EMOTIONAL CONTROL AND EXECUTIVE FUNCTIONS OF STUDENTS IN THE TRANSITION TO THE JUNIOR SECONDARY STAGE OF BASIC SCHOOL

Monika BOBÁKOVÁ,
University of Presov
monika.bobakova@unipo.sk

Miriam SLAVKOVSKÁ,
University of P. J. Safarik
miriam.slavkovska@upjs.sk

Ivan ROPOVIK,
University of Presov
ivan.ropovik@unipo.sk

Iveta KOVALČÍKOVÁ
University of Presov
Slovak Republic

Ján FERJENČÍK,
University of P. J. Safarik
jan.ferjencik@upjs.sk

Abstract:

Parallel development of executive functions and self-regulation skills play an important role in social adaptation during the transition to the junior secondary stage of basic school. This paper deals with interrelations of executive functions and emotional control. These relationships are not yet sufficiently clarified and are thus the subject of many discussions in professional circles. Attention is also paid here to gender differences in executive functions. The research sample consisted of 54 pupils (33 girls and 21 boys) with a mean age of 9.4 years. Within the concept of executive functions, the paper focuses on the level of inhibition, switching, verbal and figural fluency and working memory. The Delis - Kaplan Executive Function System (D - KEFS) test battery by the authors Delis et al., (2001), and the intelligence scales Woodcock - Johnson International Edition (WJ - IE Slovak Edition) by the authors Ruef et al., 2001 were administered to examine these functions. Emotional control was measured by a BRIEF questionnaire based on evaluation of the pupils by their teachers. The hypotheses were confirmed only partially. On the one hand, a significant correlation was found between the emotional control of pupils, according to evaluation by their teachers, and executive functions (intercorrelations ranging from r =.21 tor = .25). On the other hand though, the significance of the relationship was not confirmed by the regression analysis. Gender differences in the observed executive functions were not confirmed either. Results are discussed here in relation to the assessment of pupils from the general population using the BRIEF questionnaire and to the given age of the children.

Key Words: executive functions, emotional control, gender, teacher

1. THEORETICAL BACKGROUND

The period of transition to the junior secondary stage of basic school is, in many countries as well as in Slovakia, associated with increased demands on adaptation and academic performance. The pupil is exposed to new school subjects, a broader curriculum, new teachers and new peers in class. To cope with the situation successfully, there is a need for increased self-regulation. Self-regulation can broadly be defined as a goal-directed behaviour involving goal setting, planning, motivation towards attaining one's goals and efforts to sustain attention and action. It is the result of cognitive and emotional development. Emotional development involves the development of the ability to feel, understand and differentiate more complex emotions. The extent, course, duration, way of experiencing and external manifestations of emotions are changing. In social interactions, it is necessary for the child to control their emotional reactions and to adapt to the rules and norms of their immediate environment. Such self-control represents narrower definition of self-regulatory mechanisms and is associated with suppression of impulses. It is related to the control and switching of attention, to the inhibition of dominant processes and to the ability to continuously review of incoming information. Some connections to the concepts of cognitive flexibility can be found here, therefore it can be stated that self-control is directly related to the concept of executive functions.

Executive functions are increasingly becoming the subject of many studies in neuroscience, as well as in psychology and education. In general, executive functions are considered essential for the successful functioning of an individual in everyday life, especially in stressful situations. Usually, the term 'executive functions' broadly defines cognitive processes that underlie goal-directed behaviour (Olson & Luciana, 2008). Executive functions are necessary in situations involving planning and decision making, problem-solving, error correction, initiating new tasks, dealing with risky situations, and the need to overcome a strong habit-forming reaction (Hughes & Graham, 2002; Koukolík, 2012). They form a multi-operating system that organizes and regulates human behaviour, allowing for independent and purposeful action (Preiss & Kučerová, et al., 2006). Executive functions do not operate in isolation. They are activated together with other cognitive functions (Denckla, 2005). They include for example the ability to suppress certain behaviours, to switch between tasks, to plan a way of solving a problem, and to generate verbal or nonverbal mental products (Anderson, 2002). In 1994, at a conference on this issue, six components of executive functions were identified: 1) self-regulation, 2) sequencing of behaviour, 3) flexibility, 4) response inhibition, 5) planning and 6) organization of behaviour (Eslinger, 2005).

Although there is a considerable discrepancy in the exact definition of the components of executive functions, the existing definitions agree in that executive functions include the abilities necessary for solving complex tasks (Zelazo & Frye, 1998).

One key need for a pupil in the school environment is the ability to actively focus attention, to purposefully shift it and to suppress unwanted and distracting stimuli. Executive functions are thus an important predictor of student academic

achievement. These above abilities are developed along with other cognitive functions and are related to the overall maturity of the central nervous system of the child. Executive functions begin to appear in the first years of life, are fully developed in the adolescent age and gradually decrease following the natural aging process (Siqueira et al., 2010). Since adolescence is one of a person's sensitive periods, some authors point out gender related differences in the development of executive functions in pupils between 8 – 12 years of age. For example, Anderson et al. (2001) pointed to better cognitive flexibility in girls than in boys. Similar results were also found in the areas of planning. Bayer and Hausmann (2009) hold the opinion that the above differences are caused by hormonal changes, which start earlier in girls. In some other studies, however, gender differences in executive functions were not confirmed (e.g. Welsh et al., 1991), or were confirmed in verbal fluency only (e.g. Levin et al., 1991), which conforms with the generally accepted knowledge that women perform better than men in verbal tasks. There is a tendency to overlook gender differences in executive functions by researchers despite the legitimacy of such studies. In education, teachers often approach girls and boys in a differentiated manner, which may be due either to the different reception of the taught content by girls and boys or to the different perception of pupils by teachers. A relevant question arises about the objectivity and legitimacy of a different view and approach to boys and girls by a teacher, as well as the question of specifications of gender different areas.

The relationship between emotion and cognition has been investigated for many years, however the connection between these phenomena is still not sufficiently clear. Emotional control, i.e. the ability to modulate or appropriately mitigate emotional reactions and responses, as viewed by Gioia et al. (2000), is a part of emotional regulation, and cognitive processes are closely connected with it. The high intensity of certain emotions can block some cognitive processes because of swift reaction to a changing situation or danger. On the other hand, emotions provide important information about the environment and the situation, which can help in decision making, problem solving, focusing attention and retaining useful information. Nader-Grosbois (2011) included cognitive processes among the factors affecting the development of emotional regulation. In this context, executive functions such as inhibition and planning that could help regulate and control the emotions of an individual are brought to attention. Zelazo and Cunningham (2007) define the relationship of emotional regulation and executive functions as mutually influencing processes effective in different ways depending on the situation and the problem to be solved. They specifically distinguished between everyday problems and those which are new to the child and thus more stressful. A similar view on the relationship of executive functions and emotional regulation or control is held by Ursache et al. (2013), according to which this relationship depends on the reactivity of the individual. As the authors state, high levels of executive function ability were observed among individuals who exhibited high levels of emotional reactivity and high levels of regulation of this reactivity. Emotional regulation, however, was unrelated to executive functioning among individuals exhibiting low levels of emotional reactivity, especially in terms of negative emotions. Certain differences in emotional reactivity can be observed between men and women. According to the findings of some authors (e.g. Carter et al., 2003, Zahn-Waxler et al., 2008) girls are emotionally more expressive than boys, with more strongly manifested internalized

emotions such as guilt, sadness and fear. On the other hand, boys, whose level of emotional expression is lower than in girls, more strongly exhibit externalized emotions like anger and rage (Zahn-Waxler et al., 2008). In our research, we therefore focused on a closer look at the relationship of executive functions and emotional control, taking into account gender as an independent variable.

We were particularly interested in the following executive functions: inhibition, shifting, working memory, and verbal and figural fluency. Inhibition, shifting, and working memory are often influenced by the experiencing of mainly negative emotions. The primary evolutionary function of emotions is to help preserve the life and integrity of an individual, but in emotionally saturated performance, higher cognitive functions are often blocked. Gyurak et al. (2009) found a relationship between emotional control and verbal fluency which is often associated with high intelligence.

The research aim was to empirically verify the relationship between the selected executive functions and emotional control. We were interested in determining the extent to which emotional control contributes to the variability of executive functions ability in pupils. We also considered gender as a variable associated with a certain degree of emotional reactivity. We were specifically interested in the relationship of executive functions and gender in conjunction with emotional control.

2. STUDY

2.1. Participants

The participants comprised 54 pupils of whom 33 were girls and 21 boys. Their mean age was 9.4 years. The data were collected by psychologists during morning classes in basic schools. The research also involved the class teachers of the pupils from the sample, namely, 10 teachers, with different lengths of practice, whose task was to evaluate the emotional control of their pupils.

2.2. Instruments

To indicate the executive functions of the pupil the Delis-Kaplan Executive Function System (D-KEFS) of authors Delis et al. (2001) was used. It is still the only available standardized battery for a comprehensive assessment of executive functions. The Slovak version of the D-KEFS contains 8 separate tests for assessing a wide range of executive functions in verbal and nonverbal components. For the purpose of our research the following tests were selected:

- A modified version of the Trail-Making Test was used to evaluate shifting, namely the condition of switching numbers and letters. In this test an examinee draws the trail switching between a series of numbers and the letters of the alphabet.
- To evaluate fluency of thinking, two tests were used. To evaluate verbal fluency the Verbal Fluency Test was used – namely the Letter Fluency subtest in which an examinee should list as many words as possible which begin with the stimulus letter within the time limit. Non-verbal fluency was assessed by the Design Fluency Test in which an examinee should produce as many different figures as s/he can by connecting filled (empty) dots within the time limit.

• The ability to inhibit an automated reaction was tested by the Colour-Word Interference Test, a modification of the Stroop test. The inhibition subtest is based on interference between the cognitive processes of reading and recognizing colours. The task of the participant is to name the colour while the read text is printed in a different colour from the name denoting the colour.

To assess working memory, the reverse numerical series subtest from the international edition of Woodcock-Johnson batteries for measuring cognitive abilities (WJ-IE Slovak Edition) (Ruef et al., 2001) was used. The examinee should enumerate backwards gradually increasing sequences of digits.

Level of emotional control was assessed by the subscales of emotional control from the Behaviour Rating Inventory of Executive Function (BRIEF) by the authors Gioia et al. (2000). The scale contains 86 items grouped within 8 separate subscales (Inhibition, Shift, Attention, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor). The above subscales assess various aspects of executive functions. Information on pupils' behaviour was provided by the class teachers. They reported on a three-point scale the frequency of a particular type of behaviour.

3. RESULTS and DISCUSSION

The relationship between emotional control and executive functions as well as between gender and executive functions was determined by means of the Pearson correlation coefficient (Table 1). A significant positive correlation was demonstrated only between emotional control and some executive functions, namely, working memory, letter fluency and switching between stimuli.

TABLE 1
Correlations between Emotional Control, Gender and Executive Functions

	Working Memory	Inhibition	Letter Fluency	Design Fluency	Switching
Emotional Control	.214*	-.023	.253*	-.018	.237*
Gender	.072	.039	.091	-.004	-.038

$p<0.05$

It could be stated that the more a pupil is able to control his/her emotions, according to the teacher's report, the more items can be kept in his/her working memory, more verbal products can be produced and the pupil can move from one task to another relatively quickly. These relationships, however, apply only to a certain extent, due to the fact that the correlations were, despite their significance, very weak.

The relationship between gender and executive functions has not been established, i.e. no differences between boys and girls in the selected executive functions were found.

The relationships between the variables were then analysed by means of regression analysis, which indicates to what extent variables such as gender and emotional control predict variability in a range of particular executive functions. The results are presented in Tables 2 to 4. Following are the results of the dependent variables of working memory, letter fluency, and design fluency. Regression models with inhibition and switching between tasks as dependent variables demonstrated very similar results to the regression models given below; therefore they were not entered into the tables.

TABLE 2
The Regression Model Using the Stepwise Method with Working Memory as the Dependent Variable

		B	β	t	p
Step 1	Working memory (F_{total} (2,49)= 1,189; p= ,312); R^2=,041				
	Emotional control	,62	,19	1,45	,152
	Gender	1,39	,04	,34	,728
Step 2	Working memory (F_{total} (3,49)= 2,313; p= ,134); R^2=,039				
	Emotional control	2,09	,64	1,98	,062
	Gender	12,29	,40	1,50	,139
	Emotional control*Gender	-,92	-,64	-1,52	,134

TABLE 3
The Regression Model Using the Stepwise Method with Letter Fluency as the Dependent Variable

		B	β	t	p
Step 1	Letter Fluency (F_{total} (2,50)= 1,910; p= ,159); R^2=,075				
	Emotional control	,273	,240	1,696	,097
	Gender	1,213	,107	,754	,454
Step 2	Letter Fluency (F_{total} (3,50)= 1,460; p= ,366); R^2=,232				
	Emotional control	-,195	-,171	-,423	,674
	Gender	-2,832	-,249	-,826	,412
	Emotional control*Gender	,298	,590	1,208	,232

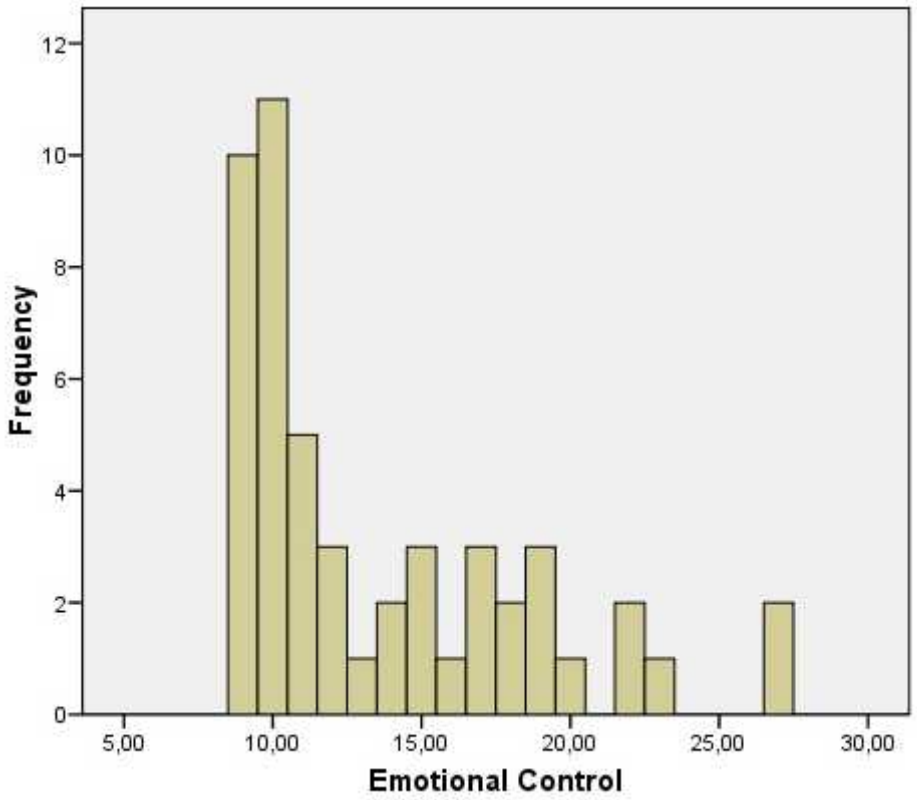
TABLE 4
The Regression Model Using the Stepwise Method with Design Fluency as the Dependent Variable

		B	β	t	p
Step1	Design fluency (F_{total} (2,50)= ,073; p= ,929); R^2=,003				
	Emotional control	-,009	-,011	-,078	,939
	Gender	-,422	-,053	-,363	,719
Step 2	Design fluency (F_{total} (3,50)= ,568; p= ,455); R^2=,012				
	Emotional control	-,290	-,365	-,742	,462
	Gender	-2,847	-,359	-,832	,410
	Emotional control*Gender	,178	,507	,754	,455

The insignificant contribution of emotional control and gender to the individual executive functions can be observed in the individual regression models. The above regression models could generally explain only a small percentage of variance, i.e. variables like gender and emotional control, according to these models, predicted the variance in individual executive functions in fewer than seven per cent of cases. It can be stated that manifested emotional control, as perceived by the teachers, is only weakly correlated with the quality of pupils' executive functions measured by the performance tests.

There is, however, another possible explanation which is based on the spread of the teachers' answers to the BRIEF questionnaire items (Figure 1). In most of their evaluations they gave their pupils the lowest value score on the three-level scale, meaning most pupils had the lowest raw score of 9-10 (after adding scores of nine items related to emotional control). Thus, the majority of teachers rated students indiscriminately as emotionally stable with a high ability to control emotional responses. The low variability of the above values is thus a limitation in formulating definite findings about the relationship between emotional control and executive functions.

FIGURE 1
Distribution of Teachers' Reports on Emotional Control in the BRIEF Questionnaire Items



4. CONCLUSION

Research on the relationship of emotion and cognition has a long tradition and the correlation between the two is undeniable. However, due to the high subjectivity of both constructs, the specifics of this relationship are not entirely clear. Interaction of emotions and cognition can be observed in the learning process when knowledge acquisition, but in particular, knowledge demonstration is often accompanied by positive or negative emotional responses. The learning process should be aimed at developing the cognitive but also affective characteristics of students. The complexity of the developmental dimensions can help a pupil in successful adaptation to the environment, in solving problems, or in motivation.

The results of our research did not confirm a direct relationship between emotional control and executive functions. One explanation is that the relationship of these constructs is not linear; as is the case with stress affecting performance according to the Yerkes - Dodson law, which explains such a relationship with a curve of an inverted U shape. According to this, to be able to perform better one needs a certain degree of stress, but excessive stress reduces levels of performance. A certain difference is also expected depending on whether the student is experiencing positive or negative emotions. In the follow-up research, it would be necessary to analyse the adequacy of using the BRIEF questionnaire, which is primarily intended for clinical practice in which there is greater suspicion of

underperformance in executive functions and related cognitive processes. Although in the area of clinical practice this questionnaire proved to be valuable, its use in the assessment of the general population of pupils by teachers seems to be questionable.

The reason may be in the low motivation of teachers to discriminate amongst the normal population of children. The problem could also be in its rather small response scale (three-point), which poorly differentiates this type of population.

The differences in executive functions between boys and girls have not been confirmed by our research. This result is in agreement with the conclusions of the study by Welsh et al. (1991) Research confirming gender differences in cognitive areas focuses more on the adolescence period in which, under the influence of physiological changes, greater changes manifest themselves in the cognitive area.

We will attempt to remove these above limitations in our next research in which we would like to contribute to a better understanding of the researched question. This, we believe, would be of value both in educational practice as well as in the pupils' learning.

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BIODATA

Monika Bobáková, lecturer and researcher at the Faculty of Education, University of Presov. Field of interest: emotions, coping, cognitive abilities and gifted children. She can be contacted at monika.bobakova@unipo.sk.

Miriam Slavkovska, lecturer and researcher at the Department of Psychology, Faculty of Arts, University of P. J. Safarik, Slovak Republic. She is interested in the assessment and treatment of patients with cognitive deficits as a result of degenerative diseases and can be contacted at miriam.slavkovska@upjs.sk.

Ivan Ropovik, researcher at the Faculty of Education, University of Presov, Slovak Republic. His field of interest covers measurement and methodology and he can be contacted at ivan.ropovik@unipo.sk.

Iveta Kovalcikova, associate professor, researcher at the Faculty of Education, University of Presov, Slovak Republic. Her field of expertise is assesment of cognitive capacities of pupils in elementary school.

Jan Ferjencik, researcher at the Department of Psychology, Faculty of Arts, University of P. J. Safarik, Slovak Republic. Field of interest: statistics, human resource management jan.ferjencik@upjs.sk.

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