

Depression and learning problems in children: Executive function impairments and inattention as mediators

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ARTICLE INFO

Keywords:

Child depression
Executive functions
Learning problems
Inattention

ABSTRACT

This study examines the relationship between depression and learning problems in children, focusing on the mediating role of executive function impairments and inattention. A sample of 115 children, aged 7 to 12 years, who had difficulties in school activities, were tested over the past three years, with different measures assessed by different raters. Regression analyses were employed in analyzing the data. The psychometric tests used were *Child Depression Inventory (CDI)* and *Conners 3rd Edition*. Children with a high level of depressive symptoms have also a very high level of learning problems, executive function impairments and inattention. Executive function impairments and inattention add significant explanatory variance for learning problems in school-aged children over and above depression. Executive function impairments and inattention have a partial mediating effect on the relationship between depression and learning problems. The assessment of the executive functions and attention is an important part in the assessment of children with depression; intervention and treatment programs for depression should include components focused on executive functions and attention.

1. Introduction

The relationship between depression and learning problems in children is well established. The fact that depression in children is associated with learning problems, that in turn coexist with cognitive deficits, particularly executive function (EF) and attention impairments, is well supported by the research literature. We know that learning requires not only cognitive abilities, but also affective skills, like self-regulation (Sung & Wickrama, 2018). We also know that executive functions (EF), the mental control processes needed to carry out goal-directed behaviors (Dajani, Llalbre, Nebel, Mostofsky, & Uddin, 2016) and to allow self-regulation (Richards, Vernucci, Stelzer, Introzzi, & Guàrdia-Olmos, 2018), are important for the successful functioning of children, both in learning activities and in social interactions. The current paper argues that not only are learning problems, EF, and inattention highly correlated and co-morbid, but the path from depression to learning problems actually leads through (i.e., is mediated by) EF and inattention. Furthermore, the current paper argues that depression is a predictor (antecedent) of all these three phenomena, thus establishing a serial mediation model, from depression, through EF and inattention and further to learning problems.

1.1. Executive functions, inattention and learning problems

Learning problems are highly correlated both with executive function impairments (Best, Miller, & Naglieri, 2011; Sung & Wickrama, 2018) and with inattention (Commodari, 2012; McClelland et al., 2007). This idea is supported both based on causal relationships (with learning as an effect of the other two constructs) and based on partial content overlap of the three.

Executive functions and learning problems. Executive functions (EF) and self-regulation are two of the main predictors of learning and academic achievement (Sung & Wickrama, 2018). The direct contribution of EF to academic achievement, especially to reading and math has been confirmed in longitudinal studies (Best et al., 2011). Self-regulated learning, characterized by persistence in tasks, attentiveness, and eagerness to learn (García, Rodríguez, Betts, Areces, & González-Castro, 2016), comprises behaviors, dispositions and affective skills that reflect the child's ability in managing behaviors, emotions, motivation, and attention for learning (Sung & Wickrama, 2018), and children with better self-regulation in learning show higher academic achievement, both in reading and in math (Welsh, Nix, Blair, Bierman, & Nelson, 2010).

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<https://doi.org/10.1016/j.actpsy.2021.103420>

Received 17 December 2020; Received in revised form 15 September 2021; Accepted 16 September 2021

Available online 27 September 2021

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Inattention and learning problems. The relation between (in) attention and learning performance is supported in the literature, attention playing a pivotal role in learning (Commodari, 2012). Since attention plays an important role in information processing, children with attention deficits often have difficulties in reading, writing and math. Chen, Zheng, and Ho (2019) found out that the composite score of visual attention span significantly predicted word reading accuracy and fluency (Chen et al., 2019). Other studies show that attention skills contribute significantly to math skills, emergent literacy, and vocabulary (McClelland et al., 2007).

EF and inattention. Some of the components of inattention are also components of EF and vice-versa, and impairment in an EF component may also lead to impairment in attention (Willcutt et al., 2005). According to the revised Baddeley model of working memory, the central executive has a major role in attention switching (Hester & Garavan, 2005). All the major facets of EF (planning for goals, inhibiting maladaptive responses, maintaining, and manipulating information in working memory, and flexibly adapting behaviors to environment) play a role in this relationship (Dajani & Uddin, 2015). In this respect, the current paper suggests that impairments in EF will lead to inattention, since studies show that the increased salience provided to the contents of working memory through active rehearsal exerts a content-specific influence on attentional control (Hester & Garavan, 2005).

Both EF impairments and inattention are associated with learning problems, particularly academic struggles in reading, writing and/or math, since children have difficulties starting or finishing projects, have the tendency to complete projects at the last minute, and have poor planning and organizational skills, which will affect his/her learning process (Espy et al., 2004; Hachmann et al., 2014). The current study therefore argues that learning problems in elementary school children are a consequence of EF impairments and inattention.

1.2. Depression and learning problems

Depression in children has become a public health concern due to its early onset and strong impact on children and their families. In the USA, the 2016 National Survey of Children's Health (NSCH) reports 1.78% of children aged 3 to 11 years diagnosed with clinical depression (Ghandour et al., 2019). International studies suggest that 5% of pre-pubertal girls and 1.5% of pre-pubertal boys manifest clinical depression (Gianakopoulos et al., 2009). The prevalence of specific learning disabilities (dyslexia, dysgraphia, and dyscalculia) across different languages and cultures ranges from 5 to 15% in school-aged children (Khodeir, El-Sady, & Mohammed, 2020).

The relationship between depression and learning problems in children is evidenced and a recent meta-analysis (Brunelle, Abdulle, & Gorey, 2020) concluded that 56% of students with learning disabilities scored higher on validated measures of anxiety and depression than did children without learning disabilities (Brunelle et al., 2020). Children with clinical depression are seriously under functioning below their intellectual capacity (Frommer, 1968), and the parents attempt to solve the school struggles by giving supplementary tutoring to the child increases the depression, as in contrary the treatment of depression increases the child's academic performance (Hollon, 1970). On the other hand, children with learning disabilities have a lower self-concept, and higher levels of depression (Al-Yagon, 2014), peer rejection and loneliness (Estell et al., 2008) compared to typical children.

1.3. Depression and executive functions

The child with depression may become unable to complete tasks that require high level cognitive skills, may experience negative emotional states, as feeling confused and overwhelmed or easily frustrated, because the child's emotional states influence learning and achievement by affecting his/her cognitive processes (Forgas, 2017). Emotions have an important role in the storage and retrieval of information (Ouherrou,

Elhammoumi, Benmarrakchi, & El Kafi, 2019), affect the child's way of thinking, the quality of information processing, attention, working memory and problem solving (Forgas, 2017; Vilgis, Silk, & Vance, 2015). On the other hand, EF in children, especially global EF and working memory scores, directly predict academic and occupational functioning (Miller et al., 2012).

The relationship between depression and EF impairments is bidirectional, impaired EF may lead to depressive symptoms, "but those symptoms in turn likely further compromise EF development, resulting in an EC psychopathology cycle of deteriorating functioning over time." (Nelson et al., 2018, p. 9). A meta-analysis on the neuropsychological functioning of children and adolescents diagnosed with depression, found that these children have a pronounced EF weakness in verbal fluency, inhibition, set-shifting and planning (Wagner, Müller, Helmreich, Huss, & Tadić, 2015). Brain neuropsychology may explain why depression and EF impairments co-exist. Neurological studies using functional Magnetic Resonance Imaging (fMRI) showed that children and adolescents with a history of rejection from peers become sensitive to new experiences of rejection, and also manifest an activation at the level of the anterior prefrontal cortex (Will, van Lier, Crone, & Güroglu, 2016).

The current study contributes to this line of research by using a sample of elementary school children with important cognitive, emotional, and behavioral impairments, and showing that depression is an important risk factor for learning problems, both standalone and in conjunction with EF impairments and inattention.

1.4. Depression and inattention

Depression in children is associated with attentional issues, since children tend to be more focused on their emotional difficulties and become less curious to explore new things (Morris et al., 1981). Brain neurology studies also show important connections between attentional circuits and the emotional brain. When comparing depressed adolescents to healthy controls using functional magnetic resonance imaging (fMRI), research has found that depressed adolescents who had attempted suicide manifested increased brain activity in attention control circuitry when they were exposed to angry faces, and reduced anterior cingulate gyrus-insula functional connectivity, which means they had a lower capacity to regulate attention when processing emotionally strong stimuli (Pan et al., 2013). Other recent empirical studies (e.g., Bernad, Servera, Grases, Collado, & Burns, 2014; Sarkisian, Van Hulle, & Hill Goldsmith, 2019) always concluded that children diagnosed with attention-deficit hyperactivity disorder (ADHD) – inattentive type and with sluggish cognitive tempo (SCT) show depression and important impairments in academic performance.

1.5. Limitations in previous studies

Our study identifies two limitations in previous research: the fact that most studies on this topic are conducted on community samples ("typical" children), and the fact that most studies use for the measurement of their variables only self-assessments by children. The current study has addressed both these limitations through the sample and design of our study.

First, as noted, most studies examining the relationship between EF and depression in children are conducted on community samples (i.e., "typical" children), not on children with clinical and educational issues. For example, Nelson et al. (2018), conducted a longitudinal study on 280 children, tested in kindergarten at age 5 and in elementary school 5 years later. They concluded that executive control (EC) in preschool years is a predictor for child depression and anxiety in primary school (Nelson et al., 2018). The authors used typical children, recruited through a flyer distribution in a small American city, and the children diagnosed with developmental, or language delays were excluded from the sample.

This study used a general education sample of elementary school children already identified with important difficulties in school activities, emotional issues, and behavioral problems, referred for evaluation by teachers and parents because they fail in school. This approach is more focused on the interconnection of the emotional and neuro-cognitive impairments of the already affected children and can deepen the previous research findings. The current study argues that depression, EF and (in) attention are a critical aspect needed to be assessed in these children. If the child is identified with depression and/or EF and attention impairments, then a prevention program can be designed in order to improve both his/her cognitive abilities and his/her emotional regulation processes. Such a program should prevent the development of learning problems and school failure in elementary school children.

Second, the present study measured the children's learning problems, EF impairments and attention from the teacher point of view, and their emotional problems from the parent point of view. This means that our study employed multiple raters, every construct being evaluated by a different rater; our measurement approach increases the validity of our study and adds to previous studies, first by eliminating common-method bias (that occurs when all of a study's variables are measured through the same method, using the same raters) and because of focusing on observer-ratings by significant adults, who may be better able in community and school contexts to estimate a child's cognitive and emotional difficulties that are stable and consistent in time. The authors acknowledge that no assessment method is free of bias; while self-ratings have been highly criticized in this context, observer-ratings may induce their own flavor of bias, with parents and teachers likely to respectively over-rate or under-rate a child's performance. Still, we may consider our approach to be innovative in the literature and rarely encountered, likely also due to the difficulty of collecting data in this manner.

Most previous studies have only used self-ratings of children in their measurement of children's cognitive and emotional difficulties. Nelson and his colleagues (2018) used the child's perspective for both variables: children completed a battery of nine developmentally-appropriate tasks designed to measure major aspects of EC, and also the self-report Child Depression Inventory (CDI-2) (Nelson et al., 2018). Weber and her colleagues (2018) also adopted a child-only assessment perspective, by testing the level of depression with the self-report Child Depression Inventory (CDI-2) and the EF impairments using performance task as the Stroop Color and Word Test: Children's version (Stroop C—W), Trail Making Test-Part B (TMT—B) and Controlled Oral Word Association Test: FAS Condition (COWAT-FAS) (Weber, Studeny, Kavanaugh, et al., 2018). Using child self-rating and performance tasks is the most widely used approach in the research literature on this subject, but this approach may easily induce biases since the main characteristic of these children is instability in time both cognitive performance and emotional states.

Teacher and parent rating scales are widely used measurement methods in the assessment of attentional and executive function impairments in children (Sáez, Servera, Burns, & Becker, 2019), especially when these impairments are frequently associated with externalizing and disruptive behaviors. Most of these impairments appear in the context of ADHD, where teachers and parents are considered the most reliable and valid evaluators (Smith et al., 2018). Even if there is no comorbidity with ADHD, a recent meta-analysis showed that the vast majority of studies on the sluggish cognitive tempo (SCT, i.e., a combination of EF impairments and attentional symptoms characterized by excessive daydreaming, mental confusion or foggy, drowsiness, and slowed behavior/thinking) used parent and teacher ratings (Becker et al., 2016). Smith and Langberg (2017) concluded that parent-rated and teacher-rated measures predicted multiple aspects of academic impairments in children with SCT (Smith & Langberg, 2017), and Becker found that high symptoms of SCT are associated with poorer self-report validity on academic functioning (Becker, Luebbe, & Joyce, 2015).

One important rationale for this approach is that if the child has EF and attentional impairments, the child's performance on tasks is unstable

over time and a one-time measurement cannot reflect the severity and the frequency of the symptoms, but only the child performance at the exact time of the test. So, it's known that attentional and executive function impairments fluctuate in time and need to be evaluated reporting to a larger period, like one month. Another rationale is that the teacher is the most adequate person to evaluate the attentional and cognitive performance of the child in time, since he/she works with the child in the classroom for 4 or 5 h per day, every weekday. So, the teacher's assessments on the child's cognitive and attentional performance are valid in time and more accurate. Also, the parent is the person that can evaluate the child's depressive symptoms in time since the parent spends several hours per day everyday with the child.

1.6. The current study

This study examines the relationship between depression, EF impairment, and inattention, as correlates for the level of learning problems in school-aged children. In light of the previously discussed literature the present study advances 3 research questions.

First, the authors argue for the idea that depression in school-aged children with learning problems may be related with EF impairments and inattention.

Research question 1: Is depression significantly related with impairments in executive function and inattention in children with learning problems?

Second, the authors argue that it is likely that if a child with depression also has difficulties starting or finishing projects, completes projects at the last minute, and has poor planning and organizational skills (all of them results of EF impairments) and is inattentive, then the child will be at more risk to develop learning problems.

Research question 2: Does executive function impairments and inattention add explanatory variance for learning problems in school-aged children over and above depression?

Third, the authors argue that children with depression will struggle with EF impairments and inattention during their first school years, and that very fact will mediate the effects of depression on the development of learning problems.

Research question 3: Do executive function impairments and inattention mediate the relationship between depression and learning problems in elementary school children?

2. Methods

2.1. Participants

The current study uses data involving a sample of 115 children (80 males and 35 females) aged 7 to 12 years, referred for evaluation to an outpatient psychology clinic because they experienced emotional difficulties associated with learning problems. All participants are primary and secondary school children, grades 0 to 6, and were referred by their teachers or their parents for psychological evaluation during the past four years (2016 to 2019), based on observed difficulties in school activities. Children were all Caucasian, from families with average or high-income levels and had Romanian as their primary language. They were all from urban or metropolitan area of Bucharest. The children did not have a psychiatric diagnosis at the time of the psychological evaluation. After the assessment, the parents of all these children received a comprehensive assessment report focused on their emotional, cognitive, and behavioral impairments, and those children meeting the clinical criteria for a psychiatric diagnosis were referred to a psychiatrist. The psychological assessment was conducted by experienced clinical psychologists, at least with a MSc level, some of them with a PhD in clinical psychology. The evaluations were conducted over four years, from 2016 to 2019. No cohort effects from changes in measures, criteria, secular, or cultural trends are expected.

2.2. Measures

Depression. Depressive symptoms of children were assessed with the Romanian version of the *Child Depression Inventory (CDI) – Parent form* (Kovacs, 1992). The study used the CDI because the CDI-2 is not yet adapted to the Romanian culture. The CDI is a parent-report instrument and consists of 17 items, each evaluating a symptom of depression or related affect. Each item presents three statements of varying symptom severity. The 17 items are distributed across two basic scales: Emotional problems and Functional problems; these also sum up to a Total Depression scale. Respondents rate the items using a 4-point scale (*not at all* = 0, *sometimes* = 1, *frequently* = 2, and *in most of the cases* = 3). Internal consistencies ranging from 0.59–0.68 have been reported in the standardization sample (Kovacs, 1992). The test was adapted for the Romanian population (Sirbu & Iliescu, 2012). The level of depressive symptoms in the sample was above the mean, compared to the standardization sample for Romanian children aged 7-12: 62.4% had the Total CDI Score over $T = 50$ (cut off point of 11), and 32.8% had the Total CDI Score over $T = 65$ (cut off point of 17).

Executive functions. The study used the Romanian version of *Conners 3rd Edition, Teacher Form* (Conners, 2008), in order to evaluate impairment in executive functions, learning problems and the behavioral problems; executive functions were therefore rated by teachers. The *Conners Rating Scales* are a comprehensive assessment for ADHD and its associated problems and disorders in children aged 6 to 19 (Conners, Pitkanen, & Rzepa, 2011). The test was adapted for the Romanian population and is commonly used in main clinics in the country (Iliescu, 2013). The Executive functions scale of the Conners-3 has 7 items (e.g., “Starts an activity or a project without making a plan”), scored from 0 (“never true/never, rarely”) to 3 (“true/very frequently”).

Learning problems were measured with the Learning problems scale of the *Conners 3rd Edition, Teacher Form* (Conners, 2008). The Learning problems scale has 6 items (e.g., “Doesn't remember what he/she reads”), scored from 0 (“never true/never, rarely”) to 3 (“true/very frequently”). The scale identifies struggles with reading, spelling and/or math and difficulties in remembering concepts.

Inattention was measured also with the *Conners 3rd Edition, Teacher Form* (Conners, 2008). The Inattention scale has 10 items (e.g., “Can maintain attention only for short periods of time”), scored from 0 (“never true/never, rarely”) to 3 (“true/very frequently”).

2.3. Procedure

Written informed consent forms were signed by the parents of all children included in the study. The *Child Depression Inventory (CDI) – Parent form* was administered individually to every parent by a clinical psychologist. The *Conners 3rd Edition, teacher form*, was sent to the teacher via children's parents, with an explanatory letter signed by the clinical psychologist, and after completion the parent bring back the test to the clinic.

The authors chose to base the present study on a multiple rater assessment procedure, obtaining data on different variables from different sources, i.e., from both parents and teachers, in order to strengthen the validity of our measurement and to avoid common-method variance. The predictor variable depression was measured through parent report (mostly by the mother), since the parents are the adults with the closer relationship with the child and they are more sensitive to the child's emotional difficulties. The mediators (executive function impairments, and inattention) and the criterion variable, learning problems, were measured through teacher report, since the teacher is the person who can best identify and evaluate best the child's cognitive and learning problems.

3. Results

3.1. Descriptive analysis

Mean scores and standard deviations for each measure are presented in Table 1.

3.2. Association with learning problems, EF impairments and inattention

Table 2 presents the correlations between variables. High levels of depressive symptoms were associated with a high levels of EF impairments ($r = 0.38, p < .001$), high levels of learning problems ($r = 0.41, p < .001$) and high levels of inattention ($r = 0.41, p < .001$). Those participants who have higher levels of depressive symptoms tend to also have higher levels of learning problems, EF impairment, and inattention. These findings support the first hypothesis.

3.3. The incremental validity of EF impairments and inattention

Table 3 presents the results of the of hierarchical multiple regression analysis predicting Learning problems from depression (Step 1), from depression and EF impairments (Step 2), and from depression, EF impairments and inattention (Step 3). The results show that step 3 brings supplementary predictive variance, i.e., that EF impairments ($B = 0.33, p < .001$) and inattention ($B = 0.29, p < .01$) adds significant explanatory variance for learning problems in school-aged children over and above depression ($B = 0.16, p < .05$).

3.4. The mediating effect of EF impairments and inattention

In order to analyze the mediating effect of EF impairments and inattention on the relationship between depression and learning problems, the study tested one serial mediation model. The relatively large age range (7 to 12 years) in our sample could potentially influence our results, as children in the lower range (7 years) may behave differently in relation with our focal variables than children in the upper range (12 years). In order to test this possibility, the authors have first conducted the serial mediation model by controlling for age as a moderator on all the mediation paths. The results showed no significant effect of age as a moderator for any of the mediation paths, with the only exception of the conditional total effect of depression on learning problems, that barely reaches a significance level of $p < .05$ ($p = .045$). The authors therefore concluded that the relatively large age range in our sample is unlikely to influence our results and proceeded with the serial mediation model.

In Step 1 of the mediation model, the path from depression to learning problems while ignoring the mediators was significant: $B = 0.11, t(109) = 2.03, p < .05$. Step 2 showed that the path from depression to learning problems, including the mediators, was also significant $B = 0.29, t(109) = 4.64, p < .001$. The mediation effect a $x d_{12} \times b = 0.24$, meaning that 18.20% of the effect of depression on learning problems is mediated by EF impairments and inattention, signaling the presence of a partial mediation effect. The mediation model is presented in Fig. 1 and the coefficients are reported in Table 4.

4. Discussion

Our study found that depressive symptoms in children are strongly

Table 1
Means and standard deviations for the study's variables.

	N	Minimum	Maximum	Mean	Std. Deviation
CDI Total Score	115	1.00	36.00	14.62	7.47
Learning problems	109	0.00	28.00	6.56	5.26
Executive function	110	0.00	23.00	9.97	4.65
Inattention	110	0.00	30.00	14.90	6.91

Table 2
Correlation coefficients between the study's variables ($N = 115$).

	1	2	3	4
1. Depression	–			
2. Inattention	0.41**	–		
3. Executive functions	0.38**	0.78**	–	
4. Learning problems	0.41**	0.62**	0.62**	–

** $p < .01$.

Table 3
Summary of hierarchical multiple regression analysis predicting Learning problems from Depression (Step 1), from Depression and Executive Functions (EF) impairments (Step 2) and from Depression, EF impairments and Inattention (Step 3) in school-aged children ($N = 109$).

Predictor	R^2	ΔR^2	β
Step 1	0.16	0.16***	
Depression			0.41***
Step 2	0.42	0.26***	
Depression			0.20**
EF impairments			0.55***
Step 3	0.45	0.03***	
Depression			0.16*
EF impairments			0.33**
Inattention			0.30**

* $p < .05$; ** $p < .01$; *** $p < .001$.

correlated with EF impairments, inattention and learning problems, that EF impairments and inattention adds significant explanatory variance for learning problems over and above depression, and that EF impairments and inattention have a partial mediation effect (18.20%) on the relationship between depression and learning problems. The findings linking depression, EF impairments and inattention are consistent with previous research (Snyder, 2013; Wagner, Alloy, & Abramson, 2015; Weber et al., 2018).

Our findings add to previous knowledge in this area. The incremental effect of EF impairments and inattention on the relationship between depression and learning problems in school children means that children with depression with both EF impairments and inattention may be more often associated with failure in academic tasks over time than other children. The present study also adds to current knowledge in terms of the mechanisms through which depression is linked with learning problems and therefore academic failure in primary school children, highlighting a partial mediation effect: when children experience

depressive symptoms, such as low self-esteem, depressed mood or feelings of inefficiency, these are also associated with EF impairments and inattention, and this may also be correlated with a negatively affected academic performance.

4.1. Theoretical and practical implications

The path depression – EF impairments – learning problems is consistent with previous studies, where not all children with depressive symptoms have an EF impairment; however, children who present with this comorbidity are at risk for more cognitive difficulties and significant psychiatric outcomes including prolonged hospitalizations (Weber et al., 2018). Other studies emphasize that children with higher EF are shown to be better in reading achievements and mathematic performances during the first grades (Sung & Wickrama, 2018), and children with low academic performance are shown to experience chronic rejection and therefore manifest decreased mood and need satisfaction (Will et al., 2016).

The investigated path is consistent with previous findings also because the main qualities of attention (stability, flexibility, focusing) are impaired in depression, being further also associated with impaired learning; children with depression have been shown to be more at risk to experience learning problems, such as difficulties in math (Espy et al., 2004), or impaired learning of reading (Hachmann et al., 2014) and writing (Shaul & Schwartz, 2014).

A number of practical implications also emerge from our results, in the domain of child clinical assessment and psychotherapy. First, when

Table 4
Mediation effect of Executive Functions impairments (EF) and Inattention (IN) on the relationship between Depression and Learning Problems (LP) ($N = 109$).

Regression paths	B	t	p
Mediation a_1 path (Depression on EF)	0.24	4.27	< .00
Mediation a_2 path (Depression on Inattention)	0.12	2.05	< .05
Mediation path d_{12} (EF on Inattention)	1.08	11.49	< .00
Mediation path b_1 path (EF on LP)	0.37	2.82	< .00
Mediation path b_2 (Inattention on LP)	0.22	2.51	< .05
Total effect c' path (Depression on LP; no mediator)	0.11	2.03	< .05
Direct effect c (Depression on LP, including EF and Inattention as mediator)	0.29	4.64	< .00
Indirect effect bootstrapped ($c - c'$) 95% CI	–0.18		

B = unstandardized coefficient; CI = confidence interval. Fit for EF model $R^2 = 0.40$, Adjusted $R^2 = 0.16$, $F(1, 109) = 21.56$, $p < .00$.

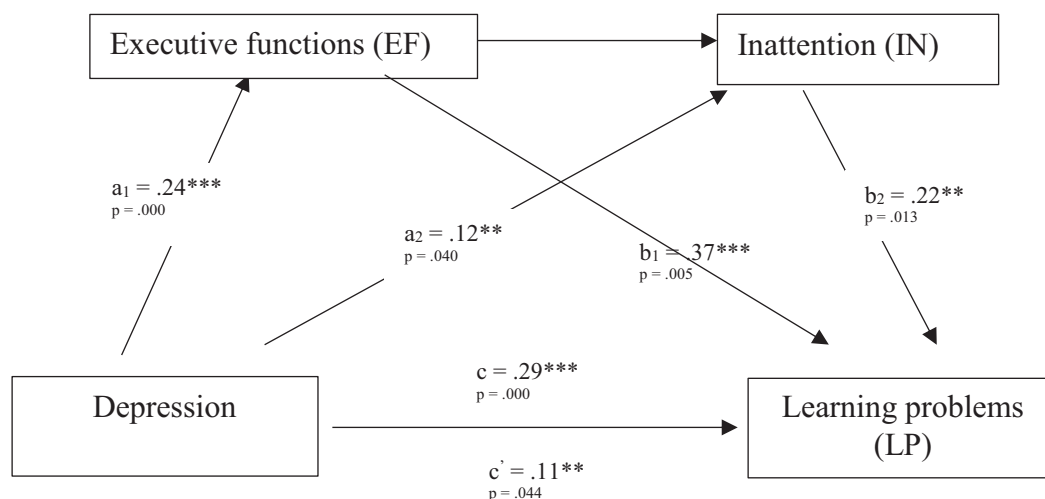


Fig. 1. Path analysis diagram showing the mediational relationship of Executive Functions impairments (EF) and Inattention (IN) mediating the effect of Depression on Learning problems (LP).

* $p < .05$. ** $p < .01$ *** $p < .001$.

assessing children with depression, clinicians should also include assessments of executive functions in the process. Second, treatments for depression in children should include a component focused on EF impairments and inattention; for example, treatments could continue to focus on emotion centered interventions, but could also comprise remedial activities targeted at executive functions and attention.

4.2. Limitations of the current study

One of the limitations of our study is the relatively modest sample size, of only 115 participants. The relatively small number of participants is an effect of the fact that all the children included in the sample were clinical cases, referred for assessment over a period of three years; conducting research on clinical population makes the accumulation of a large number of participants in a reasonable time span more difficult. Another important limitation is the cross-sectional nature of our study, that makes a robust investigation of causal effects impossible. The issue of common method variance present in cross-sectional studies is to some extent mitigated by the multiple rater design of our study. A third limitation is related to the use of subjective observer-ratings by significant adults: learning problems, EF impairments and attention were assessed from the teacher point of view, and emotional problems from the parent point of view. Despite the rationale of our choice, further studies are needed using more objective neuropsychological and achievement measures.

4.3. Further research directions

A number of interesting research directions are opened by our study. First, the theoretical model of the relationship between depression and learning problems, partially mediated by EF impairments and inattention, proposed by us, needs to be tested in more depth, using larger and more diverse samples, as well as longitudinal designs; sample diversity in terms of age, gender and especially culture would be important to test the stability of the suggested relationships, while longitudinal designs would make it possible to investigate these relationships in a causal approach. Second, researchers may be interested to develop an evidence-based intervention protocol for children with EF impairments that would follow the relational pattern outlined by our study, using more robust neuropsychological assessment tools, i.e., approaches that would provide more objective measurement on brain states and neuropsychological mechanisms associated with depression, executive function impairments, and inattention.

Ethical approval details

APA ethical standards were followed in the conduct of the study. All authors acknowledge ethical responsibility for the content of the manuscript and will accept the consequences of any ethical violation. This research is not part of a larger study. The assessment described in this paper are made in a psychology individual practice office approved by the Romanian Board of Psychologists. Written informed consent forms were signed by the parents of all children included in the study.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

CRediT authorship contribution statement

Both authors revised the draft and read and approved the final submitted manuscript.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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