning engagement," and "learning behaviors" are all concepts that relate to processes and activities designed to achieve new knowledge or skills. Next, a short overview of the current theories that illustrate and explain learning motivation in childhood is given (Cook & Artino, 2016).

Expectancy-value theories (Eccles & Wigfield, 2020; Wigfield & Eccles, 2000a, 2000b) are based on identifying two motivational factors: expectation of success and task value. Expectation of success is shaped by motivational beliefs (goals, self-concept, and task difficulty). The value of the task is determined by interest or intrinsic value; utility or extrinsic value; importance or attainment value; opportunity costs. According to this approach, a person's motivation displays in such observable behaviors as choice, engagement, effort, persistence, achievement, and performance. Attribution theory (Weiner, 1985) explains motivation through not entirely conscious post factum search for the reasons that led to success or failure. Each result finds its explanation through attributions, that is, through internal or external factors that, after the fact, seem to have determined the outcome. Attributions are divided into several aspects: locus (internal or external), stability (likely to change or fixed), and controllability (within or outside one's control). Established attributions then manifest themselves through emotions and influence motivation to perform future tasks. Social-cognitive theory (Bandura, 1994) considers motivation as a process that ensures a person's proactive activity to achieve personal goals. A major component of motivation is self-efficacy — a person's beliefs about what he or she can handle under the conditions of given personal, behavioral and environmental factors (Bandura, 1994). Self-efficacy largely determines how a person regulates his or her behavior and manipulates the environment (Zimmerman & Cleary, 2006). When self-efficacy is high, a person is active and proactive in achieving goals, while low self-efficacy prevents a person from expecting positive results before starting a task and thus from putting enough effort in it (Zimmerman, 2000). Self-determination theory (Ryan & Deci, 2000) argues that motivation is characterized not only by its magnitude, but also by its orientation. Initially a person tends to do things that bring pleasure and is guided in this by natural intrinsic motivation. But as a person age, more and more activities become linked to external motivation, such as career goals, expected rewards or punishments. Healthy motivation development, increased personal autonomy, and the maintenance of authenticity and self-determination become possible only when external motivation and personal interest are interiorized and integrated (Ryan & Deci, 2000). Cultural-historical theory (Leontiev, 2012) postulates that motivation is formed in the individual system of human activity and depends on personal and environmental (cultural and social) factors. This theory includes an age periodization of mental development where each stage is characterized not only by features of cognitive, emotional and behavioral development, but also by a leading activity (Elkonin, 1971; Kravtsova, 2006; Veresov, 2006). The leading activity is the activity which brings the greatest pleasure to the person and at the same time promotes development adequate for each age. In other words, it realizes individual needs and the desire to learn and achieve mastery in age-specific activities. For example, for a preschooler, the leading activity is role-playing. Children eagerly engage in play and learn to communicate with each other, cooperate, agree and try on the social roles they will perform in the future.

1.2. Learning motivation in preschool age

Young children show individual differences in learning motivation (Hidi et al., 2004) even before they start kindergarten or school. This suggests that motivation is influenced by a variety of factors, including the child's individual characteristics and home environment. Nevertheless, there are different motivational patterns as well as developmental trajectories. Until recently, it was thought that young children did not respond to success and failure in the same way that older children do. However, research has shown that as early as approximately two years of age, children pay attention to how their performance is judged by others, and show positive emotional reactions to success and negative emotions when they fail (Stipek et al., 1992). One year later, at the age of three, children are already able to evaluate their success on their own, without relying on the reactions of adults. From the age of three, children experience success and failure more vividly than younger children (Dweck, 2002; Dweck & Master, 2009). However, researchers have noted that at the age of 3–4, children do not yet have well-established beliefs about their abilities despite having vivid emotional reactions to their own performance (Heyman et al., 1992). Metacognitive skills of assessing one's own performance, as well as beliefs about one's abilities and characteristics in various activities are formed later — closer to 6 years of age (Chatzipanteli et al., 2014). At the same time, the child's learning motivation (Dörnyei & Ushioda, 2013) and learning strategies (Appleton et al., 2008) begin to form based on his or her experiences, beliefs, and reactions of adults. Further, learning motivation plays an important role in learning engagement and influences the child's academic growth trajectories at different stages of learning (Appleton et al., 2008; Bulotsky-Shearer & Fantuzzo, 2011; Li-Grining et al., 2010). The results of research indicate that there are gender differences in learning motivation and general motivation in children (Brody et al., 2020).

Cultural-historical approach and the results of empirical research indicate that during the preschool years, children's intrinsic motivation is most clearly manifested in play. According to age periodization (Elkonin, 1971), play is the leading activity in preschool age. Recent studies have shown that play promotes motivation in children (Habgood & Ainsworth, 2011; Sawyer, 2017). Play-based approach to learning has been shown to increase intrinsic motivation, in both traditional format and digital games (Habgood & Ainsworth, 2011). It is also positively related to children's engagement and willingness to continue playing.

1.3. Observable indicators of learning motivation

To date, several categories of observable indicators of learning motivation can be identified based on the current theoretical and empirical literature on learning motivation in preschool children (Appleton et al., 2008; Birch & Ladd, 1997; Connell & Wellborn, 1991; Fredricks et al., 2004). Most commonly, behavioral categories such as attention to instruction, task behavior, persistence, self-control, enthusiasm, and affect are evaluated.

Pakarinen assessed children's interest in activities that are included in the Finnish preschool curriculum, as a measure of motivation (Pakarinen et al., 2010). Children were shown eight pictures of different learning activities and asked how much they liked doing them in kindergarten (Content Interest Rating Scale for Children) (Lerkkanen et al., 2006). The study found that learning motivation was related to children's success in developing phonological awareness and high-quality class organization (Pianta et al., 2008) and low teacher stress levels. The role of children's motivation as a mediator between teacher stress and children's phonological awareness was also revealed. The Dimensions of Mastery Questionnaire (DMQ) (Morgan et al., 2009; Morgan et al., 2013; Morgan et al., 2019) is designed to assess mastery motivation in children and adolescents. It evaluates a child's level of persistence and enjoyment on cognitive, emotional, large motor, and

social tasks as one measure (Barrett & Morgan, 2018). The DMQ-18 version of the methodology is a parent questionnaire and is used to assess mastery motivation of 2–6 years old children.

The present study relied on the three-part motivation model developed by Lehtinen et al. (1995) which was later examined by Lepola et al. (2007) to understand the development of young children's learning motivation during teacher-guided activities. The three-part motivation model includes three groups of indicators that are assessed individually by the teacher for each child: task orientation, task avoidance, and social dependence. In this study, we used CBeMo based on the three-part motivation model because, first, from the theoretical point of view, it covers important observable indicators of learning motivation and, second, is aimed to assess children's behavior in structured classes, which meets the features of the preschool curriculum in Russia. The detailed description of CBeMo is presented in the Materials and methods section.

1.4. Executive functions

The exact definition of executive functions has been subject to discussion for a long time. In terms of our study, we rely on the following definition: "cognitive processes that are required for the conscious, top-down control of action, thought, and emotions, and that are associated with neural systems involving the prefrontal cortex" (Lerner et al., 2015, p. 271). The main hot and cold executive functions parameters are three cognitive competences: (i) inhibitory control (resisting habits, temptations, or distractions), (ii) working memory (retaining and using information), and (iii) cognitive flexibility (Miyake et al., 2000; Nelson et al., 2016). Executive functions competences develop intensively throughout the preschool years and have a significant influence on child's later performance.

Executive functions crucially impact the formation of academic skills such as word reading, vocabulary, spoken and written language comprehension, mastering of initial mathematical concepts, development of speech skills, as well as the outcomes in high school (Blair & Razza, 2007; Cheie et al., 2015; Torres, 2015; Utendale et al., 2011; Zelazo et al., 2003). Studies indicate the presence of individual variations in executive functions development by the time children start school (Garon et al., 2008; Lan et al., 2011; Liebermann et al., 2007). Children with considerably lower executive functions indicators are disadvantaged even before their first school year. This starting difference between the advantaged and the less advantaged only grows over time (Lensing & Elsner, 2018; Prencipe et al., 2011). Considering the current agreement on the significance of executive functions in early years, there is growing interest in determining factors that contribute to the development of these skills, especially during the preschool period.

1.5. Motivation and executive functions in preschool years

A number of studies have focused on associations between motivation and executive functions in adolescents and adults (Berger & Karabenick, 2011; Pintrich & De Groot, 1990; Schunk & Zimmerman, 2012). However, much less is known about this relationship in preschool age. As with older ages, researchers have difficulty differentiating between manifestations of motivation and manifestations of self-regulation in the preschool years. For example, a child's persistence in completing an activity or task can be viewed as both a key indicator of motivation (Berhenke, 2013; MacTurk et al., 1995) and a behavioral indicator of self-regulation (McClelland et al., 2007). Motivation and executive functions seem to be intertwined, at least at the level of empirical behavioral indicators. The situation is exacerbated by confusion over the terms used. For example, the concept of "self-regulated behavior" can refer to self-directed behavior. It is not possible to differentiate these concepts definitively, since in reality the tasks used to measure self-regulated behavior often require children to behave in a self-directed way. A good example of such an intersection are tasks for inhibitory control, where the child needs to do or say something in contrast to the experimenter's instructions — that is, to act in a self-directed way (Inhibition, NEPSY-II, Korkman et al., 2007; Head-Toes-Knees-Shoulders, Ponitz et al., 2008). Finally, in assessment, it is necessary that the child is motivated to perform the proposed tasks.

On the other hand, there are examples when motivated people fail to achieve a specific goal (De Castella et al., 2013; DeShon & Gillespie, 2005). It may be assumed that in some cases one of the factors of failure can be underdeveloped skills of regulation of cognitive and emotional processes. Therefore, research is needed to determine whether self-regulation always depends on motivation for the task at hand. Understanding the nature of associations between motivation and executive functions is important for theoretical and practical purposes. For example, these connections may clarify the pedagogical dilemma about what kind of help is needed: to support the child's self-regulation skills or to interest him or her using different methods?

1.6. Current study

The aim of the present study was threefold. The first objective was to validate the questionnaire on learning motivation among Russian preschoolers and to address its underlying structure. Validation is required for several reasons. First, there are significant differences in terms of the educational system between Russia and Finland, where the rating scales were developed. In Russia, children attend kindergarten up to the age of seven, and by that time they are mostly able to read, write, and solve mathematical problems with two-digit numbers, since every day is filled with activities of formal reading, writing, and math. In Finland, children attend kindergarten until their sixth birthday. And no formal lessons on literacy or numeracy are offered before that time. Second, there are likely to be cultural differences between the two countries that could potentially influence children's attitudes and behaviors, as well as teachers' perception of children in their classrooms. These differences can significantly affect the degree of learning motivation of a child participating in an adult-led activity and the way it manifests itself in the child's behavior. The second objective of the study was to examine whether expected gender differences in motivational factors are observed in the samples of Russian children. Finally, the third objective was to explore associations between motivation and hot and cold executive functions among preschoolers.

2. Materials and methods

2.1. Participants

The sample comprised 434 typically developing 5–6-year-old children (46.9 % boys) with a mean age of 5.21 years (SD = 0.3). Parents or caregivers gave their informed written consent for children to participate in the study. Due to their age, children did not sign any forms, but all gave their verbal consent prior to testing. The recruitment process was based on an existing agreement between Moscow State University and 12 preschools in Moscow (Russia), which are located in middle socioeconomic areas.

2.2. Procedure

Kindergarten administrators invited teachers to take part in a study on children's participation in adult-led learning activities. Each teacher received an information letter that provided comprehensive information about the project. After agreeing to participate, teachers received printed observation protocols for each of the children in their classroom with a brief demographic form.

A total of 23 teachers took part in the study. All of them have either a bachelor's or master's degree in preschool education and had at least one year of experience of working with the participating children. Teachers were asked to assess the characteristics of children's motivation and

learning activities using questionnaire items. The average time teachers worked with these students was no <8 months. Teachers filled in the questionnaire individually for each child based on direct observation of his or her behavioral and emotional manifestations during frontal group sessions or small group sessions. The filling of the questionnaires was spread over the course of the week to avoid overburdening teachers. Teachers evaluated several children a day. It is important to note that in Russian kindergartens, keeping observation diaries and recording children's achievements is a regular part of teachers' work. Before assessing a child's behavior on a 7-point scale, the educator was asked to recall instances where the child did something under his or her supervision or was offered a new activity, over the last kindergarten year. Therefore, the motivation assessment by the educator was based on an overall picture that emerged from the many situations where the child participated in group activities.

2.3. Instruments

The Child Behaviour Motivation Scale (CBeMO) was designed by Lepola, Mattinen and Salonen (Lepola et al., 2007) based on the three-part motivation model earlier developed by Lehtinen et al. (1995). The questionnaire consists of 18 items with a seven-point scale and requires teachers to rate children's behaviors relevant to attention, emotional expressions during teacher-guided group activity, and the environment in the day-care center (from score "1" = 'this behavior does not occur at all' to score "7" = 'the behavior occurs most of the time to always'). The questionnaire is designed to be completed by an educator who has been working with a child or a group of children for a long time. The instructions for the questionnaire are as follows: 'Before you rate the child's behavior (7-point scale), try to recall especially the situations where the child played or crafted under your guidance or was asked by you to try a new activity. The idea is that your assessment is based on the general picture that is the sum of many situations where the child is guided to the tasks, performs craft tasks or stops an activity. The focus of this assessment is not free-play situations, nor the child's linguistic skills and abilities, but the way the child adapts to the situations guided by an adult in a day-care center. Giving an exact assessment to some statements may be difficult, but please present your own impression at the moment.' The questionnaire in its original factor composition includes three factors: Task orientation (8 items), Task avoidance (6 items), and Social dependence (4 items). The questionnaire was translated from English into Russian by a native Russian speaker who lives permanently in Russia. Questionnaire structure, instructions, sequence of statements, scoring scale, and layout features were retained.

2.3.1. Cold executive functions measures

The Dimensional Change Card Sort (DCCS, Zelazo, 2006*)* is an executive functions task aimed at measuring cognitive flexibility. In the DCCS task, a child is asked to sort cards in three rounds, according to different rules. The first sorting is based on pictures' color (pre-switch trial), the second one — on shape (switch trial), and the third one — on the conflicting rules: on the color or the shape of a card depending on whether there is a frame on the card or not (post-switch trial). In the analysis we used the final score of the methodology with a range of scores from 0 to 24.

The subtest *Inhibition* (Korkman et al., 2007) is an executive functions task that assesses the child's ability to inhibit automatic cognitive responses. It includes two series of shapes (circles/squares and arrows). Firstly, the child is asked to name the shape or direction (Naming trial). In the second part of the task, the child is asked to name the shape or direction conversely: to say "circle" when a square is presented and "square" when it's a circle (Inhibition trial). In the analysis we used the Combined Inhibition score with a range of scores from 0 to 19.

The subtest *Sentences Repetition* (Korkman et al., 2007) aimed to assess verbal working memory. This technique uses 17 sentences, gradually increasing in their complexity (sentences become longer and syntactically more complex). For example, while the first sentence consists of 2 words and has a simple structure — "Good night", the twelfth sentence consists of 14 words and has a complex structure — "The woman, who stands next to a man in a green jacket, is my aunt". Omitting a word, replacing it or adding another word was considered an error. Changes in the word order was also considered an error. If a child received 0 points for four consecutive sentences, the test was terminated. The final score ranges from 0 to 30.

The subtest *Memory for Designs* (Korkman et al., 2007) aimed to assess visual working memory. Two parameters of visual memory were measured — memorization of content and a spatial arrangement of the pictures. For each task, 2 points were awarded for each correctly chosen card ("Content score") and 1 for each correctly indicated place ("Spatial score"). Two bonus points were given on each trial if a child selected a card correctly and placed it in its right place ("Bonus score"). As a result, four estimates were obtained for visual working memory: a content score, a spatial score, a bonus score and a total score (the sum of all points in all tasks), as described in the NEPSY-II battery.

2.3.2. Hot executive functions measure

The *Statue* subtest (Korkman et al., 2007) was used to assess motor persistence as a hot executive functioning ability. It requires a child to silently maintain a static body position with the eyes closed for 75 s. The child is instructed to not respond to sound distracters, which the experimenter makes 4 times. Four scores were computed for the Statue subtest — Statue, Body Movement, Eye Opening and Vocalization, and a Total score. The tester recorded the number of movements the child made in five-second intervals (e.g., head turning, eyes opening or vocalizing and/or laughing).

2.3.3. Non-verbal intelligence measure

Non-verbal fluid intelligence was assessed via the Russian adaptation of R*aven's Colored Progressive Matrices* (CMPM) (Raven et al., 2002). The task involved completing matrices of patterns and figures by deducing which of the four options fits correctly. We counted correct answers until the child made four mistakes in a row, then the test was stopped. The final score can vary between 0 and 36.

All methods have been adapted and validated on the Russian sample and have shown high psychometric qualities (Veraksa et al., 2020). Trained researchers measured the variables and outcomes of the study under standardized conditions. All data were collected at the same time in the morning, between 8:00 am and 11:00 am. Children were assessed individually, in their kindergartens, after that we obtained the completed demographic forms. On an average, the test lasted 15 to 20 min. The study and consent procedures were approved by the Ethics Committee of Faculty of Psychology at Lomonosov Moscow State University (the approval No: 2018/41).

2.3.4. Data analysis

Validation of the Russian version CBeMO and exploration of the underlying structure of the scales were done using Structural Equation Modeling Software v.6.2 (EQS v.6.2). The goodness-of-fit of the models was evaluated using chi-square (χ^2), the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). The recommendations developed by Hu and Bentler (1999) were used in evaluating the model: the model indicates a good fit when the RMSEA value is close to 0.06, the SRMR is close to 0.08 and the CFI cut-off value is equal to 0.95. Correlation analysis was used to assess the relationship between all study variables (children's age, non-verbal intelligence, learning motivation tendencies and executive functions). ANOVA was used to assess the influence of the child gender on individual CBeMO scales scores reflecting learning motivation tendencies. Three separate General Linear Models (GLM) were built to explore which executive functions impact on learning motivation tendencies among children when controlling for group size (continuous), age (continuous in months), gender

(categorical with two levels) and non-verbal intelligence (continuous). Jamovi software, version 1.0.7.0 (The jamovi project) was used for all the analyses run in the current study.

3. Results

3.1. Validation of the Russian version of the Child Behavior Motivation Scale

Confirmatory factor analysis (Maximum likelihood estimation method) was used to assess the factor structure of the data obtained on the Russian sample using the Russian version of the CBeMO. The correspondence between the empirical and theoretical models was assessed using the main indices: *CFI* = 0.855, *SRMR* (433) = 0.060, *RMSEA* = 0.0984, χ^2/df was 5.20 ($p < .001$). Thus, two of the fit indices suggested that according to the evaluation criteria, the model is poorly fitted to the data (Hu & Bentler, 1999). However, these results were somewhat at the boundary, hence the reason for keeping the model. Factor loadings are provided at Table 1.

An exploratory factor analysis (Principal axis factoring extraction method) was used in combination with an oblimin rotation to identify the internal structure of CBeMO items and test the alternative model on the Russian data. Sampling adequacy was checked using Kaiser-Meyer-Olkin Test (KMO). The total KMO was 0.882, above the commonly recommended value of 0.6 and indicating that variables were not multicollinear. Bartlett's test of sphericity was significant (χ^2 (153) = 3681, $p < .001$). The number of factors was determined using parallel analyses. The minimum factor load was 0.4. As a result, two factors were extracted. One of them matches the original configuration of Task orientation scale entirely. The second factor combines all items from Task avoidance and Social dependence scales. Confirmatory factor analysis was used to test how this extracted two-factor model fits to the Russian data. The fit indices *CFI* = 0.765, *SRMR* (433) = 0.007, *RMSEA* = 0.125, χ^2/df was 7.76 ($p < .001$) suggest that the alternative model still does not fit better than the three-factor one.

Regarding the internal consistency reliability testing of the adapted Russian version of CBeMO questionnaire, Cronbach's α internal consistency analysis was carried out. Obtained values confirmed high reliability and unidimensionality of the CBeMO scales on the Russian data: Task orientation (α = 0.845), Task avoidance (α = 0.861), and Social dependence orientation (α = 0.790). All of the above Cronbach's α values exceed the value (>0.70), which indicates a sufficient level of internal consistency between the items of the CBeMO scales. In the following analysis, mean scores for each of the original questionnaire scales were used, relying on their sufficient reliability and in consideration of the possibility of cross-cultural comparisons.

Table 1
The factor loadings of the CFA model of the CBeMO with the Russian sample.

Factor	Indicator	Stand. estimate	SE	Z	*p*
Task orientation	Is able to concentrate on crafts and play-like tasks	0.776	0.0658	18.1	<0.001
	Is able to continue her/his activity despite external disturbing	0.706	0.0793	15.9	<0.001
	Is satisfied when s/he has managed to finish a crafts work	0.511	0.0539	10.7	<0.001
	Wants to continue the tasks	0.631	0.0847	13.7	<0.001
	Shows desire to do more challenging things	0.573	0.0844	12.2	<0.001
	Struggles, doesn't give up in crafts or play-like situations	0.658	0.0789	14.5	<0.001
	Enjoys doing the tasks	0.550	0.0643	11.6	<0.001
	Ponders on alternatives and plans what s/he does	0.664	0.0825	14.6	<0.001
Task avoidance	Is easily frustrated	0.509	0.0880	10.5	<0.001
	Complaining, whimpering and moaning	0.673	0.0724	14.9	<0.001
	Shows strong disappointment toward	0.677	0.0697	15.0	<0.001
	Uses materials for other things than the task at hand	0.718	0.0793	16.6	<0.001
	Shows unwillingness at the very beginning of the activity	0.844	0.0648	20.7	<0.001
	Wants to quit the activity by pretending that s/he is tired	0.818	0.0652	19.7	<0.001
Social dependence orientation	Imitates the peers' activities	0.553	0.0895	11.1	<0.001
	Clings to an adult when transferring	0.616	0.0856	12.2	<0.001
	Asks immediately for help from the adult	0.694	0.0777	14.3	<0.001

3.2. Preliminary data analysis

Descriptive statistics and Pearson's correlation were calculated for all the study variables, including children's age, non-verbal intelligence, CBeMO scales scores and executive functions (see Table 2). The analysis revealed that task orientation increased as the children grew older. While task avoidance and social dependence were not related to the age ($p > .05$). Age is probably not a significant factor in the formation of these motivational tendencies in preschool children. According to teachers' observations, children with higher levels of nonverbal intelligence demonstrated Task orientation significantly more frequently, and Task-avoidance and Social dependence significantly less frequently in their behavior.

In terms of executive functioning variables, the results indicated that there were significant associations between Task orientation and inhibitory control, cognitive flexibility, motor persistence, visual working memory, and verbal working memory. Task-avoidance was significantly negatively related to all of the studied indicators of executive functions except cognitive flexibility. Social dependence was significantly negatively related to all of the studied indicators of executive functions, namely: inhibitory control, cognitive flexibility, motor persistence, visual working memory, and verbal working memory.

Significant relationships were also found between motivational tendencies. For example, children with high Task orientation scores were significantly less likely, as observed by teachers, to exhibit Task-avoidance and Social dependence. However, children with frequent Task-avoidance behaviors were also significantly more likely to exhibit Social dependence behaviors.

3.3. Gender differences

Gender differences in children's motivational tendencies were analyzed using Independent Samples *T*-Test (Student's t). Statistically significant differences were found between girls and boys on all three motivational orientation scales. On average, girls scored higher on Task orientation ($M = 5.15$, $SD = 1.08$) than boys ($M = 4.51$, $SD = 1.07$) (t (1,430) = −6.17, $p \leq .001$, Cohen's $d_z = -0.594$). Boys were more likely to show higher levels of Task-avoidance ($M = 2.44$, $SD = 1.40$) and Social dependence ($M = 2.97$, $SD = 1.32$) than girls ($M = 1.90$, $SD = 1.13$ and $M = 4.51$, $SD = 1.07$ respectively) (t (1,430) = 4.18, $p \leq .001$, Cohen's $d_z = 0.403$; t (1,430) = 2.47, $p = .014$, Cohen's $d_z = 0.234$ respectively).

Table 2
Descriptive statistics and Pearson's r correlation for age, non-verbal intelligence, learning motivation and executive functions variables.

	M	SD	1	2	3	4	5
2. Age in months	62.86	3.82	–				
3. Non-verbal intelligence	14.03	7.76	0.024	–			
4. Task orientation	4.84	1.13	0.132**	0.224***	–		
5. Task-avoidance	2.27	1.26	−0.008	−0.151**	−0.490***	–	
6. Social dependence	2.80	1.35	−0.039	−0.121*	−0.503***	0.663***	–
7. Inhibitory control	9.09	3.13	0.092	0.307***	0.231***	−0.108*	−0.147**
8. Cognitive flexibility	19.08	2.72	0.203***	0.272***	0.214***	−0.164	−0.101*
9. Motor persistence	23.18	6.47	0.037	0.181***	0.275***	−0.252***	−0.204***
10. Visual working memory	69.66	21.40	0.081	0.446***	0.361***	−0.230***	−0.237***
11. Verbal working memory	17.44	4.63	0.059	0.167***	0.349***	−0.181***	−0.184***

* Correlation is significant at $p < .05$ (2-tailed).
** Correlation is significant at $p < .01$ (2-tailed).
*** Correlation is significant at $p < .001$ (2-tailed).

3.4. Impact of executive functions on learning motivation

GLM (Task orientation ~1 + 'Group size' + Gender + 'Age in months' + 'Non-verbal intelligence' + 'Inhibitory control' + 'Cognitive flexibility' + 'Motor persistence' + 'Visual working memory' + 'Verbal working memory') was performed to explore which executive functions impact such learning motivation tendency as Task orientation, when controlling for group size, age, gender and non-verbal intelligence. An ANOVA Omnibus test indicated that the model described the data well: $F(9) = 16.109$, $p < .001$, $\eta^2p = .280$. There was a significant effect of gender, age, motor persistence, and visual and verbal working memory on the Task orientation (see Table 3). No significant main effects of group size, non-verbal intelligence, inhibitory control, or cognitive flexibility were detected ($p > .1$). Child's gender together with verbal and visual working memory had the greatest positive impact on Task orientation (see Fig. 1).

Table 3
General Linear Models (GLM) predicting three learning motivation tendencies among preschool children.

	df	F	p	η^2p
GLM for task orientation				
Group size	1	1.953	0.163	0.005
Gender	1	26.158	<0.001	0.066
Age in months	1	4.725	0.030	0.013
Non-verbal intelligence	1	1.472	0.226	0.004
Inhibitory control	1	2.867	0.091	0.008
Cognitive flexibility	1	0.448	0.504	0.001
Motor persistence	1	5.079	0.025	0.013
Visual working memory	1	14.323	<0.001	0.037
Verbal working memory	1	16.092	<0.001	0.041
GLM for task avoidance				
Group size	1	4.189	0.041	0.011
Gender	1	10.849	0.001	0.028
Age in months	1	0.286	0.593	0.001
Non-verbal intelligence	1	0.624	0.430	0.002
Inhibitory control	1	0.005	0.942	0.000
Cognitive flexibility	1	1.737	0.188	0.005
Motor persistence	1	12.265	<0.001	0.032
Visual working memory	1	2.956	0.086	0.008
Verbal working memory	1	1.272	0.260	0.003
GLM for social dependence				
Group size	1	2.092	0.149	0.006
Gender	1	3.366	0.067	0.009
Age in months	1	0.407	0.524	0.001
Non-verbal intelligence	1	2.254	0.988	0.000
Inhibitory control	1	1.599	0.207	0.004
Cognitive flexibility	1	8.861	0.976	0.000
Motor persistence	1	7.526	0.006	0.020
Visual working memory	1	5.546	0.019	0.015
Verbal working memory	1	2.385	0.123	0.006

Next GLM was built with the same as above factors and covariates to explore the impact of executive functions on the Task avoidance. An ANOVA Omnibus test indicated that the model described the data well: $F(9) = 6.511$, $p < .001$, $\eta^2p = .136$. Analysis revealed a significant effect of group size, child's gender and motor persistence. There were no significant main effects of age, non-verbal intelligence, inhibitory control, cognitive flexibility, or visual and verbal working memory on the tendency of Task avoidance ($p > .1$) (see Fig. 2). Task avoidance behavior was less frequent among girls, children with high motor persistence, and those from the classrooms with large groups.

The last GLM was built to explore the effect of executive functions on Social dependence among children. According to the ANOVA Omnibus test values, the model described the data relatively poorer compared to other models: $F(9) = 4.83$, $p < .001$, $\eta^2p = .105$. The model revealed a significant positive effect of motor persistence and visual working memory. No significant main effects of group size, gender, age, non-verbal intelligence, inhibitory control, cognitive flexibility, or verbal working memory on Social dependence were detected ($p > .1$) (Fig. 3).

4. Discussion

The aims of the present study were to (1) validate the Russian version of CBeMO questionnaire by exploring its underlying structure on the sample of the 5–6 years old Russian preschoolers; (2) to examine whether gender differences in learning motivation tendencies exist among Russian children; and finally, (3) to explore the contribution of executive functions in learning motivation tendencies. Confirmatory factor analysis was used as a construct validity-test to check whether empirical data confirm the original theoretical model. The three-part structure of CBeMo has been previously confirmed on the Finnish, Israeli and German samples (Brody et al., 2020), using slightly different items to confirm the three motivational orientations. However, the model is poorly fitted to the Russian sample (Hu & Bentler, 1999). This is quite common in the practice of full international validation of questionnaires, primarily due to the differences in cultural and social environment (Gideon, 2012). In Finland, where this questionnaire was developed, no formal instruction on literacy or numeracy is offered to children until the age of 6. In Russia, children learn to read, write, and solve mathematical problems with two-digit numbers by this time, because the preschool educational program includes many lessons of formal reading, writing, and math.

Exploratory factor analysis was performed to identify the internal structure of CBeMO items on the Russian sample and test the fit of the alternative model. Two factors were identified with all the items included. One factor matched the original configuration of the Task orientation scales entirely. However, the second factor was a combination of two remaining scales (Task avoidance and Social dependence). A comparison of CFA fit indices showed no advantage of the alternative model over the original model. As a part of validation, the reliability of

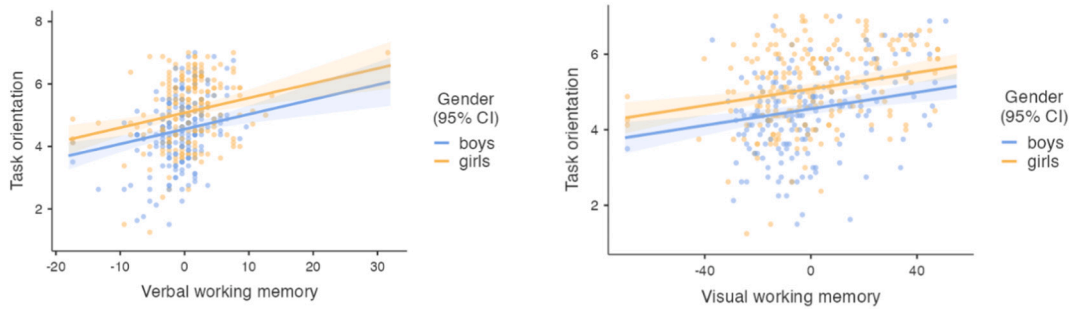

Fig. 1. Verbal and visual working memory effect on Task orientation among preschoolers controlling for age, gender and non-verbal intelligence.

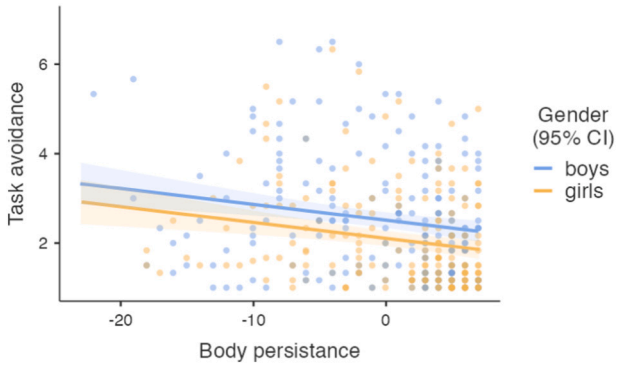

Fig. 2. Motor persistence effect on Task avoidance among preschoolers controlling for age, gender and non-verbal intelligence.

the questionnaire confirmed that the CBeMO scales (Task orientation, Task avoidance and Social dependence orientation) are unidimensional. The result confirms the reliability of the Russian-language version of the questionnaire, which reflects the unambiguous interpretation of the statements by the participating teachers. Thus, no additional procedures to improve the Russian translation are required for further use of the Russian version of the questionnaire. Hence, original scales were used in all analyses relying on their sufficient reliability and envisioning the possibility of cross-cultural comparisons. Thus, similar to previous studies on the Finnish, Israeli, and Dutch samples of preschool children (Brody et al., 2020), this paper also found significant gender differences in motivational tendencies among Russian preschoolers on all three scales of the instrument: girls on average have higher levels of Task orientation and lower levels of Task-avoidance and Social dependence than boys.

Concerning executive functioning, it was revealed that only motor persistence, referring to hot executive functioning, significantly impacted all three learning motivation tendencies (*Task orientation*, *Task avoidance* and *Social dependence*). Motor persistence tasks required a child to control his/her body and voice, and also to inhibit the impulse to respond to sound distractors. Children with more developed motor persistence skills have shown a higher tendency to be interested in and happy about teacher-guided learning activities and have been less likely to show avoidance or dependent behaviors. Visual working memory, that refers to cold executive functioning, had a significant influence on *Task orientation* and *Social dependence.* Consequently, children who have better memorized new visual material have also shown interest and enjoyment of activities more frequently and have been less likely to imitate peers, cling to others and ask for help immediately. However, no significant influence of visual working memory on task avoidance behaviors has been found. This suggests that visual memory and negative emotions related to task performance are not working hand in hand. Finally, verbal working memory, which also refers to cold executive functioning, has significantly impacted *Task orientation.* Children who have been able to retain more complex verbal instructions in working memory have also shown more persistence and have experienced more interest and pleasure in participating in teacher-guided activities. However, the present study shows no evidence that verbal working memory is linked to task avoidance or socially dependent behaviors. Also, no evidence was found about an influence of inhibitory control and cognitive flexibility on any of the three learning motivation tendencies. All effects of executive functions on learning motivation tendencies were revealed in this study when controlling for group size, age, gender, and non-verbal intelligence.

One possible explanation of a significant advantage of children with developed motor persistence skills in terms of learning motivation in the context of teacher-guided activities may be their ability to quickly assess and consciously ignore distractors. The assessment of motor persistence in this study was based specifically on children's skills to control their body and voice and also inhibit the impulse to respond to distractors (Skogli et al., 2014; Veraksa et al., 2019). In preschool group activities, children typically experience an abundance of sound, physical, and visual distractions that can provoke an attention span switch, decrease learning engagement and social dependence (Bull & Scerif, 2001; Habgood & Ainsworth, 2011). According to the study results, poorly developed motor persistence skills influence not only a child's interest in

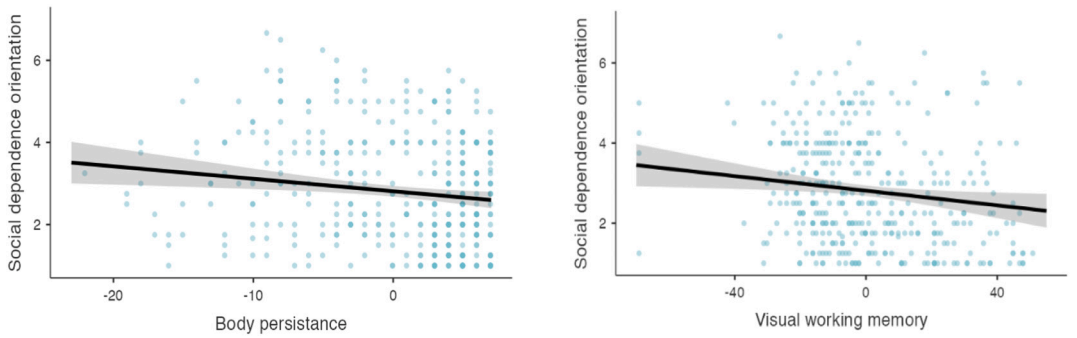

Fig. 3. Motor persistence and visual working memory effect on Task avoidance among preschoolers controlling for age, gender and non-verbal intelligence.

group teacher-guided activities and dependence behaviors, which seems reasonable, but may also provoke a non-task orientation. As a result, a child's accumulated experience of being unable to overcome distractions leads to the negative beliefs about his or her ability to succeed in such activities.

The significant positive impact of visual and verbal working memory as cold executive functioning skills on children's motivation to participate in teacher-guided activities and on the tendency for independent behavior can be partially explained by the ability to retain more important information in mind (Barenberg et al., 2011; Kyttälä et al., 2015). In a group setting activities, the ability to retain the necessary information in working memory allows a child to comprehend, follow and navigate the instructions and be able to catch up on several steps of a task on his or her own. Based on the findings, a definitive conclusion cannot be made about the nature of the relationship between learning motivation and executive functioning in preschool years. Nevertheless, the results obtained allow us to clarify some of the methodological issues raised in earlier works. For example, Ponitz pointed out that the concept of "self-regulated behavior" can mean "self-directed behavior" (Berhenke, 2013). The tasks used to measure executive functions often require self-directed behavior of children (Brown & Matusovich, 2013). This study used an inhibitory control task where the child had to say something backwards contrary to the visual stimuli — that is, to act in a self-directed way (Inhibition, NEPSY-II, Korkman et al., 2007). According to the results, the child's inhibitory control skills were, however, not associated with learning motivation, including the tendency to dependent/independent behavior. This can be evidence of the separate nature of self-regulated and self-directed behavior.

The results of the current study must be interpreted in the context of some limitations. First, the validity of the adapted questionnaire was not fully verified (not all fit indices in confirmatory analysis can be considered acceptable, and factors configuration in the exploratory analysis are partially different from the original tool scales). Despite the reliability and unidimensionality of the scales used, the findings obtained must be considered with caution. Second, the study sample was limited to one Russian region (Moscow). Future studies need to replicate the results with more diversity in order to have a more representative Russian sample and make the questionnaire applicable to other regions of Russia (including the autonomous republics, with translation of the methodology into national languages). Third, the age and work experience of the teachers were not taken into account, although they may have a potential impact on the variables under study. The fourth limitation of the study is the age of the participating children (5 to 6 years), which was caused by the current organizational capacity. In the future, in order to study the age dynamics in terms of children's learning motivation and its connection to regulatory functioning, additional research with an expansion of the age composition of the sample is required. Despite the limitations mentioned above, the present study contributes to the field of learning motivation in preschool children by providing evidence of the positive impact of working memory and motor persistence on learning motivation of children, even when controlling for age, sex and nonverbal intelligence. More research is needed to better understand the nature of associations between motivation, executive functions, and children's future academic achievement.

5. Conclusion

Current study contributes to the field of learning motivation in preschool children by providing evidence for the positive impact of children's hot and cold executive function skills on learning motivation, even when controlling for group size, age, gender and non-verbal intelligence. It is shown that motor persistence skills and working memory have a significant influence on the tendencies of learning motivation among children. Cognitive flexibility and inhibitory control did not have statistically significant influence on any of the children's motivational tendencies. The validation of the Russian version of the CBeMO questionnaire has scientific and practical significance as it provides a reliable tool and the possibility of using it for a quick and financially inexpensive assessment of children's learning motivation. In future research, the data from the Russian version of CBeMO (Lepola et al., 2007, Centre for Learning Research, University of Turku) will be used in a longitudinal study on tracing and predicting children's later achievement.

Declaration of competing interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript

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