

## Comparison of Memory and Learning in Children with ADHD and ODD

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### ABSTRACT

The purpose of this study is to compare one of the neuropsychological features (memory and learning) in children with Attention Deficit/Hyperactivity Disorder and children with Oppositional Defiant Disorder (ODD). The statistical community consists of the elementary school students in the city of Isfahan within the educational period of 2011-2012. Sample size included 120 persons who have been selected by means of multi-stage random cluster sampling method.

The research method was causative-comparative and the measurement tools included: neuropsychological questionnaire Connors 1- Children & Adolescents neuropsychological questionnaire, which was provided by Connors (2007) for the evaluation of neuropsychological features as like attention, executive functions, sensory-motor functions, language functions, memory and learning functions; Connors 2- parents' form standardized by Connors et. al (1999) for the evaluation of 5 factors (behavior-, psycho-somatic, impulsivity, hyperactivity, anxiety, and learning problems); and Oppositional Defiant Disorder Ranking Scale (ODDRS) created by Homerson, Muray, Ohan, Johnston (2006) for the diagnosis of children with ODD based upon DSM-IV-TR criteria. Research data was analyzed through the multivariate analysis method or MANOVA by using SPSS software.

Conclusion: The findings indicated a meaningful difference between memory and learning of children with ADHD and children with ODD ( $p < 0.001$ ,  $f = 69.15$ )

**KEYWORDS:** Attention Deficit/Hyperactivity Disorder, Oppositional Defiant Disorder, Memory and Learning

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### 1. INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD) are the childhood disorders that have been discussed by psychologists, psychiatrists, parents, and teachers as an outstanding issue since these children's behavioral features including motor control inability, attention deficit, learning inability, aggression, educational problems, arousal and movement instability are the major problems for parents, peers, and educators and may damage the child's mental talents and social-sentimental skills (1). Plenty of educational and occupational problems in the adulthood period of these children are meaningfully more than the ordinary population. Recently, numerous researches have been done to recognize the nature of such disorders and evidences of genetic factors were found in the family and genetic levels (2). High prevalence of aforesaid disorder in a child's life involves in his family, school, and society such that his inabilities will continue even by the maturation ages and improves non-treatment aspects of the child regarding social and psychiatric damages in his future life. On the other hand, some of the psychiatric disorders as like bipolar disorders have a very close relation with ADHD (3&4). ADHD is the most prevalent neural disorder among school aged children and diagnosis requires at least 6 months from the disease time. Relevant symptoms have to begin before the age of 7 and make disorders both at home and school in the child's functions.

Other determining features of ADHD include short attention field and quick distraction (3). Its outbreak is 4 to 7 percent of children in the world (5). Researches indicated that aforesaid disorder is the result of complex interactions between genetics, environment, and biological factors (6). Concerning much attention on the issue, it is stated that ADHD has made outstanding problems for lots of students including education, cognition, social, anxiety functions and even occupation and family during adulthood. One of the fundamental problems of these children is attention deficit, which prevents from their learning during the elementary period (7). Oppositional inattention disorder is a kind of disease in which children ignore all the willing and regulations created by adults and show their inattention to them. The most important feature of the above disorder includes negative behaviorism, pertinacity, opposition, inattention, and enmity against power, which is mostly referred to the parents and teachers and is evident in elementary students. Oppositional defiant disorder normally appears between 8-12 years of age and boys have more evidences than the girls (8). Studies on the etiology of ODD have suggested a combination of the child's genetic or biological specifications and tendencies, wrong child rearing styles, and the environmental conditions (9,10).

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Children with both of these disorders are not able to do their homework and require more attention from the teachers. They often do not obey their parents at home. These children act impulsively and entrapped with emotional instability and are stimulating and explosive. Approximately 75% of the children with ADHD show aggressive and oppositional behaviors in a relatively stable way (3). These behaviors have to occur more often than the normal age and growth level and lead to the outstanding family and educational problems. Diagnosis of these two disorders is a clinical issue and interview with the parents would be the first beneficial step in our evaluation process. In case parents, physician, and teachers are the resources of disorders altogether, prevalence will be less than the time these resources are individually involved (11&12). Parents mostly recognize ADHD symptoms in girls less than the boys (4). Principally, boys are referred to the clinic sooner (3&4). Studies show that oppositional behaviors in girls are less than the boys. In other words, major symptom among girls is distraction while the boys indicate hyperactivity (4). In addition to the above, other researches exist on these two disorders but lack of studies is still evident on the etiology and treatment of such disorders in nervo-health fields. As such, the aim is to find out whether any differences exist between memory and learning (one of the neuropsychological features) of children with ADHD and children with ODD.

### **Theoretical and implication framework**

**Attention Deficit/ Hyperactivity Disorder:** Attention Deficit/ Hyperactivity Disorder is a set of symptoms with the attention field limitation that is inconsistent with the person's growth and leads to concentration weakness, sudden behaviors, and hyperactivity. In other words, the major feature of ADHD is existence of a stable pattern of inattention or hyperactivity/impulsiveness, which is more severe than those persons in the same level. Symptoms of ADHD have to appear in two circumstances (as like home, school) and create problems in the person's social and educational functions (1).

**Oppositional Defiant Disorder:** As per the revised definition in Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV-TR), "oppositional defiant disorder is a recurring pattern of negative, hostile, disobedient, and defiant behavior in a child or adolescent against the powers".

**Attention:** Attention is a process in which an individual applies his/her senses to perceive the outside world. Attention concentration means being aware of an issue and ignoring others.

**Memory and learning:** Memory and learning consists of inter-related complex and important skills. These include quick memory for words, memory for names, memory for faces, memory for works and learning list.

Children with ODD symptoms usually do not have optimal improvements at school (14), but they have neuropsychological problems as like active memory and functional defects (15), and mainly do not have cognitive, social, and sentimental skills required for the adults' requests. As memory and learning disorders among these children is mostly due to disorders and damages in their level of attention and functions and cause the engagement of other parts such as function and active memory and even active memory disorder may create problems both at the time of learning and restoring, functional and attention disorders may lead to the learning disorders among these children. One of the realizable problems in elementary students with neuropsychological/evolutional inability is the functional and attention disorder (16&17). provided a cognitive model of ADHD based upon this assumption: physical feature of children with ADHD results in these problems of functional performance. Functional performance focuses on the supreme cognitive processes engaged for thinking, action, and feeling control. Functional performances defects (active memory – planning, organization attention, impulse control, time management) are evident among students with ADHD. Likewise, such defects are also evident in the active memory of children with ODD but this is due to the existence of disorder along with ADHD, as (18) pointed out. Additionally in a research by (19) on children with ADHD and children with reading learning inability, ADHD persons have shown deficits in processing speed, naming different things, behavioral prevention, and even variation during response, whether a combination of learning and memory inability or the ADHD itself while children with learning inability and a dominant form of learning inability to ADHD have indicated defective evidences of speech active memory, slow restoring speed, and low spatial vision processing. One of the hopeful aspects concerning the research conclusions on ADHD and ODD is stability of these results regarding the relation between neuropsychological features of these children including memory and learning and their problems (20). School lessons are one of the children's learning disabilities (21). Executive functions adjust the behavioral outputs and usually include prevention and control of the stimulants, working memory, cognitive flexibility, attention planning and organizing (22&23). Factors analysis indicated response prevention, working memory, self-adjustment, and interference control as the four executive function factors( 24&17). suggests that children with ADHD have problems in their executive functions, the most important of which are the active memory deficit, response prevention, decision making, motor control, and time realization. However, the most important executive function deficits in children with ODD include response prevention, organizing and planning inhibitions. Barkley added that ODD children may have problems in response prevention especially thinking, excitement, and behavior adjustments against adults. In addition, other studies verify all the above, although these are a few, and more studies are required in this respect. According to the above findings, the major issue in this study is the comparison and examination of children's memory and learning capacity with

ADHD and ODD as well as the diagnosis, evaluation, clinical interventions, and preventive measures on the future disorders related to these children. It is necessary to mention that infrastructural reason for learning and memory disorder amongst these children is the disorder in their executive functions.

## **RESEARCH METHOD**

According to the nature and main purpose of the present study regarding comparison of memory and learning in children with ADHD and ODD, comparative-causative (ex post facto) method has been used. In this method, it was possible to compare children groups after an occurrence. However, it was not possible to completely control, take the samples, and replace the testable items with different testing conditions.

Participants were categorized into 2 groups (ADHD, ODD, as per the diagnosis type and compared with each other concerning grades for neuropsychological indexes.

### **Statistical population**

The population used in this study consisted of boy and girl students with ADHD, ODD, at elementary level (6-10 years old) within 2001-2002 educational periods in the city of Isfahan.

### **Sample, sampling method, and sample sufficiency**

This research was done on 2 children groups (with ADHD, ODD, ODD,. Multi-stage random-cluster method sampling was applied to select the items. In the first stage, 20 elementary schools of Isfahan were randomly selected (10 girl schools and 10 boy schools) on which ADHD and ODD diagnosis tests were performed. Afterwards, 60 students with ADHD (30 girls and 30 boys), 60 students with ODD (30 girls and 30 boys), were selected as the sample, totally 120 persons and they were compared regarding neuropsychological features. suggested the sample size for comparative-causative studies equal to 15 to 30 persons in each group. Likewise, all the 2 groups set out in the above were unified and compared concerning parental education, economical and social conditions of the family, and lack of other disorders.

### **Tools**

Connors neuropsychological questionnaire: Connors neuropsychological questionnaire for children and adolescents (25) for the evaluation of neuropsychological skills including attention, functional performances, sensory-motor functions, language functions, memory and learning functions. This questionnaire is completed by parents and teachers. Validity of this form by means of factor analysis method and the relevant reliability using Cronbach's Alpha method has been 0.90 and 0.85, respectively. In the present study, evaluation subscales and memory and learning measurement were applied. These subscales include: memory and learning, short term memory, long term memory, active memory, and general memory, all have been measured.

Connors questionnaire for the parents (PRS-48): Connors questionnaire for the parents was standardized by(26). In the present study, a 48 item version is used. This version is evaluating 5 factors (i.e. behavior, psychosomatic, impulsiveness, hyperactivity, anxiety, and learning problems) consist of 4 options, grading from 0 to 3 This questionnaire is being used to assess students with ADHD and is filled-in by their parents. Connors ADHD evaluation scales are considered to be of the first measurement and evaluation scales for ADHD and the existing sample is in fact the result of Connors' 30 years of doing research. Self-evaluation forms for parents, teachers, and adults are also available on long term basis. Short term form (parents=27 items; teacher=28 items; self-evaluation=27 items) and long term form (parents=80 items; teacher=59 items; self-evaluation=87 items). Any of the short term samples include subset that asks questions about hyperactivity, cognitive/inattention problems, opposition, behavioral problems, and ADHD. The long term sample is allocated to the parents and teacher including similar subsets to the short term format. In addition, other items are included as like anxiety/shamefulness, social problems, DSM-IV signs subscales, and Connors-Wallers Global Annexure (27). The sample related to parents also includes a psychological subset. Self-assessment scale designed by Connors-Wells is suitable for adolescents between 12-17 years old (27). In the long term sample of this scale, four major limitations of the short term scale are taken into account and family problems, anger control, sentimental problems, and DSM-IV subscale are also added. Any of the scales acting as an evaluator for the symptoms are graded based upon a four-options scale ranging from "absolutely wrong (0) to absolutely correct (3)" by(27). CRS scale can be purchased from Connors, which is available in French, Spanish, and English and has been standardized by using a standard database collected from 200 information websites (in the North America, various domestic samples). Fundamental data for the recent scales derived from 2000 parents, 2000 teachers, and more than 300 adults. Separate standards are also provided for the boys and girls between 3-17 years of age. CRS advantages include powerful psychological features and fundamental data. Likewise, availability of CRS in parents, teacher, and adults samples makes it suitable for clinical, scientific, and research applications. Disadvantages include price (1 USD) for each scale and grading especially the long term sample (28).

Oppositional Defiant Disorder Rating Scale (ODDRS): This scale was suggested by (29). To diagnose children with oppositional defiant disorder based upon DSM-IV-TR factors. This scale is applied to 5-15 year-old children. Reliability factors (internal parallelism) by Cronbach's alpha method and the validity factor by retest method were 0.92 and 0.95, respectively. Validity of this scale is also confirmed by 5 psychiatrists and psychologists. Generally, this scale has suitable validity and reliability to diagnose oppositional defiant disorder. This questionnaire is used for the diagnosis of children with ODD and is filled-in by the parents.

Table 1: Mean and standard deviation for various memory and learning types

Groups	Variables statistical indexes	Mean value	Standard deviation
ODD	Memory and learning	1/18	0/85
	Short term	1/04	0/58
	Active	1/6	0/65
	Long term	0/73	0/61
	General	0/63	0/69
ADHD	Memory and learning	1/55	1/043
	Short term	1/45	0/53
	Active	2/2	0/65
	Long term	1/09	0/62
	General	0/68	0/6

To test to assumption, memory and learning and relevant factors are classified in 2 groups and then created groups are compared two by two.

As there are more than one group and variable and no variable exists for control, multivariate analysis method and consequently pair comparison were applied so as to compare the groups two by two concerning the variables. Results are displayed in table 2. In addition, Box Test indicated that presumption for the co-variances equality for the multivariate analysis has also been observed ( $p > 0.05$ ).

Table 2: Summary of multivariate analysis results for the 4 groups

Variables/statistical indexes	Wilk's Lambda	F	Effect size	Meaningfulness level	Statistical power
Memory and learning and relevant factors	0.3	22.65	0.32	0.0001	0.99

As it is evident in table 2, multivariate analysis results indicate that a meaningful difference exists between four groups regarding centroid of memory and learning variables ( $p < 0.01$ ). In addition, results indicate that group membership determines 32% of changes related to the centroid of memory and learning and relevant factors ( $p < 0.01$ ). Statistical power equal to 0.99 indicates that sample size has been sufficient for analysis. Group membership for the individual variables is included in table 2 (continued).

Table 2: Continued

Dependent variables/statistical indexes	Total squares	Degree of freedom	Mean squares	F	Effect size	Meaningfulness level	Statistical power
Memory and learning	57/68	1	19/22	36/05	0/31	0/0001	0/99
Short term	45/82	1	15/27	48/86	0/38	0/0001	0/99
Active	137/22	1	45/74	109/65	0/58	0/0001	0/99
Long term	25/70	1	8/56	24/37	0/23	0/0001	0/99
General	14/23	1	4/74	12/96	0/14	0/0001	0/99

As you can see in the above table, variance analysis results show that a meaningful difference is evident between 2 groups regarding memory and learning ( $p < 0.01$ ). Likewise, the biggest difference is related to the active memory with 58% and the smallest one is related to general memory with 14%. To compare the groups two by two, LSD method was applied for which the results are displayed in table 3.

Table 3: Pair comparison of the 2 groups regarding memory and learning grades and relevant factors by means of LSD method

	Group (I)	Group (J)	Means difference	Meaningfulness
Memory and learning	ODD	ADHD	-0/37	*0/025
Short term	ODD	ADHD	-0/4	**0/001
Active	ODD	ADHD	-0/63	**0/0001
Long term	ODD	ADHD	-0/92	**0/0001
General	ODD	ADHD	-0/05	0/73

\*is meaningful in at 0.05 level

\*\*is meaningful at 0.01 level

## DISCUSSION AND CONCLUSION

Research results and pair comparisons between 2 groups regarding types of memory and learning ( $p < 0.001$ ,  $F = 22.6$ ). Additionally, pair comparison indicated that ADHD group gained higher meaningful scores than the group (ODD regarding all the memory and learning variables and relevant factors. Thus, there is a meaningful difference between memory and learning of children with ADHD and children with ODD. Therefore, research assumption is confirmed ( $p < 0.05$ ) and the results are conformed to the previous studies.

Additionally in a research by (30) on children with ADHD and children with reading learning inability, ADHD persons have shown deficits in processing speed, naming different things, behavioral prevention, and even variation during response, whether a combination of learning and memory inability or the ADHD itself while children with learning inability and a dominant form of learning inability to ADHD have indicated defective evidences of speech active memory, slow restoring speed, and low special vision processing.

Expression: According to the difference between memory and learning and the reason for greatness of this problem in children with ADHD, we would be able to express why memory and learning in these children is more vulnerable: sine these children usually have attention deficit, and memory and learning disorder in these children is due to the attention/executive functions deficits and disorders, and make disturbances in the active memory, and active memory disorders will create interferences in children both at the time of learning and restoring and the result will be learning disorders, and one of the problems in pre-school children with neuropsychological/evolutional learning disabilities would be the executive functions and attention disorders (16). One of the required abilities by children is learning the school lessons (21). Executive functions adjust behavioral outputs and usually include prevention and control the motives, working memory, cognitive flexibility, attention planning and organizing (22&23). Factors analysis indicated response prevention, working memory, self-adjustment, and interference control as the four executive function factors (24).

Executive functions and attention are the abilities required by children to learn school lessons in future (21). Executive functions adjust behavioral outputs and usually include prevention and control the motives, working memory, cognitive flexibility, planning and organizing (22). In other words, executive functions are the supreme capabilities including self-regulation, self-starting, planning, cognitive flexibility, working memory, organizing, dynamic understanding, future forecast, and problem solving that help the child in his/her daily activities and homework. Factor analysis has shown the four executive functions: response prevention, working memory, self-adjustment, and interference control (24). The research by (31) based upon neuro-imaging, have discussed the engagement of sub-cortex and thalamocortical processes in the pre-frontal networks. Under the influence of these findings, neuropsychological pattern related to ADHD has been proposed by neuropsychologists during recent decades. Cognitive deficits, particular damages in attention assumptions, and major executive functions are included in the above disorder. In the relevant studies, special attention is paid to the quality of executive functions amongst cognitive functions, which is addressing a group of mental operations as like: planning, active memory, retention and alteration of mental conditions, and prevention from dominant responses. Children with ADHD have indicated lower grades and weaker performance regarding vigilance, stained attention, motor preventions and speech and memory learning.

Other studies also confirm more damages among children with ADHD both in executive function and non-executive function groups than the control group, especially if the learning inability is a type of mathematics disorder (30).

It is said that deficits pattern is similar to the findings out of persons with pre-frontal lobe damages. This claim is considered to be the base for pre-frontal cortex deficits with ADHD (31). In some studies, special attention is paid to the quality of executive functions amongst cognitive functions, which is addressing a group of mental operations as like: planning, active memory, retention and alteration of mental conditions, and prevention from dominant responses. Indeed, this is a combination of the whole system different from basic functions, feeling, realization, language, memory, and executive functions deficits related to the pre-frontal cortex damages such that recent studies have discussed about damages in the cortical and sub-cortical structures of the brain or more penetrating damages. According to the past, knowledge related to the neurobiology of ADHD emerging from neuro-imaging studies and neuropsychology as a multi-branch science is developing very quickly. Key dimensions from this point of view as a prevalent disorder in children with ADHD including attention, executive function, discipline, motivation, and a group of incongruent behavioral and cognitive aspects are considered to be a reflection of neurobiological basis related to ADHD with parallel data processing patterns. These studies stated that functions in orbitofrontal and dorsolateral cortexes are interfered (32). Recent attentions by ADHD studies are paid to the role of prefrontal and upper sections as well as basic parts of the brain as like coudat nucleus of Globus pallidus. Neuropsychological, neuro-chemistry, and histological studies have focused on the different role of right hemisphere mechanisms especially for behavioral control and ADHD, and believed the multiple manifestations as the result of neural disorders especially pre-frontal and right hemisphere parietal and their connection with sub-cortical structures as like stratum, limbic system, and diencephalic cores (33). Data processing as the base for analytical studies is an outstanding aspect that focuses

on histology and neurotransmitters, as well as gender differences and plays an important role for the better determination of aforesaid disorder. A part of these findings are discussed in this study. MRI examinations show that studies based upon technology of some of the pre-frontal areas (upper, lower, frontal) and basal ganglia (Globus pallidus and coudat nucleus) in ADHD is approximately 10% smaller. Moreover, molecular genetic studies with polymorphism on people with ADHD have indicated that dopamine transmitting gene (D dopamine receiver gene) is engaged (34). Altogether, a remarkable set of studies have introduced dopamine and nor-epinephrine as the two neuro-chemical factors, and basal ganglia as the nervo-muscular factors specifically responsible for ADHD (32).

One of the most outstanding neuropsychological theories indicates the relation between symptoms of the above disorder and ADHD, executive functions disorder, and is considered to be a cognitive-neural problem solving process to reach the targets. Executive function addresses to a person's capabilities of behavior stability in a set of targets besides the complexity of behavioral organization. The most sensible pattern could have explained the practical implications of cognitive control as like response prevention, response alteration, opposition discovery, stabilize the active memory through the control of mental intervention, preventing from offensive oppositional responses, and response adjustment through awareness. In this respect, executive functions consist of: intervention control, prevention, alteration, design, and active memory ... it is said that aforesaid mechanisms can be related to the sections of basal-cortical ganglia and thalamus separately and in parallel, which is modulated by dopamine (34).

Moreover, biological attitudes are based upon the belief that neuropsychology is influential and is related to the functions of brain frontal areas (31). In addition, medical treatment effects for these patients indicate that biological-neural basics are engaged in ADHD. Neuropsychological studies in this period of childhood illnesses confirm the efficacy of medical treatment on the patients' functional quality. For example, it is said that children's response to the incorrect functional assignments without medical treatment is slower than the compared group. This slow response indicates problems in movement preparations not the movement itself and incorrect responses are the reflections of problems in response prevention and selective attention, impulsivity, and hyper-vigilance. As such, children under medical treatment displayed a few incorrect responses regarding impulsivity, although they did not have any lag for their movement preparations. At the end, researchers summarize the initial findings as below:

Stimulant drugs may resolve some of the deficits related to executive function, attention, and movement (35). Bonsera and colleagues have found in a cross research on the consumption of blind reciprocal on adults with ADHD along with methylphenidate placebo that aforesaid drug could improve the preventive problems as the major difficulty in ADHD and has improved some of the other cognitive capabilities in our patients. Odriskol in his study on the boys with ADHD under different sub-groups has addressed to the positive effects of methylphenidate on response prevention and motor planning in the subgroups with ADHD, inattention symptoms, and ADHD with compound signs (36).

#### **Recommendations:**

If possible, use the experimental plans in which it is possible to highly control the internal validity.

Doing the present research on a larger sample and different populations may lead to more certain and general data. It is suggested to do such researches in different social and cultural levels that can be generalized to the whole society.

If possible, it is recommended to apply interview and other tools along with the present ones in future researches.

It is proposed to harmonize questionnaire completion terms for different groups in future studies and control the environmental factors.

In addition, coincidence of both disorders, gender differences, differences in various disorders, stability of symptoms during the time along with linear studies, relation between response prevention and active memory have to be considered in ADHD.

#### **Applied suggestions:**

First of all, mental health experts must be informed about the existence of neuropsychological features in nuisance disorders. This is feasible through the followings:

Training courses for the prevention and treatment, in which neuropsychological features are taken into account

Application of the results of this study for the etiology and evaluation of nuisance disorders

Necessity to hold training courses in cultural centers as like cultural centers, educational centers, consultancy centers

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