

The Comparison of response inhibition, planning and reconstitution of thought in ADHD and normal children

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Abstract: Attention deficit disorder/hyperactivity (ADHD) is the most common childhood disorders. In explaining ADHD is referred to deficits in executive functions. Hence, the objective of the current study is to compare some executive functions in ADHD and normal children. In this present study, 25 ADHD children of combined subtype, 25 ADHD children of inattentive subtype and 25 normal children were selected. In this study, the children symptom inventory, Raven's Coloure Progressive Matricies Test (RCPM), Stroop Color- Word Test, Tower of Hanoi puzzle, and Vygotsky's test were used. In order to analyze data, the researcher used MANOVA and follow-up test. The results indicated that there is significant difference between response inhibition, planning and reconstitution of thought in ADHD and normal children. The result also indicates that the function of ADHD children with combined subtype were weaker than attention ADHD children with inattentive subtype. It can be concluded that ADHD children have deficit in executive functions. But it is necessary to note that there are different executive functions in subtypes of this disorder.

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1. Introduction

Attention deficit disorder /hyperactivity (ADHD) is the most common childhood disorders. According to Diagnostic and American Psychiatric Association's and statistical Manual (DSM) estimated prevalence of this disorder in children between 3 to 7 percent (APA, 2000). This disorder is defined through three primary symptoms of Inattention, Hyperactivity and Impulsivity. In recent years, these three signs in the form of both individual behavior and the dimensions of inattention, hyperactivity/ impulsivity have shown by using the results of the factor analysis (Barkley, 2006). With respect to two dimensions, DSM considered three different subtypes including predominantly inattentive subtype (ADHD-I), Impulsivity subtype, and combined subtype (ADHD-C). The conducted research in behavioral, genetic, neuropsychological areas and the studies relating to Structural imaging and brain interaction, prefrontal lobe frontal and executive dysfunction support this disorder.

Executive functions is an umbrella term covered many cognitive process which serve the targeted behaviors and actions (Barkley, 2006; Nig, 2006). From the point of view of Nero- psychology, executive functions are a part of activities that patients suffering from frontal lobe hurts are not able to do them (Tehranidost, 2002). Penington and Qzonoff (1996) by reviewing researches which were related to the executive functions of children

suffering from ADHD, found out that about 15 to 18 surveys have pointed to the significant differences between people suffering from ADHD and ordinary people in one or more executive function's measures. Inhibition is main components which are under the umbrella of executive functions (Gorfein & MacLeod, 2007). Lack of inhibition is mostly related to attention's constructions and impulsivity (Schachar et al. 2000). Many studies have shown that inhibition in people with this disorder is a failure. Lezak et al. (2004) defined this executive action as the ability to identify and organize the required steps and elements to accomplish a purpose or achieving a goal. Since the planning ability is a part of excellent actions of cortex prefrontal, it is believed that hurt or disorder in prefrontal areas and some areas of brain 's cortex is significantly related to the children's planning ability (Lezak et al. 2004; Fuster, 2008). In most researches that have measured planning ability in people who are suffered from ADHD, found out significant difference between their function compared with normal children (Nigg et al. 2002; Vilkat et al. 2005; Kopesky et al. 2005; Young, Toone, Tyson & Morris, 2007). It is necessary to note that Geurt et al (2005) in their research found that there is not significant difference among subtypes. In addition, reconstitution of thought is one of the executive functions that referred to conceptual model of Barkely (1998). This empowerment is a goal-oriented creativity that enables individual to cross from

situations that be needed to problem solving. Functions of reconstitution of thought also includes of another competence entitled verbal fluidity (Barkely, 1998). Geurts et al (2005); and Shallice (2002) conducted a research. They found that there is no significant difference among two groups of reconstitution of thought. Barkely (2003, 2005) maintain that hyperactive children in response to the events have less ability to analyze and synthesize and so purposeful creativity reduce. Since different results cited in the relevant literature, therefore; the objectives of the present study is study executive functions such as response inhibition, planning and reconstitution of thought in ADHD and normal children.

2. Methods

The present study is causal- compare experiment. The study sample consisted of ADHD children with ages between 8 and 11 years old of Tabriz city. The sample consisted of 75 children which composed of 50 ADHD children. Among these 50 children with ADHD, 25 individuals were ADHD-C children and the rest were 25 ADHD-I children. In order to collect data, the researcher used the children symptom inventory and clinical interview in the present study. 25 normal children whom their age were between 8 and 11 years old were selected with respect to variables such as age, intelligence, gender. The sampling method of the ADHD children was available sampling and normal children (control group) were selected randomly. In this study, the children symptom inventory, Raven progressive matrices test, and Stroop Color- Word Test, Tower of Hanoi puzzle, and Vygotsky test were used.

2.1. Instrument

Children symptom inventory (CSI-4): This inventory is behavioral rating scale which was developed by Gadow and Sprafkin (1984). In order to screening emotional and behavioral disorders of children, this inventory was designed and edited by Gadow and Sprafkin (2007). Children symptom inventory (CSI-4) consisted of two forms relating to parents and teacher. In this study, parents form was used which consisted of 97 items for screening 15 emotional and behavioral disorders. Eremis (2009) reported the reliability of this inventory 0.72% and construct validity also was confirmed by Suveg (2009). In Tavakolizade research in Iran (1376) the validity of parent's form got with test – retest method and it's validity up holded by using expert 's ideas according to the correct translation and adapting it with the main content too. Raven's Coloure Progressive Matricies Test (RCPM): This test is a non-verbal intelligence test and was originally

developed by [John C. Raven](#) in 1936. In each test item, the subject is asked to identify the missing element that completes a pattern. Many patterns are presented in the form of a 4x4, 3x3, or 2x2 [matrix](#), giving the test its name. Stroop Color-Word Test: In [psychology](#), the Stroop effect is a demonstration of the [reaction time](#) of a task. When the name of a color (e.g., "blue," "green," or "red") is printed in a color not denoted by the name (e.g., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. The effect is named after [John Ridley Stroop](#) who first published the effect in English in 1935. The effect had previously been published in Germany in 1929. The original paper has been one of the most cited papers in the history of [experimental psychology](#), leading to more than 700 replications. The effect has been used to create a psychological test (Stroop Test) that is widely used in clinical practice and investigation. Tower of Hanoi Puzzle (TOH): is a mathematical game or puzzle. It consists of three rods, and a number of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top, thus making a conical shape. The objective of the puzzle is to move the entire stack to another rod, obeying the following rules:

- Only one disk may be moved at a time.
- Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
- No disk may be placed on top of a smaller disk.

With three disks, the puzzle can be solved in seven moves.

Vygotsky Test:

In order to how to measure reconstitution of thought, the researcher used Vygotsky Test. The aim of vygotsjy test is to show concept formation test, how to combine ideas and consider them to be rebuilt. The test is made of 22 wooden beads in the shape, color, size and height of the four types. The scoring of this test is performed by using the formula and record the running time and the number of test piece. Hashemi and Alipour (2000) calculated relaibility cronbach's alpha 0.76% in their study.

2.2. Procedure

In order to identify ADHD children, from among 9-11 year-old boys who as children were

suspected of having the disorder, individuals were selected and after obtaining written consent from the parents and complete CSI-4 parent form and clinical interviews with children, and the disorder subtypes were determined. Then, the selected tests were performed on children and the results were registered. It is necessary to note that children's IQ was at least 90 on the Raven test. In order to analyze and interpret, the researchers used MANOVA and Levene's significant difference (LSD) follow-up test.

3. Results

As it can be seen, the table (1) indicates mean and standard deviation different test-takers performance on Tower of Hanoi Puzzle (TOH), Stroop Color-Word Test, Vygotsky test.

In order to investigate difference group's performance in these tests, multiple analyses of variance (MANOVA) were used. As the table (2) indicates that there is significant difference between group's performance on planning, response inhibition and reconstitution of thought.

In order to pair sample comparisons on group's performance Levene's Significant difference (LSD) in variables (including, planning, response inhibition and reconstitution of thought) were used.

Table 1. Mean and Standard deviation different test-takers performance of normal and ADHD Children

Subjects		Variables	N	Mean	St. dev
ADHD-	Planning (Hanoi Puzzle)	Numbers of errors	25	4.48	2.46
		Time off pattern	25	84.08	52.76
		Number of moves	25	15.24	6.75
	Response inhibition (Stroop test)	Numbers of errors	25	9.84	4.99
		Time off test	25	129.72	36.28
	Reconstitution of Thought (VigotskyTest)		25	371.88	110.33
ADHD-C	Planning (Hanoi puzzle)	Numbers of errors	25	16.16	9.85
		Time off pattern	25	146.8	76.26
		Number of moves	25	31.96	13.34
	Response inhibition (Stroop test)	Numbers of errors	25	28.68	6.47
		Time off test	25	178.12	52.95
	Reconstitution of Thought (Vigotsky Test)		25	565.96	131.87
Normal	Planning (Hanoi puzzle)	Numbers of errors	25	0.24	0.435
		Time off pattern	25	30.84	19.07
		Number of moves	25	7.4	0.654
	Inhibition Response (Stroop test)	Numbers of errors	25	0.80	1.25
		Time off test	25	61.04	12.66
	Reconstitution of Thought (Vigotsky Test)		25	255.6	51/64

Table 2. Multiple analyses of variance (MANOVA) in difference group's performance

	Trace	Trace rate	F	Df	Mean St. dev.	Sig	Co Eta
Group	Pillai's trace	1.104	13.97	12	0.136	0.001	0.552

Table 3. pair sample comparisons

Dependent variable		Group A	Group B	Average differences	Mean St. dev	Sig
Planning	Number of errors (Hanoi puzzle)	Normal	ADHD-I	4.24	1.66	0.013
			ADHD-C	15.92	1.66	0.001
		ADHD-I	ADHD-C	11.68	1.66	0.001
	Time off pattern	Normal	ADHD-I	53.24	15.59	0.001
			ADHD-C	115.96	15.59	0.001
		ADHD-I	ADHD-C	62.72	15.59	0.001
Response inhibition	Number of moves	Normal	ADHD-I	7.84	2.44	0.002
			ADHD-C	24.56	2.44	0.001
		ADHD-I	ADHD-C	16.72	2.44	0.001
	Numbers of errors (Stroop test)	Normal	ADHD-I	9.04	1.350	0.001
			ADHD-C	27.88	1.35	0.001
		ADHD-I	ADHD-C	18.84	1.35	0.001
	Time off test (Stroop test)	Normal	ADHD-I	68.68	1.35	0.001
			ADHD-C	117.08	10.68	0.001
		ADHD-I	ADHD-C	48.40	10.68	0.001
Reconstitution of thought (Vigotsky Test)		Normal	ADHD-I	116.28	10.68	0.001
			ADHD-C	310.36	29.31	0.001
		ADHD-I	ADHD-C	194.08	29.31	0.001

As it can be seen, the above table shows components of number of errors and spent time on Stroop test in response inhibition. Based on the obtained results, there is significant difference between normal and ADHD children. The result also indicates that there is significant difference between ADHD-I children and combined subtype (ADHD-C). According to results, there are significant difference between normal children and ADHD children in components of number of errors (Hanoi puzzle), Time off pattern and Number of moves (Planning variable). Also above results observed between ADHD-I and ADHD-C children. In general, ADHD children in comparison with normal children, had worse performance in each all third variables. This worse performance also observed in ADHD-C children in comparison with ADHD-I children. The result also indicated that there is significant difference among groups in reconstitution of thought at 0.01 levels.

4. Discussion

Attention deficit disorder / hyperactivity (ADHD) is the most common childhood disorders (Barkely, 2006; Fuster, 2008). The main core of many explanatory theories is deficit in response inhibition (Barkely, 1997, 2005, 2006; Nigg, 2006). In order to study response inhibition, the researcher used Stroop Color-Word Test. In general, the duration of card reading time and reading errors in the ADHD group was significantly more than the control group. Since children with ADHD are less of attention, so they spend more time reading. On other hand, reading out color card involves two functions: first, conceptual inhibition and second change to another field. Since this function requires attention and concentration, ADHD children spend more time on reading it. On other hand, reading color cards involves two performances: First refers to conceptual skill which comes from mind and second refers to changing into another area. Hence, since this function requires attention and concentration, ADHD children spend more time on reading it. These findings are consistent with the findings of Sergent et al (2002), Shouwiger et al (2007); Lasenberg et al (2007); Shalis et al (2002); Golden et al (2002). This subject of the present study can be supported by Barkely theory. The results also suggest that performance on ADHD combined subtype is worse than ADHD inattention subtype children. This result is consistent with the findings of Nigg et al (2002), Klerman et al (1999), Likkod et al (2001). However, this result is not consistent with the findings of Murphy et al (2001), Guerts et al (2005). The results also indicate that there is significant difference in comparison of planning with ADHD children and normal children.

These findings are consistent with the findings of Sergent et al (2002), Klerman et al (1999), Papa douplos et al (2005), Wilkat et al. (2005), but these findings are not consistent with Hokton et al. (1999), Skeres et al. (2004). On other hand, the result shows that ADHD children's performance with combined subtype in proportion to inattention subtype is weaker. These findings are consistent with the findings of Brakley et al. (2005), Nigg et al (2005), Kopeski et al (2005), and Wikat et al (2005). However, Geurts et al (2005) conducted a research on subtypes by using meta-analysis. They found that there is not significant difference among subtypes. Barkely's theory (2008) is an explanation for this difference. The Barkley model is a system of hierarchy. Response inhibition locates at the top of the hierarchy and executive functions at the bottom. He believes that the response inhibition causes delayed response to an event. During delaying in responding, the actions of executive are formed. In other words, response inhibition leads to executive functions occur and keep them from interfering. Barkley (2005) stated that ADHD-C due to executive dysfunction in inhibition and planning recognized. The analysis of data indicated that there is significant difference among these three groups in reconstitution of thought. Meanwhile, these findings are not consistent with the findings of the Guerts et al (2005), Murphy et al (2001). These scholars did not see the significant difference between attention inhibition subtype and combined subtype. In explaining these findings, it can be found in Barkley's theoretical predictions. Response inhibition plays a crucial role for the formation of re-thinking. Barkley(2003 , 1998) stipulated that children suffering ADHD have less combination and analysis ability in responding events because of deficit in behavioral inhibition system , it means that these children are unable to create multiple projects for helping to purposeful behavior and so their creativity will decrease. As a result, the findings of the present study are consistent with Barkely's Theoretical predictions. In general, the results of the present study suggest that performance of ADHD children compared with normal children in response inhibition tasks, planning and reconstitution of thought is weaker. It is hoped that in the further researches by use of large sample grope and control variables such as comorbid disorders with ADHD, executive function exactly are studied.

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