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COMPARATIVE STUDY OF WORKING MEMORY AND SELF REGULATION BETWEEN LEARNING DISABILITY AND ATTENTION DEFICIT HYPERACTIVITY DISORDER

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ABSTRACT

The main aim of the present study is to investigate the effect of learning disability and ADHD on self-regulation and working memory. Sample 35(n) children were selected from different schools of Haripur and Peshawar. The age range of the sample was 6-17 years (M=11.77, SD=2.18).). It was hypothesized that learning disability has and ADHD has effect on working memory forward than backward. Learning disability and ADHD has impact on cognitive self-regulation and emotional self-regulation. Another hypothesis was to compare the children with learning disability and ADHD on self-regulation and Working memory. By using Paired sample t-test the results showed that children with learning disability scored a bit high than ADHD on self-Regulation scale and working memory ($p<.001$). And to investigate the effect of learning disability and ADHD binary logistic regression was used so, it indicated that learning disability and ADHD has greater impact on working memory forward which was negative but significant. While on working memory backward the relationship was negative but non-significant. And on self- regulation, cognitive self-regulation was significantly but negatively associated with learning disability and ADHD ($p<.001$). While emotional self-Regulation was negatively but non-significantly associated with learning disability and ADHD effect the cognitive self-regulation.

Keywords: Learning disability, ADHD, self-regulation, working memory

INTRODUCTION

Learning disability occurs in 1 out of 10 children. So around the world there are 7 billion population and then 700 million children and adults having literacy problem throughout their lives and they face social exclusions. The international statistics reported that 15-20% of the children having learning disability. And 12 million children in Pakistan out 60 million needs intense help (daily times).

Children with learning disability have problem in academic achievement and the problem occur because of minimal use of self-regulatory strategies and disturb working memory. (include definition) the classic model of working memory proposed by **Baddeley and Hitch (1974)** this has been divided into three parts central executive system, visuo- spatial sketch pad and phonological loop. The phonological loop is responsible for provisional storage and related to phonological information. Visuo- spatial sketch pad take responsibility of temporary storage and processing of visual space information, while central executive system is responsible for controlled attention as well as for coordinating and adjusting information from phonological loop and visuo- spatial sketch pad. **Baddeley (2000)** proposed the fourth major component in this model named episodic buffer of working memory. There is considerable evidence that children with dyslexia have deficits in phonological processing and storage **(Schuchardt, Maehler, & Hasselhorn, 2008; Vellutino, Fletcher, Snowling, & Scanlon, 2004)**. Researchers studying working memory functioning in children with dyscalculia have reported deficits in the visual–spatial sketchpad **(Schuchardt *et al*., 2008)**, whereas mixed results have been reported for the phonological loop and central executive. Some studies show them not to be impaired **(McLean & Hitch, 1999; Schuchardt *et al*., 2008)**. Self-regulation can be defined as the "process whereby students activate and sustain cognitions, behaviors, and affects, which are systematically oriented toward attainment of their goals" **(Schunk & Zimmerman, 1994)**. **Zimmerman's (2000, 2011)** model describes three cyclical phases of self-regulated learning: forethought includes planning and selection of strategies appropriate for the task, performance control involves the execution of those strategies, and self reflection involves judgments and evaluation of strategy use after task performance. According to **Lyon *et al.* (2003)**, dyslexia is a distinct learning disability of neurobiological origin that is

characterized by difficulties with decoding, word recognition, and spelling that can persist into adulthood and may have problems in reading comprehension and the building of domain knowledge as secondary consequences. Given the established link between articulation rate and memory span (**Baddeley, Thomson & Buchanan, 1975)**, there is an intriguing possibility that the cognitive deficits in children are attributable to a deficit in working memory which is itself attributable to motor deficit in articulation speed. The research reported here investigates this hypothesis by means of a series of investigations of working memory. First, however, we summarize the evidence linking phonological deficit and working memory deficit with dyslexia. **Miles (1983)** has shown that a deficit on digit span is one of the most common symptoms of dyslexia, with particular deficits often shown on backwards span. **Barkley (1997)** proposed that children with ADHD have impairments in working memory, defined as the "simultaneous storage and processing of information" **(Baddeley, 1992)**.

(Tannock, Ichowicz, & Schachar, 1995) and mental arithmetic asks to measure working memory, which required children to both remember the information and conduct mathematical operations using that newly acquired information. Deficiencies in arithmetic performance have been found in both preschoolers **(Mariani & Barkley, 1997)** and school-age children **(Loge, Staton, & Beatty, 1989)** with ADHD.

METHODOLOGY

Objectives

1. To examine effect of Learning Disability, Attention deficit hyperactivity disorder on working memory and self-regulation among children
2. To examine the self-regulation and working memory of children with LD.
3. To examine the self-regulation and working memory of children with ADHD.

Hypotheses

1. Learning disability children score relatively higher on Self-regulation than ADHD.
2. Learning disability children score relatively higher on working memory than ADHD.

Population:

As the population is unknown in order to define the population researcher will use purposive sampling in which the following inclusion criteria will be followed.

Before starting the formal study school characteristic will be found through topographic school representation. Purposive sampling technique will be used to collect the sample.

Table 1: Sample

S. No	School	Total number of student enrolled in school	Potential participants	Randomly collected actual participants
1	2 schools		100	21
2	One government school for special children		14	14

Inclusion criteria

Only those children were the part of study that had been screened out through WRAT-3 for learning disability. On the basis of WRAT-III scores children were categorized with learning disability. ADHD were screened out through Vanderbilt test.

Instrument

- **Self-regulation questionnaire**

  This is a 13-item questionnaire used to assess children's ability to regulate negative emotions and disruptive behavior, and to set and attain goals. Respondents rate how true each item is for them, ranging from 1 (never true) to 4 (always true). After reverse coding items 1, 2, 3, 4, 5, 8, 10, 11, 12 and 13, higher scores represent the child's ability to regulate his/her emotions (items 1, 2, 3, 4, 5), behavior (items 9, 10, 11, 12), and cognitions (items 6, 7, 8).

- **Vanderbilt ADHD diagnostic rating Scale.**

  It is diagnostic tool for Attention deficit hyperactivity disorder symptoms and their effects on behavioral and academic performance in children with the age range of 6-17 years. This measure was developed by Mark Wolraich at the Oklahoma health science center. It includes sub scale of oppositional defiant disorder, conduct disorder, Anxiety and Depression which is often comorbid with ADHD.

- **Digit Span (WISC-III-R)**

  There are two parts to this subtest. In the first part (digits forward) the individual is read a series of numbers and is required to say them back to the examiner. 172 Appendices In the second part (digits reversed) he/she is again read a series of numbers but this time she/he is required to say them back to the examiner in reverse order. The test was developed to measure verbal short-term memory, and attention.

- **WRAT-3**

  The Wide Range Achievement Test—3rd edition (WRAT-3) by Wilkinson and Robertson, published in 2006, is

the most recent of the WRAT measures which date back to 1946 **(Wilkinson & Robertson, 2006)**. The original Word Reading, Spelling, and Math Computation subtests have been expanded in the WRAT4 to include a Sentence Comprehension subtest and a reading composite score. The test with alternate forms is designed to be used with individuals between the ages of 5 and 94; and while brief in nature, it provides a foundation from which to further assess academic skill competencies if necessary. For the seasoned clinician, the Spelling subtest, for example, is a useful first step in determining if there may be a deficit in decoding on account of phonological awareness or processing issues because of the phonemic and nonphonemic nature of the stimulus words. The Word Reading subtest again provides data with respect to decoding and printed word recognition. The Math computation subtest gives the opportunity to identify errors of inattention to detail (misread operational signs) or the misalignment of numbers as examples, as well as initially identifying skills or lack thereof in basic math operations to the level of basic algebraic equations without the use of a calculator.

Sample

Sample size determined on the basis of screening. Children with learning disability were screen out from normal population so it depends the number of potential participants. So, 21 children were screen out with learning disability, similar procedure was repeated to screen out children with ADHD. And Random Sampling technique was used.

Procedure

The sample represented 35(n) children with learning disability and ADHD aged 6-17 years (M= 11.77, SD=2.18). To get ethical approval contact will be made with high authority of the schools. Initially different schools of Peshawar and Haripur will be contacted. Formally children of specific age were randomly selected and administered WRAT-3. After scoring WRAT-3 children were screened out with learning disability and included into the research and then administered self-regulation questionnaire and digit span a sub scale of WISC-III-R. In the second phase ADHD children were screened out through screening tool used for ADHD.A government school for special children, Hayatabad was contacted. After taking permission again screening tool

Vanderbilt test (Teacher form) was administered and screened out ADHD children with the help of teacher. After screening, formerly Self- regulation scale was administered and then digit span a sub scale of WISC-III-R. In the end a special thank had been paid to children and school principal.

RESULTS

Table 3 shows; there is significant difference between the scores of Children with Learning Disability and ADHD on Working Memory Forward. Children with LD (M=6.86, SD=2.12) scored higher than ADHD (M=3.07, SD= 1.49), t (33) = 5.76, with mean difference 3.78, p<.001; d= 2.06, CI 95% [2.45, 5.12]. The effect size for this analysis was found to exceed **Cohen's (1988)** convention for large effect (.80).

On Working Memory Backward, there is significant difference between the scores of Children with Learning Disability and ADHD. Children with LD (M=3.76, SD=1.49) scored higher than ADHD (M=1.36, SD= 1.27), t (33) = 4.02, with mean difference 2.40, p<.001; d= 1.73, CI 95% [1.18, 3.62]. The effect size for this analysis was found to exceed Cohen's (1988) convention for large effect (.80).

On Working Memory, there is significant difference between the scores of Children with Learning Disability and ADHD. Children with LD (M=10.62, SD=3.41) scored higher than ADHD (M=4.43, SD= 2.17), t (33) = 6.00, with mean difference 6.190, p<.001; d= 2.16, CI 95% [4.09, 8.28]. The effect size for this analysis was found to exceed Cohen's (1988) convention for large effect (.80).

Table 4 does not show significant difference between children with Learning Disability and ADHD on sub scale of Self-Regulation. On emotional self-regulation children with LD (M= 10.57, SD=4.15) scored lower than ADHD (M=13.43, SD=1.74), t (33) = -2.42, with mean difference -2.85, p>.021; d = 1.93, CI 95% [-5.25, -.461]. The effect size for this analysis was exceeding Cohen's (1988) convention for large effect (.80).

On Cognitive Self- Regulation, there is significant difference between the scores of Children with Learning Disability and ADHD. Children with LD (M=8.62, SD=2.01) scored higher than ADHD (M=4.29, SD= 1.54), t (33) = 6.82, with mean difference 4.333, p<.001; d= 2.41, CI 95% [3.04, 5.62]. The effect size for this analysis was found to exceed Cohen's (1988) convention for large effect (.80).

On Behavior Self-Regulation, there is significant difference between the scores of Children with Learning Disability and ADHD. Children with LD (M=14.36, SD=2.56) scored higher than ADHD (M=11.76, SD= 1.44), t (33) = 3.42, with mean difference 2.95, p<.001; d= 1.25, CI 95% [4.13, 1.05]. The effect size for this analysis was found to exceed Cohen's (1988) convention for large effect (.80).

A logistic regression analysis is used to predict working memory forward (WMF), working memory backward (WMB) as predictors. A test of the full model against a constant one predictors was statistically significant (chi square 28.154, p<.001, df= 2). The walden criterion demonstrate that working memory forward has negative but significant contribution to the prediction (p<.001). Exp (B) value of three factors is also increased **(Table 5)**.

A logistic regression analysis is used to predict emotional self-regulation (ESR), cognitive self-regulation (CSR) as predictors. A test of the full model against a constant one predictors weas statistically significant (chi square 28.153, p<.001, df= 2). The Walden criterion demonstrates that emotional self-regulation has negative but non-significant relationship. And cognitive self- regulation has negative but significant contribution to the prediction (p<.001). Exp (B) value of three factors is also increased **(Table 6)**.

Table 2: Psychometric Properties of Major Study Variables of Learning disability and ADHD (n=35)

					Range		
Variable	**n**	**M**	**SD**	**α**	**Potential**	**Actual**	**Skew**
Self-Regulation Scale	**35**	**26.77**	**3.57**	**.371**	**4-52**	**19-34**	**-.544**
Digit span	**35**	**62.50**	**13.21**	**.875**	**3-105**	**34-46**	**.039**

Table 3: Mean Difference, Standard Deviation, t- Value of the children with learning disability and Attention deficit hyperactivity disorder on Sub Scale of working memory (N=35)

	b (SE)	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Learning Disability Vs ADHD				
Constant	**6.747(2.453)*****			
WMF	**-1.30(.542)*****	**.093**	**.270**	**.782**
WMB	**-.486 (.410)**	**.275**	**.615**	**1.37**

Note: WMF: Working Memory Forward, WMB: Working Memory Backward, WM: Working Memory. Higher the scores on working memory higher will be working memory

Table 4: Mean Difference, Standard Deviation, t- Value of the children with learning disability and Attention deficit hyperactivity disorder on Sub Scale of Self- regulation (N=35)

	Learning Disability (n=21)		ADHD group (n=14)						
	M	SD	M	SD	t(33)	P	CI 95%		Cohen's d
							LL	UL	
WMF	6.86	2.12	3.07	1.49	5.76	<.001	2.45	5.12	2.06
WMB	3.76	1.49	1.36	1.27	4.02	<.001	1.18	3.62	1.73
WM	10.62	3.41	4.43	2.17	6.00	<.001	4.09	8.28	2.16

Note: ESR: Emotional Self-Regulation, CSR: Cognitive Self-Regulation, BSR: Behavior Self-Regulation. Higher the scores on Self-regulation higher will be the Self- Regulation

Table 5: Logistic regression Analysis of emotional intelligence among delinquents and Non delinquents (N=200)

	Learning Disability (n=21)		ADHD group (n=14)						
	M	SD	M	SD	t(33)	P	CI 95%		Cohen's d
							LL	UL	
ESR	10.57	4.15	13.43	1.74	-2.42	>.021	-5.25	-.461	0.86
CSR	8.62	2.01	4.29	1.54	6.82	<.001	3.04	5.62	2.41
BSR	14.36	2.56	11.76	1.44	3.42	<.001	4.13	1.05	1.25

Note: R^2 = .553(Cox & Snell), R^2 = .747 (Nagelkerke). Model Chi-Sq. (df= 2), 28.154, p value = .001. * = p<.05, ** = p< .01 & *** = p<.001

Table 6: Logistic Regression Analysis of Working Memory of children with Learning Disability and ADHD (n=34)

	b (SE)	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Learning Disability Vs ADHD				
Constant	11.29(5.171)**			
ESR	-1.41(.508	.542	.799	1.17
CSR	-1.413(.508)***	.090	.243	.658
Note: R^2 = .557(Cox & Snell), R^2 = .753 (Nagelkerke). Model Chi-Sq. (df= 2), 28.153, p value = .001. * = p<.05, ** = p< .01 & *** = p<.001				

DISCUSSION

Aim of the study was to assess the effects of Learning Disability and ADHD on self -Regulation and working memory. The present study showed that children with learning disability have somewhat better working memory than ADHD. And self-regulation (cognitive self-regulation)is similarly better than ADHD. Working memory has two domains which are working memory forward and working memory backward. Current studies showed that children learning disability and ADHD has significant but negative relationship with working memory forward, with working memory backward they have negative but non-significant relationship it was also supported by previous studies conducted by **Swanson and Siegel (2001)** believe that intrinsic working memory limitations are the primary cause of learning disabilities. Some investigators (e.g. **Korkman and Pesonen, 1994; Hanly, 2005; Swanson and Jerman, 2006**). **Henry (2001)** determined that children at 11- to 12 years old with a moderate learning disability could retain verbal instructions that contained up to three units of information, whereas normal children

could manage five units of information. When students process other information while retaining verbal instructions (a typical classroom situation), those with learning disabilities can maintain only three item of information, whereas ADHD students can't handle an average of three units of information **(Henry, 2001)**. Recent meta-analytic **(Martinussen *et al*. 2005; Willcutt *et al*. 2005)** and experimental **(Brocki *et al*. 2008; Rapport *et al*. 2008a)** studies are highly consistent in documenting working memory impairments in children with attention deficit/hyperactivity disorder (ADHD) relative to typically developing children. ADHD-related working memory deficits have been linked recently with classroom inattention, which in turn is a primary catalyst for clinical referrals **(Pelham *et al*. 2005)**. **Kane *et al*. (2007a)** provide further experimental evidence for a link between working memory and attentive behavior. In a novel, naturalistic study, they concluded that individuals with low working memory abilities were significantly more likely to report task-unrelated thoughts (i.e., inattention), especially during challenging or difficult tasks throughout the day. Furthermore children with learning disability have shown somewhat fair results on self-regulation than ADHD on independent sample t-test. While logistic Regression indicated that children with learning disability and ADHD has non-significant but negative relationship occur with emotional self-regulation while negative but strong relationship with cognitive self- regulation. it has also been indicated by previous studies conducted by self-regulation must involve self-regulation may involve integrated functioning of high- level of cognition but it is lower in ADHD and learning disability (Pennington2005). Cognitive self - regulation plays an important role in organizing behavior and developing appropriate plan which is actually lacking in ADHD, but children with Learning disability shows somewhat better on planning and organizing the behavior it has also been consistent with previous studies by Self-monitoring has a long-standing record of effectiveness for increasing on-task behavior for children with LD **(Briesch & Chafouleas, 2009; McDougall *et al*., 2006; Reid, 1996)**. More than 30 studies involving children with LD have reported increased on-task behaviors. The self-regulation problem leads toward social problem but current study shows that children with learning disability try to adjust their self-regulatory strategies according to social

context as compared to ADHD one of previous study. The social milieu also poses problems for many of these children. **Bryan (1997)** estimated that over a third of children with LD also have impaired social skills. In fact, some have proposed that social deficits be included in the definition of LD **(Lerner & Johns, 2009)**. The problem is even more serious with children with ADHD as many of the symptomatic behaviors reflect difficulty in social functioning **(Miller, Miller, Bloom, Hynd, & Craggs, 2006)**.

Recommendation of the Study

Following are the recommendations

- For conducting further study Gender must be taken into the account as current study only focused on boys.
- For future research self-regulatory strategies should be focus of attention for learning disability and ADHD.
- Current study focused on clinical aspect of the sample for further study social and academic aspect must explore.
- For future studies Data collection should be extended and collected from different cities of Khyber Pakhtukhawa.

Limitation of study

- Sample was small so problem occurs in generalizability of the study.
- Data were selected specifically from haripur and Peshawar and only small number of schools permitted for conducting study.

CONCLUSION

The current study investigated the effect of learning disability and ADHD on self-regulation and working memory. Children were selected from the different schools of Haripur and Peshawar. Independent sample t- test were used to find out the difference of mean score between the children with learning disability and ADHD. Result indicated learning disability showed somewhat better performance on working memory and self- regulation than ADHD. And binary logistic regression showed that working memory forward has significant negative relationship in ADHD. While in learning disability and ADHD both have negative but significant relationship with cognitive self-regulation. They negatively impact emotional self-regulation but as non- significant relationship.

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