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ADHD Symptoms Predict Second Language Learning Performance Better Than IQ

[1]Işın Paralik, [1]Aysın Sınal, [2]Ibrahim Orhan
[1]Girne American University, Cyprus
[2]University of Gloucestershire, United Kingdom

Abstract: Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that sets off in childhood and can persist into adolescence and adulthood. Findings in the literature demonstrated that ADHD is linked with academic impairment. At least six symptoms are needed for a diagnosis of ADHD. However, reports in the literature suggest that typically developing (TD) children who have less than six symptoms experience the adverse effects of subclinical ADHD symptoms. However, there is no research which studied the impact of ADHD symptom levels on learning a second language (L2) among TD primary school children. The present study aimed to investigate whether ADHD symptom rate and IQ are significant predictors of L2 learning performance and whether ADHD symptom rate explains a higher amount of variance than IQ among non-patient primary school children. The participants were 48 primary school children aged 7-10 years. Data from the Conners' Teacher Rating Scale-Long Form, Vocabulary and Matrix Reasoning subtests from Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II; Wechsler, 2011) were analysed using correlation and hierarchical regression analyses. L2 acquisition performance was evaluated based on the end-of-year test grades for the French language course. Significant relationships were obtained between ADHD symptom level, IQ, and Conners subscales. The results of the analyses showed that ADHD symptom level was a negative predictor of L2 learning performance. Moreover, IQ predicted L2 as well; however, it was a weaker predictor when compared to ADHD symptoms. The findings of the present study suggest that ADHD symptoms could influence L2 learning more than IQ scores among TD primary school children.

Keywords*:* ADHD symptoms, second language learning, IQ, subclinical ADHD symptoms, primary education.

1. Introduction

Childhood is a perfect time to learn a second language (L2) as children acquire language more easily than adults due to better brain plasticity (Lenneberg, 1975). Their ability to learn languages without effort diminishes as they reach puberty (Jackendoff, 1994). Learning an L2 enables individuals to engage with other traditions, which may have different understandings of self-related values and qualities (Mercer, 2011) and would support intellectual development, educational opportunities, and future employment.

Hancock (1977) pointed out the cognitive benefits of learning a second language in a school setting. Moreover, research indicated that bilingualism positively shapes the human brain and behaviour (Bialystok, 2017). Despite the importance of learning an L2 at an early age, some children have trouble with L2 acquisition in primary school. Studies in the literature suggest that attention problems are a conspicuous reason for this difficulty.

Attention deficit hyperactivity disorder (ADHD) is a condition that is marked by a persistent pattern of inattention and is a common neurodevelopmental disorder in school-age children (Sayal et al., 2018). According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) diagnostic criteria, a child can be diagnosed with ADHD when they exhibit at least six out of nine inattention or hyperactivity symptoms. A child with five or fewer symptoms would not receive a diagnosis. However, existing

evidence in the literature demonstrates that children with subclinical ADHD symptoms (i.e., five or fewer symptoms) experience various difficulties, including behavioural and cognitive problems (Murray et al., 2022; Brown & Casey, 2016; Rielly et al., 2006). One of the adverse effects of having subclinical ADHD symptoms could be the difficulty acquiring an L2.

Previous studies investigated the effect of ADHD diagnosis on academic achievement and L2 acquisition. There is evidence in the literature supporting the relationship between ADHD and academic impairment in elementary school-aged children (Bender & Smith, 1990). Furthermore, children with ADHD have been reported to experience difficulty in learning an L2 (Kałdonek-Crnjaković, 2022; Paling, 2020). However, no research so far has investigated the impact of subclinical ADHD symptoms on L2 learning among TD primary school children. Therefore, the present study aims to investigate the influence of subclinical ADHD symptoms in learning French as an L2 among TD primary school children.

1.1 TD children and learning an L2

In the past fifty years, researchers have been exploring the processes behind children's second language acquisition. Some experts proposed that there are significant similarities between the processes of learning both first language (L1) and L2. For example, Lenneberg (1969) proposed that children learn language instinctively and naturally. Furthermore, many scientists hypothesised that children rely on this intuitive and natural ability when they learn an L2. It can be speculated that this may be one of the factors with the potential to influence L2 learning performance between children and adults.

According to Chomsky's (1960) universal grammar hypothesis, children are born with a language acquisition device that becomes activated when exposed to language produced by others. Bley-Vroman (1998) explains that children acquire L2 naturally because they still have access to their universal grammar. As children grow older and reach puberty, their ability to effortlessly learn new languages decreases (Jackendoff, 1994).

During the primary school years, learning an L2 requires a significant amount of cognitive effort (Kim, 2008; Laufer & Hulstijn, 2001). It involves utilising higher-level cognitive processes such as analysing, sustaining attention, using mnemonic strategies, encoding to memory, and recalling. Children with ADHD have been reported to exhibit poorer performance in learning an L2 when compared to their TD peers (Siu & Zhou, 2014) due to impaired attention processes (Barkley, 1997).

1.2 Children with ADHD and learning an L2

ADHD is characterised by a consistent pattern of inattention and hyperactivity-impulsivity. DSM-5 identifies three presentations of ADHD: predominantly inattentive, predominantly hyperactive-impulsive, and combined. The initial symptoms of both presentations can manifest in at least six distinct ways, persisting for a minimum of six months.

Symptoms of inattentive presentation briefly consist of difficulty staying focused on tasks or activities, frequently avoiding activities that require sustained mental effort, and being easily distracted by extraneous stimuli. On the other hand, some hyperactivity symptoms are leaving one's seat in the classroom where seating is expected and being unable to play or engage in leisure activities quietly (DSM-5; American Psychological Association, 2013). They have been observed trying to answer questions before they are completed, have poorer organisational skills, and experience impaired self-control (Liontou, 2019; Thapar et al., 2013; Orhan et al., 2023). Existing evidence in the literature demonstrates that ADHD symptoms can significantly interfere with academic tasks and impair performance in learning an L2 as well (Barry et al., 2002).

In a recent study, Paling (2020) investigated whether ADHD interferes with L2 learning performance among adults. They examined forty-three adult L2 learners diagnosed with ADHD. Participants were asked a series of questions regarding their L2 learning process, including whether they had achieved their initial language learning goals and what difficulties they had encountered while learning the target language.

The findings of Paling's (2020) study showed that the ADHD group experienced greater difficulty focusing during the sessions, did not feel confident enough to speak in the target language, and described their present level of L2 achievement negatively than the non-patient adults. In sum, individuals with ADHD reported facing more challenges in their L2 learning progress when compared to nonpatient adults. This study's findings suggest that ADHD symptoms significantly interfere with the L2 learning process among adults with ADHD.

It has been reported that children with ADHD also experience a higher rate of difficulty in learning an L2 when compared to their TD peers (Sparks et al., 2009). Reports in the literature demonstrate that they find it challenging to remain focused on a task and experience difficulty resisting distractions (Barkley, 1997; William & Mathes, 1995). These symptoms can make it difficult for them to learn an L2 effectively, as a significant amount of attention needs to be paid while learning an L2.

Several studies showed that attention plays a crucial role in L2 acquisition (Dörnyei & Skehan, 2003; Kormos, 2020). Children with ADHD reported experiencing difficulty in paying attention to details and having slips of attention. Some study findings in the literature demonstrate that when reading in an L2 context, students with ADHD may often skip over letters, words, or even entire sentences. This can lead to misunderstandings and difficulty grasping the main ideas of longer texts (Turketi, 2010; William & Mathes, 1995).

The research by Okumura et al. (2021) found that having undiagnosed symptoms of ADHD is associated with poorer social functioning, lower self-esteem, and emotional and peer relationship problems compared to those without ADHD symptoms and diagnosis. Moreover, Loe and Feldman (2007) revealed that children with symptoms of inattention, hyperactivity, and impulsivity without formal ADHD diagnoses have poorer educational outcomes. Reports showed that having subclinical ADHD symptoms significantly increased the risk of grade retention and graduation failure (Bussing et al., 2012) and affects negatively the general functioning scores. It can be argued that, attention impairment and hyperactivity could be the reasons of these adversities in children with subclinical ADHD symptoms. Considering the existing evidence in the literature, first and the main hypothesis of the current study is that subclinical ADHD symptoms should negatively predict L2 learning performance among TD primary school children. In other words, TD children with a higher degree of ADHD symptoms should exhibit a poorer L2 performance.

1.3 IQ and L2 learning performance

Studies in the literature demonstrated that IQ is strongly related to academic achievement in TD primary school children (Quilez-Robres et al., 2021). Research showed that students with higher IQ tend to make greater academic progress in reading and writing than those with lower IQ (Kaufman et al., 2012; Mayes et al., 2009; Shaywitz et al., 2004).

Literature includes evidence of a link between IQ and L2 learning performance. Learners with higher IQ have been reported to achieve better results on language tests. It has been demonstrated that intelligence can predict the rate and success of reading and performance of L2 acquisition in the formal language classroom (Genesee, 1976). In a recent study, it was found that there is a positive correlation between IQ and L2 learning performance among young individuals (Xie & Pisano, 2019). Therefore, considering the previous study results, in the present study, IQ is expected to be a positive predictor of L2 learning performance. In other words, TD children with a higher IQ score should have a better L2 learning performance.

However, notably, Jepsen et al. (2009) demonstrated there is a weak correlation between ADHD symptoms and IQ. Naglieri et al. (2005) also studied the correlation between IQ scores and behavioural ratings of inattention and impulsive-hyperactive behaviours in a group of 117 children aged between 6 and 16 years. The study administrated various measures, including WISC-III, Conners' Parent ADHD Rating Scales-Revised Long Form (CPRS-R:L), and Conners' Teacher ADHD Rating Scale-Revised Long Form (CTRS-R:L; Conners, 2000).

The results indicated that parent ratings of the Cognitive Problems/Inattention subscale had no significant correlation with any of the three WISC-III IQ scores. Similarly, parent ratings on the DSM-IV subscale of ADHD

symptoms also did not show any significant correlation with the IQ scores. Therefore these children's failure in L2 cannot be attributed to their IQ. Considering the previous reports, the present study hypothesizes that IQ's influence on L2 performance should be lower when compared to the influence of ADHD symptoms.

To clarify the interplay of ADHD symptoms, IQ, and L2 learning, the present study aims to investigate whether ADHD symptom level influence second language learning performance among typically developing primary school children and whether ADHD symptoms explain a higher amount of variance in L2 learning performance when compared to IQ rates.

In the present study, Conners' Teacher Rating Scale-Revised/Long (CTRS-R/L) (Conners et al., 1997) was used for evaluating the rate of ADHD symptoms. This instrument includes several subscales which were also completed by the teachers of the children who participated in the study. For this reason, these additional scale scores will also be included in the analysis, but because the analysis will be exploratory, no specific hypothesis were developed.

2. Methods

2.1 Participants

The participants were 48 children aged between seven and ten, consisting of 25 males and 23 females, with an average age of 8.73 years. All children were recruited using the convenient sampling technique, from a primary school in Nicosia, Cyprus. The inclusion criteria were being a Turkish language speaker, learning French as a second language, having the consent of the parent and being willing to take part in the study. Exclusion criteria were having visual or auditory difficulties, any mental disability, a reading disorder that could affect their ability to understand and answer questions, a diagnosis of ADHD, or using any psychiatric medication. Informed consent was obtained from the children before the data collection. Ethics approval was obtained from the Girne American University.

2.2 Instruments

2.2.1 *Conners teacher rating scale-long form*

The Conners' Teacher Rating Scale-Long Form (CTRS-LF; Conners, 1997) is a tool used to evaluate the emotional and behavioural issues in children aged 3 to 17. This is a commonly used measure of behavioural problems associated with ADHD. The scale comprises 59 questions in total, to be answered by a teacher. It consists of 13 subscales, including oppositional, cognitive problems/inattention, hyperactivity, anxious-shy, perfectionism, social problems, Conner's global index, restless-impulsive, emotional liability, ADHD index, DSM-IV inattentive, and DSM-IV hyperactive-impulsive. The questions are rated on a 4-point Likert scale, and this instrument has been translated into Turkish and psychometric properties were evaluated by Kaner et al. (2006), with Cronbach's Alpha values ranging from .72 to .90 for the subscales. In the present study, outputs of six subscales were used in the analyses: oppositional, cognitive problems/inattention, anxious-shy, perfectionism, social problems, and emotional liability.

2.2.2 *French language assessment test*

The final academic grade for the French language course was obtained by measuring the students' French language performance throughout the academic year using the book Les Loustics'. This book contains tests at the end of each unit for assessment based on the Common European Framework of Reference for Languages (CEFR) levels of a second language. The questions at the end of each unit were used to evaluate the amount of learning. The assessment incorporated three modules: listening, reading comprehension and writing production. In the listening module, students were required to listen to spoken French and circle the correct answer in a multiple-choice record form. In the reading module, students read a short text and answer the related questions as true or false. In the writing module, students had to fill in the blanks with the correct words. Finally, the scores of each module were added up to obtain the final French language performance score. The final score was taken as the measure of L2 learning performance. The grades were given by the teacher based on the assessments conducted throughout the

year in the French language to evaluate the level of students' acquisition of the curricular content. All children from different classes had the same amount of lesson time and studied exactly the same chapters.

2.2.3 The Wechsler abbreviated scale of intelligence - second edition

The Wechsler Abbreviated Scale of Intelligence - Second Edition (WASI-II; Wechsler, 2011) is a tool designed to provide a brief and accurate estimate of an individual's intelligence. It consists of four subtests: Vocabulary, Similarities, Block Design, and Matrix Reasoning. The Vocabulary and Matrix Reasoning subtests can be used together to obtain an estimate of general intellectual ability. The raw scores from these two subtests are transformed into T scores, which are then added together to produce the estimated full IQ. Research indicates that the WASI-II is a reliable tool for children between the ages of 7 to 11 years, with internal consistency coefficients for vocabulary ranging from .86 to .92, and for matrix reasoning ranging from .98 to .94 (Wechsler, 2011).

2.2.3.1 Matrix reasoning test

The Matrix Reasoning Subtest of the Wechsler Intelligence Test for Children - IV (Wechsler, 2011) is used to assess abstract reasoning ability. In this test, participants are shown a partially filled grid and are asked to choose the item that correctly completes the matrix. For instance, participants are presented with two sets of shapes, such as stars and pentagons, with one set arranged in a specific colour sequence. They are then asked to determine the correct colour sequence of the second set of shapes to complete the grid. Banks and Franzen (2010) have demonstrated that the Matrix Reasoning Subtest has high convergent validity with the Test of Nonverbal Intelligence.

2.2.3.2 Vocabulary test

The Vocabulary Subtest of WISC-IV (Wechsler, 2011) is designed to measure an individual's knowledge of word meanings and verbal concept formation. During the test, the participant is asked to provide oral definitions of given words. The participant can receive 0, 1, or 2 points based on the quality of their answer. The test comprises 30 words, but it is ceased after three consecutive incorrect answers that score 0. The subtest has been translated into Turkish and tested for validity and reliability using a sample of 2225 children (Uluç et al., 2011).

2.2.4 Procedure

Before the data collection, the participants' parents provided informed consent, and both the teachers and parents were informed of the study's objective. Ethical guidelines were strictly followed during the data collection process, and the students' identities were kept confidential. Each student was interviewed individually and face-to-face, and during the interview process, a child first received the Matrix and then Vocabulary subtests of WASI-II. The interviews lasted around 20 minutes. Demographic data was provided by the parents, and the Conners' teacher rating scale was completed by the classroom teachers.

2.2.5 Data analysis

The Pearson's moments correlation was used to investigate the relationships between the study variables. Multiple regression analysis was employed to determine whether the rate of ADHD symptoms and IQ were predictors of L2 performance. Hierarchical regression analysis was used to investigate the amount of variance between ADHD symptoms and IQ explained separately. All the variables used in the correlation and regression analyses were continuous variables. In the regression analysis, L2 performance was the dependent/criterion variable, while ADHD symptom level and IQ levels were the independent variables/predictors.

3. Results

The Microsoft IBM SPSS 24 statistical package was used to analyse the data. Initially, descriptive statistics were computed. Participant characteristics can be observed in Table 1.

Table 1. Descriptive statistics

Demographic variables		Frequency	Per cent	Min/Max	Mean	Sd
Children's age				8-10	8.73	0.71
Father age				34-55	43.27	5.01
Mother age				33-52	40.47	4.88
Place of birth						
	Cyprus	46	95.8			
	Turkey	2	4.2			
Place of living						
	City	37	77.1			
	Village	11	22.9			
Number of brothers and sisters						
	None	21	43.8			
	One	23	47.9			
	Two	4	8.3			
Time of birth						
	Early	9	18.8			
	Normal	39	81.3			
Complication at birth						
	No	45	93.8			
	Yes	3	6.3			
Chronic illness						
	No	45	93.8			
	Yes	3	6.3			
Marital status of parents						
	Together	45	93.8			
	Divorced	3	6.3			
Income						
	11.800-23.600	5	10.4			
	23.600 and above	43	89.6			

Pearson correlation coefficients were computed to investigate the relationships between study variables, and significant relationships were obtained. L2 performance had a strong negative relationship with ADHD symptom level and a moderate positive relationship with IQ. Moreover, statistically significant relationships were obtained between ADHD symptom level, the Vocabulary and the Matrix reasoning subtests of the WASI, and Conners subscales. Correlation values for all the study variables can be observed in Table 2.

Table 2. Zero order correlations between the study variables

	1	2	3	4	5	6	7	8	9	10
1. L2 performance	1	-.69**	.55**	.50**	.36*	-.18	.47**	-.86**	-.37*	-.22
2. ADHD symptoms		1	-.38**	.36**	.45**	.43**	-.36*	.84**	.36*	.64**
3. IQ			1	.82**	.64**	.01	.30*	-.52**	-.24	-.06

4. Vocabulary	1	.46**	.11	.19	-.53**	-.27	-.06
5. Matrix reasoning		1	-.10	.20	-.43**	-.20	-.14
6. ODD			1	-.05	.14	.22	.78**
7. Perfectionism				1	-.43**	.18	-.09
8. Cognitive problems					1	.39**	.27
9. Social problems						1	.29*
10. Emotional stability							1

Note. L2: second language; ODD: oppositional defiance;

*p < .05, **p < .01

Means and standard deviations of the study variables were computed, which can be observed in Table 3.

Table 3. Means and standard deviations of L2 performance, IQ, Conners Subscales

Measure	Study group (N = 48)	
	M	SD
L2 performance	73.58	24.43
IQ	106.27	16.36
ConADHDtotal	11.25	13.95
ConCogProbs	4.54	6.44
ConSocProbs	2.25	3.39
ConEmoStab	1.83	2.73

Note. L2: second language; ConADHD total: Conner's ADHD symptoms subscale; ConCogProbs: Conner's cognitive problems subscale; ConSocProbs: Conner's social problems subscale; ConEmoStab: Conner's emotional stability subscale.

Before running the analysis, assumptions of a linear multiple regression were tested. Standardised residuals were found to be between -3.00 and 3.00 (-2.38 and 1.88), which indicated the normality of residual error distribution. Visual inspection of Q-Q plots for residuals versus predicted values showed that variation of the error terms was constant indicating homeoscasticity assumption was met. Additionally, there were no correlation values greater than .70 between predictor variables, indicating that the collinearity assumption was met. Finally, all the correlation values between the predictor and the dependent variables were greater than .25. All the assumptions of multiple linear regression test were met.

In the regression model, the enter method was used, and L2 performance was predicted from ADHD symptom level and IQ. The model was significant F (4, 43) = 15.78, p < .001, R2 = .59. ADHD symptom level and IQ were significant predictors of L2 performance (see Table 4).

Table 4. Multiple regression of ADHD symptom level and IQ

L2 performance	β	SE	t	p
ADHD symptom level	-0.97	23.54	-5.26	**.001**
IQ	0.43	0.16	2.61	**.013**

Note. Significant values are presented in bold. β = Unstandardized regression coefficients.

To investigate the separate contributions of the predictors in explaining variance in the dependent variable, a two-step hierarchical regression analysis was conducted. L2 performance was the criterion variable. ADHD symptom level was entered in the first step. Results of the analysis showed that the ADHD symptom level accounted for 47% of the variance in L2 performance, F (1,46) = 41.51, p < .001. Afterwards, IQ was entered at the second step. Results showed that ADHD symptoms and IQ together accounted for 57% of the variance in L2 performance, which means that IQ level contributed and explained an additional 10% of the variance in L2 performance F (2,45) =29.86, p < .001. The results of the hierarchical regression analysis can be observed in Table 5.

Table 5. Summary of the hierarchical regression analysis, predicting scores on ADHD symptom level and IQ

	L2 performance				
Predictors	β	t	R^2	ΔR^2	ΔF
Step 1			.47	.47	41.51^{***}
ADHD S.	-1.21	-6.44^{***}			
Step 2			.57	.10	10.05^{**}
ADHD S.	-0.98	-5.32^{***}			
IQ	0.50	3.17^{**}			

Note. L2 =Second language learning; ADHD S. = ADHD symptom level.

$^{**}p < .01$, $^{***}p < .001$

4. Discussion

The present study aimed to investigate whether ADHD symptom rate and IQ are significant predictors of L2 performance and whether ADHD symptom rate explains a higher amount of variance than IQ among TD primary school children. The study's hypotheses were confirmed. The findings of the hierarchical regression analysis demonstrated that the ADHD symptom rate was a better predictor of L2 learning performance than the IQ level.

The findings of the present study show that the ADHD rate, IQ, and L2 performance are significantly related. The highest correlation value appears to be between L2 performance and ADHD rate (r = -.69, p < 0.01). This finding of a negative association suggests that children with higher levels of ADHD symptoms are more likely to experience greater difficulty in L2 tasks. This finding is consistent with previous research that has linked ADHD symptoms, especially attentional difficulties, to challenges in L2 learning (Leons et al., 2009).

Multiple regression analysis results demonstrate that ADHD symptom rate and IQ are significant predictors of L2 performance. In the present study, it was hypothesised that ADHD rate should be a better predictor of L2 performance when compared to IQ. The results of the hierarchical regression analysis confirmed the second hypothesis, showing that the ADHD rate was a better predictor of L2 performance. ADHD rate explained 47% of the variation in L2 scores. On the other hand, IQ explained only 10% of the variation. These findings can be interpreted to mean that the rate of ADHD symptoms surpasses the influence of IQ regarding L2 learning among TD primary school children. More specifically, one unit change in the ADHD rate is related to a 1.21-point change in the L2 performance. On the other hand, one unit change in the IQ score is associated with a 0.50-point change in the L2 performance. These results suggest that ADHD symptoms may adversely influence L2 learning more than IQ rate.

It was essential to determine whether ADHD symptoms have a more significant impact on L2 than IQ as we may not be able to increase IQ levels; however, we may be able to interfere and reduce the adverse effects of ADHD symptoms among TD children. In this vein, early identification and treatment of ADHD symptoms may improve their L2 performance.

The present study reveals a modest negative correlation between the ADHD rate and IQ score, consistent with previous research indicating a link between ADHD diagnosis and IQ performance (Simonoff et al., 2007). It is important to note that IQ is a composite construct comprising various cognitive capacities, including attentional skills, with prior studies reporting predominantly weak associations between IQ scores and attention deficits (Jepsen et al., 2009). Notably, the sample's mean IQ score stands at 106.27, which is within the normal range. This suggests that the study's inclusion of participants with average IQ contributes to the generalizability of findings across a diverse range of children. This can be argued to be an advantage of the present study that increases its external validity.

The L2 learning difficulty among children with higher ADHD rate can be attributed to attentional problems. Reports demonstrated that children with attentional problems experience higher difficulty in educational activities (Colomer et al., 2017; Fergusson et al., 1997). Attention impairment, as one of the features of ADHD, may lead to experience difficulty in focusing attention and transferring information into long-term memory. According to Schmidt's (1990) noticing hypothesis, input in L2 only becomes ‘acquired’ if it is consciously noticed. The consensus among researchers is that to learn an L2, learners have to pay attention to and become aware of the target language input (Schmidt, 2012). Based on these results, it can be speculated that TD children with subclinical ADHD symptoms may have difficulty in L2 learning due to their inattention symptoms, such as difficulty in sustaining attention in tasks, not giving a close attention to details, or being easily distracted by extraneous stimuli.

In the literature, some contradictory results exist in terms of ADHD and L2 relationship. For example, Sparks et al. (2004) proposed that ADHD symptoms may not interfere with L2 learning performance. The study’s findings showed that students with ADHD displayed similar L2 skills with their TD peers. However, it is essential to note that the participants were 68 adult college students using prescribed medications. Firstly, they were required to take L2 courses either because of the graduation requirements of their college or entering requirements of the university, which is a sufficient reason to increase their motivation. Secondly, in Sparks’s study, students were given the opportunity to choose which language course they wanted to attend. It can be argued as; if they choose the language they study, they may put in more effort to succeed or pass the exam requirements. That means they have been studying the L2 to fulfill an academic requirement, out of necessity. These factors could be the reason why no group differences were found in Sparks et al.’s (2004) study.

However, a later research study by Sparks et al. (2008) found that students with ADHD often make letter insertion errors, leading to numerous misspellings in their writing. Their results suggest that students with ADHD frequently misspell words by inserting, substituting, or omitting letters due to inattention. The latter results are in line with the present study’s findings, and it can be speculated that TD children with ADHD symptoms may also have similar experiences which lead them to struggle with L2 learning.

IQ may influence some cognitive abilities relevant to L2 learning, such as problem-solving and verbal comprehension. However, it may not entirely comprise the complex interplay of factors that contribute to L2 acquisition, such as attention, awareness, and working memory (Juffs & Harrington, 2011). On the other hand, ADHD symptoms, with their implications for executive functioning, often cause difficulties in inhibition and cognitive flexibility. These skills are crucial for L2 learning, enabling learners to focus, retain information, switch between different language rules, and adapt to new linguistic contexts. Therefore, this could be offered as a reason why the ADHD symptom rate is a better predictor of L2 learning performance than IQ level.

In the present study, the Conner's scale was primarily used for evaluating the rate of ADHD symptoms. However, teachers were asked to complete the form throughoutly. For this reason, the data from the other subscales was analysed in an exploratory manner. According to the exploratory analyses results, there is a strong positive correlation between the rate of ADHD symptoms and cognitive problems ($r = .84$, $p < .05$). This indicates that the symptoms of ADHD could be affecting cognitive abilities and leading to lower performance in L2 learning. Therefore, it is suggested that a future research should investigate whether the rate of ADHD symptoms may be a mediator in the relationship between cognitive problems and L2 learning performance.

These cognitive problems, which may include limitations in working memory and executive functions, can interfere with memory retention, attention, problem-solving, and information processing in the context of L2 learning. Additionally, essential cognitive abilities such as verbal cognition, processing speed, memory, phonetic coding ability, and grammatical sensitivity are crucial for L2 learning. Research revealed specific cognitive impairments in children with ADHD, potentially contributing to their difficulties in learning an L2. It is reasonable to speculate that TD children with ADHD symptoms may also face challenges in L2 learning due to similar cognitive problems.

It was previously shown that ADHD symptoms and working memory impairment are related (Barkley, 2014; Rapport et al., 2001). Children with ADHD often struggle with working memory (Klingberg et al., 2010) and they have lower phonological memory capacity which is crucial for mastering sound patterns and language elements (Baddeley, 2000; Juffs & Harrington, 2011). It can be speculated that TD children with a higher ADHD symptom rate could have a poorer phonological memory capacity that might affect their L2 learning adversely. This possibility should also be investigated in a future study.

The present study's results demonstrate a positive correlation between the vocabulary subtest of WASI-2 and L2 learning performance, supporting Cummin's (1979) linguistic threshold hypothesis. This hypothesis link L1 and L2 competence and proposes that a learner's L1 skill influences their L2 skills. In the present study, obtained results suggested that TD children with ADHD symptoms may face challenges in their L1 literacy, which might hinder their L2 literacy skills. It can be speculated that, TD children with ADHD symptoms may tend to have poor vocabulary knowledge in their L1 and consequently this may influence their L2 learning performance. This finding suggest that children who are better in their own language, would have a better ability to grasp an L2 as well.

The present findings also demonstrate a positive link between perfectionism and L2 learning performance However, this relationship is not very strong as excessive perfectionism can lead to lower achievement in L2 learning due to the fear of making mistakes. Perfectionism is regarded as a personality trait, which can cause language learning anxiety and impede L2 acquisition, however the present study uncovers its positive influence. Perfectionism can serve as a motivator, driving learners to face challenges and set high standards in mastering the target language. Based on this result, it can be speculated that, TD children with some ADHD symptoms may tend to be perfectionists and this may reflect positively on their L2 performance.

Results of exploratory analyses also showed that social problems are also negatively correlated with L2 scores. This finding support the evidence as engaging in social activities may help children to increase their L2 learning potential (Villamil & Guerrero, 1996). However, social problems are a common feature of ADHD and they often lead to functional impairment (Kofler et al., 2011). Based on this result, it can be speculated that, TD children with ADHD symptoms may face difficulty in learning L2 due to their social and behavioural problems. In the

social context, TD children with ADHD symptoms, especially hyperactivity and impulsivity symptoms, may have more difficulties in interacting with their peers and teachers in order to communicate in L2, which might hinder children from developing good social skills in a learning environment. This situations may lead them to underachieve in learning an L2.

Teaching an L2 to primary school children with ADHD symptoms requires adapting traditional methods. Research recommends smaller class sizes, parent-teacher collaboration, and hands-on learning for these children. Similar strategies can be employed for TD children with subclinical ADHD symptoms facing L2 challenges. Tailored teaching methods, focusing on visual, physical, or kinesthetic approaches, could improve L2 outcomes. Multisensory strategies can help engaging multiple senses and positively impact motivation and cognitive connections. Linking movement and language learning is found to be effective, especially for tactile learners. Reading comprehension challenges can be addressed with multisensory, creative drama, physical response, and experiential learning techniques (Hvozdíková & Stranovská, 2022).

5. Conclusion

The present study provides evidence that the subclinical ADHD symptom rate is a better predictor of L2 learning performance than the IQ scores among TD children. This means that TD children with higher levels of ADHD symptoms may face greater challenges when learning a second language regardless of their IQ level within the normal range (i.e., between 90 and 110). To overcome these challenges and improve L2 learning outcomes, it is important to identify and intervene early to address ADHD symptoms among TD children in primary schools. This is crucial as these children with subclinical ADHD symptoms often remain undiagnosed, impacting their L2 learning and they could not receive support they require. Although the present study has some limitations as having a small number of participants, it is an important step forward in exploring the effect of subclinical ADHD symptoms among TD primary school children for L2 performance. The present findings, highlight the need for increased awareness and intervention strategies to support these children in terms of increasing their L2 learning performance.

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