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How Executive Function Predicts Participation in Activities Outside of School in Children with Specific Learning Disability

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Abstract

Background: Children with specific learning disabilities (SLDs) face various problems in occupational performance. They also exhibit weaker performance in executive functions (EFs) compared to normal children.

Objectives: This cross-sectional study was conducted to investigate the predictive effect of EF as the most important cognitive factor influencing participation in activities outside of school in children with SLD.

Methods: Children between 7 and 11 years of age with SLD (n = 106) were selected using the convenience sampling method from the special education centers of the Ministry of Education. The Children Participation Assessment Scale-Parent version (CPAS-P) and Behavior Rating Inventory of Executive Function (BRIEF) were used for data collection. Data were analyzed by running Pearson correlation coefficient and simple linear regression.

Results: The correlation between EF and diversity of leisure ($P < 0.05$), diversity of education ($P < 0.05$), and frequency of education ($P < 0.05$) was significant. Additionally, according to the results of regression analysis, the total score of EF can predict the frequency of education and diversity of leisure.

Conclusions: It could be expected that in children with SLD, poor EF might lead to the demonstration of diverse leisure activities. Furthermore, the EF deficits in children with SLD increase the likelihood of participation in more extracurricular educational activities. It seems that addressing EF problems in these children can probably help them focus more on their leisure time and reduce the need for extracurricular activities.

Keywords: Executive Function, Participation, Specific Learning Disability

1. Background

Specific learning disabilities (SLDs) are developmental disorders related to school age, characterized by a reduced ability in academic school activities and observed in children who have normal intelligence. The prevalence of this disorder is 5 - 15% among school-age children. The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) shows a conceptual change in the diagnostic criteria of learning disabilities, shifting from medical terminology to a definition that includes children's problems in occupational performance and activities of daily living (ADL) in the community, school, and home (1).

Studies show that children with SLD have limitations in the areas of self-care, productivity, and leisure. In the latest definition of SLD, in addition to academic activities, participation in other activities is emphasized (2). In children with SLD, participation in daily routine activities and the satisfaction of their parents is lower than that of normal children (3). These children do not

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have suitable social participation with their peers (4). Previous studies have shown that children's participation in purposeful out-of-school activities leads to increased participation in school and suitable social relationships with other children (5).

According to the International Classification of Functioning, Disability and Health (ICF), participation is defined as “involvement in a life situation”. It also emphasizes the executive function (EF) problems of children with SLD. In this classification, EF is considered an important component in occupational performance, which directly interacts with the participation of the individual. This model also explains the effect of SLD on participation and occupational performance in daily activities (6). The EF is a group of high-level brain processes that guide one’s cognition and behavior towards a specific goal (7). It is defined as the components that enable an individual to engage in purposeful, independent, and self-fulfilling behaviors (8). These higher levels of cognitive abilities allow a person to adapt to new situations and achieve goals (7). Children with SLD have deficits in EF and different cognitive skills compared to normal children (9, 10).

In children with SLD, academic achievement is influenced by cognitive functions (11). Evidence shows that the EF of children with SLD has many problems and plays a crucial role in their cognitive functions as well (2, 12-15). For instance, Moll et al. examined the cognitive risk factors associated with reading and math disorders (16), and Toll et al. investigated the predictive effect of EF on children's math problems (17). According to previous studies, the role of EF in academic problems is more focused on other areas of occupation, such as self-care, and social and leisure activities (18). Yet, EF is an ability that affects all areas of a child’s life.

Up to now, the effect of EF on ADL has been shown in normal children (19). Meanwhile, the ultimate goal in the rehabilitation of children with various disabilities is to maximize their participation in various areas of life. Despite the increasing number of studies on children's participation, there are few studies on the participation of children with various disabilities, especially children with SLD, and on identifying effective interventions.

Therefore, the question is which areas of daily activities are influenced by EF. To our knowledge, considering theoretical concepts, this effect can be hypothesized, but there is not sufficient scientific evidence (19). Previous studies have not investigated the relationship between EF and participation in different areas of participation in real-life situations in children with SLD. In fact, in recent years, considering the importance of this subject, as mentioned above, and the importance of participation as the outcome of rehabilitation (18), conducting the present study seemed necessary.

2. Objectives

As a result, the current study was carried out to investigate the role of EF in the participation of children with SLD in the real environment. We aimed to determine which areas of occupation are affected by EF.

3. Methods

This cross-sectional study aimed to investigate the predictive effect of EF as the most important cognitive factor influencing participation in activities outside of school in children with SLD. Ethical permission was obtained from the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC.1398.409), and written informed consent was obtained from every parent.

3.1. Participants

Using convenience sampling, 106 children (53 boys and 53 girls) with SLD were selected (age: 7 - 11 years old). They were selected from the special education centers for students with SLD affiliated with the Ministry of Education of Tehran. Since students with SLD from all public schools in Tehran have been referred to these centers, it is safe to state that the sample of the current study represents the entire population of students with SLD. The inclusion criteria for parents were: (1) They were able to read and write, and (2) they had no severe psychiatric disease based on a psychiatrist's decision. The children were diagnosed with SLD by a psychiatrist and a psychologist using the Wechsler Intelligence Scale and teacher-made tests, and (3) the child was between 7 and 11 years old. The samples were considered ineligible if they (1) had a minor or major neurological dysfunction.

3.2. Procedure

Data were collected between April and July 2020 from different rehabilitation clinics in Tehran, Iran. After verifying the inclusion criteria, the research and its

objectives were comprehensively explained to the parents before they signed the consent form. Next, they completed the questionnaires. Parents filled out the Behavior Rating Inventory of Executive Function (BRIEF) and the Children Participation Assessment Scale-Parent version (CPAS-P) in activities outside of school. The researcher was present when the parents completed the questionnaire to guide them if they encountered any problems with the concepts of the items, ensuring that the questionnaires were filled out completely. The time required to complete the questionnaires was 45 minutes.

3.3. Instruments

3.3.1. Behavior Rating Inventory of Executive Function

This instrument focuses on assessing EFs in the child's real life and is designed for the age range of 6 - 18 years for disorders such as SLD, attention deficit and hyperactivity disorder, developmental disorders, traumatic brain injury, depression, and other developmental and neurological lesions. We used the parent's version of the BRIEF, which consists of 86 items. The sum of these two indexes shows the total score of the Global Executive Composite (GEC). In addition to the mentioned scales, the BRIEF has two indexes and eight scales of problem-solving, attention, reasoning, organization, programming, memory, inhibited control, and impulse control. It also includes scales to indicate the absence of psychiatric illness in parents (Negativity Scale) and the validity of the answers (Inconsistency Scale). The questionnaire items are scored as never (1), sometimes (2), often (3); a higher score indicates more EF deficit. For this version, the Cronbach's alpha coefficient for the whole test was calculated to be 0.86. Additionally, the Pearson correlation coefficients for BRI and MCI were 0.81 and 0.83, respectively. The total score was found to be 0.80 (20). The Persian version of BRIEF2 had good reliability (internal and test-retest) and satisfactory to good validity (convergent and construct) (21).

3.3.2. Children Participation Assessment Scale-Parent Version

The CPAS-P, developed by Amini et al., consists of 71 items categorized into eight domains, including ADL, Instrumental ADL, leisure, education, play, social participation, work, and sleep/rest. For each activity item in the questionnaire, the performance of the activity by the child, the number of times he/she participates, who the activity is performed with, the level of enjoyment, and the level of parental satisfaction are assessed. In the present study, the score of diversity of the activities [doing (1); not doing (0)] and the frequency of doing them (the number of times during a day, week, or month) were used. Overall, Cronbach's alpha for the participation measures ranged between 0.87 and 0.91, indicating good homogeneity (22).

3.4. Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 21 was used for all analyses. The normality distribution was determined. The correlation between EF and participation was calculated using the Pearson correlation coefficient, and for data with a significant correlation coefficient, simple linear regression was used to show the predictive effect of the independent variable. A P-value < 0.05 was accepted as the level of significance.

4. Results

Participants' demographic information is presented in Table 1. As shown in the descriptive characteristics in Table 2, among the participation variables, the highest mean is related to the frequency of ADL, and the lowest mean is related to the diversity of work.

4.1. Diversity of Leisure and Frequency of Education Outside of School

The Pearson correlation coefficient showed a statistically significant relationship between the total EF score and the diversity of leisure, as well as the diversity and frequency of education (Table 3). Additionally, simple linear regression analysis demonstrated that EF has a significant impact on predicting the diversity of leisure ($R^2 = 0.3$, $P = 0.2$), with its regression equation found to be $Y = 0.022 \times X + 7.85$. Moreover, EF significantly affected the prediction of the frequency of education ($R^2 = 0.3$, $P = 0.2$), with the regression equation calculated as $Y = 0.024 \times X - 0.277$. There was no significant relationship between EF and other variables in the Participation Questionnaire.

5. Discussion

In the present study, we investigated the predictive relationship between EF and participation in activities

Table 1. Demographic Information [a]

Variables	Participations (N = 106)
Gender	
Male	53 (50.0)
Female	53 (50.0)
Grade	
First	33 (31.1)
Second	36 (34.0)
Third	24 (22.6)
Forth	11 (10.4)
Fifth	2 (1.8)
Age (y)	8.56 ± 1.18

[a] Values are expressed No. (%) or mean ± SD.

Table 2. Descriptive Data for All the Variables

Variables	Min-Max	SE	M ± SD
GEC	9 - 188	2.97	130.48 ± 30.60
Diversity of activity of daily living	5 - 11	0.12	9.88 ± 1.21
Frequency of activity of daily living	25 - 75	0.85	54.98 ± 8.75
Diversity of instrumental activity of daily living	1 - 10	0.20	7.57 ± 2.02
Frequency of instrumental activity of daily living	0 - 65	1.15	35.07 ± 11.87
Diversity of play	2 - 13	0.26	8.53 ± 2.63
Frequency of play	6 - 69	1.20	34.13 ± 12.32
Diversity of leisure	2 - 16	0.31	10.73 ± 3.18
Frequency of leisure	11 - 66	1.28	37.02 ± 13.17
Diversity of social participation	0 - 12	0.26	5.63 ± 2.70
Frequency of social participation	0 - 39	0.69	12.13 ± 7.11
Diversity of education	0 - 4	0.09	0.85 ± 0.91
Frequency of education	0 - 14	0.33	2.85 ± 3.39
Diversity of work	0 - 2	0.04	0.92 ± 0.39
Frequency of work	0 - 8	0.21	5.09 ± 2.11
Diversity of sleep/rest	1 - 3	0.04	2.84 ± 0.46
Frequency of sleep/rest	5 - 18	0.32	16.25 ± 3.29

Abbreviations: min, minimum; max, maximum; SE, standard error; M, mean; SD, standard deviation; GEC, Global Executive Composite.

outside of school in students with SLD. The findings indicated that there are significant relationships among EF, diversity of leisure, and education, as well as between EF and the frequency of educational activities. Additionally, EF predicts the diversity of leisure and the frequency of leisure activities. The findings demonstrated that poor EF might lead to a poor diversity of leisure activities experienced by the child. When EF skills increase, the ability to make independent choices and plan/organize activities increases as well (23). As EF increases, the child chooses to participate only in activities of interest, so the diversity of leisure will probably decrease too. Evidence shows that people with SLD have difficulty managing time for leisure activities. Grinblat and Rosenblum stated that managing daily routine activities requires organizing activities within the framework of time, and children with SLD face time management problems (24). The nature of leisure activities is that they are selected and guided by the child in his/her free time (25). In children with SLD, greater weakness in the ability to manage time, as well as planning and organizing activities (26), results in parents' suggestions to fill their leisure time;

Table 3. Correlations Between Subscale Scores of the Children Participation Assessment Scale-Parent Version, Global Executive Composite, and Behavior Rating Inventory of Executive Function

Variables	GEC	
	P	r
Education		
Diversity	0.03 [a]	0.20
Frequency	0.01 [a]	0.22
Leisure		
Diversity	0.02 [a]	0.22
Frequency	0.30	0.10
ADL		
Diversity	0.75	0.03
Frequency	-0.38	-0.09
IADL		
Diversity	0.24	0.11
Frequency	0.83	0.02
Play		
Diversity	0.21	0.12
Frequency	0.87	0.02
Social participation		
Diversity	0.05	0.21
Frequency	0.06	0.19
Sleep/rest		
Diversity	0.18	0.13
Frequency	0.92	0.01
Work		
Diversity	0.50	0.07
Frequency	0.30	0.10

Abbreviations: GEC, Global Executive Composite; ADL, activity of daily living; IADL, instrument of activity of daily living.

[a] Correlation is significant at the 0.05 level.

consequently, (10) the children are directed to a greater variety of activities.

In addition, children with SLD have obvious dysfunctions in attention and memory. Attention deficit disorder is the most common disorder in these children (25). Low attention may result in the child's lack of sufficient concentration to engage in and complete an activity, causing him/her to shift to another activity without completing the first one. As a result, a child with an EF deficit is more likely to have a higher variety of leisure activities in his/her free time. According to the findings of the present study, the EF deficits in children with SLD increase the likelihood of participation in more extracurricular educational activities. In the CPAS, these activities include having a private tutor, art classes, sports, and social skills training classes. Bryan et al. found that children with SLD had more problems doing homework compared to normal children. Attention and memory problems in children with SLD necessitate supervision while doing their homework (25). This issue probably prompts parents to seek help from a private tutor to supervise the child. Additionally, due to these children's communication problems, participation in social skills classes or group therapy is often recommended by the teacher or therapist (4). It is also argued that sports or music are effective in improving children's EF (27, 28), and children with low EF are recommended to participate in sports and art classes. Thus, in the current study, we found that when the child encounters more problems while participating in daily activities due to EF deficits, parents feel the need to enroll their children in extracurricular classes.

The findings showed that there was no relationship between EF and the diversity/frequency of ADL, IADL, social participation, play, work, and sleep/rest. In the

only similar study that investigated these relationships in normal children (19), no relationship was observed between these variables either. The EF is often involved in activities that require complex and high-level brain processes; however, IADL, ADL, play, and sleep/rest are often performed by the child routinely and do not require complex cognitive skills (8). Some studies, however, reported findings incompatible with ours. For instance, they showed that there is a correlation between ADL and IADL and EF in neurological and cognitive disorders (29-31). This may be explained by the fact that children with SLD suffer from a mild cognitive deficit that may not affect their ADL or IADL.

The present study did not clarify the relationship between social participation and EF. A cursory review of the literature reveals that a variety of non-cognitive factors may be considered in social participation in children with SLD, who experience continuous failures in their social interactions with peers (4) and in academic achievement (32). The work section in CPAS includes two subtests: Doing homework and doing hourly-paid work, both of which are compulsory tasks, and therefore, children with high or low EF ability have to perform them (22), so this correlation is not expected to be significant. Also, due to the challenges that children with SLD face while doing homework, families usually guide and supervise them (10); as a result, EF skills are not used abundantly.

5.1. Conclusions

In children with SLD, EF deficits lead to greater diversity in leisure activities as well as diversity and frequency of educational activities outside of school. Additionally, the overall ability of EF can predict the diversity of leisure and the frequency of educational activities outside of school. These findings suggest that paying attention to EF in children with SLD may lead to optimal participation in terms of the diversity and frequency of activities they like to do, such as leisure activities, or need to do, like educational activities.

5.2. Limitations

One limitation of the present study was that, due to the high number of items, many parents were reluctant to fill out the questionnaire. In addition, we were only allowed to distribute the questionnaire in state-run centers. The centers run by the private sector did not accept our request to carry out the study. Given that in this study all types of learning disabilities (reading, math, and writing) were studied, we cannot compare them, and it is suggested that in future studies the participation of children with SLD be compared with their type of learning disabilities as well.

5.3. Further Research

Further studies are recommended to assess the possible effects of other factors on the participation of children with SLD. It is also recommended that the impact of EF components be studied on different factors of participation. Moreover, it seems necessary to study the correlation between EF and participation in adolescents due to the importance of people's participation in society.

Footnotes

Authors' Contribution: Study concept and design: F. H. and M. K.; Analysis and interpretation of data: S. K. M. and Z. P. A.; Drafting of the manuscript: M. P.; Critical revision of the manuscript for important intellectual content: F. H., M. K., and M. P.; Statistical analysis: F. K.

Conflict of Interests Statement: The authors declare no conflict of interest.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after its publication.

Ethical Approval: The permission of the University Ethics Committee was received (IR.SBMU.RETECH.REC.1398.409).

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