

# Comparing Executive Function Between Adolescents With Conduct Disorder and the Normal Ones in Iranian Population

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## Abstract

**Background:** Although conduct disorder during the past few decades experienced a rapid extension, few researches are done on the role of executive function in this disorder. The current study aimed to investigate the role of executive functions in task disorder.

**Materials and Methods:** It was a causal-comparative study. The study sample consisted of adolescents with conduct disorder kept in a juvenile institution in Isfahan, Iran, in 2013. The sample of 60 patients included 30 adolescents with conduct disorder and 30 normal ones. The accessible sampling method was used and continuous performance tests and the Wechsler subscale of similarities and numerical memory were performed on them.

**Results:** There was a significant difference in the executive functions of working memory and fluid reasoning, between normal adolescents and the ones with conduct disorder. The mean of fluid reasoning ( $P > 0.001$ ) and working memory ( $P > 0.001$ ) in normal adolescents was significantly greater than that of the ones with conduct disorder. But there was no difference between the two groups in sustained attention. The performance of the conduct disorder group in functions of working memory and fluid reasoning ( $P > 0.001$ ) was lower than the normal group.

**Conclusions:** According to the study findings, compared to the normal group, the conduct disorder group had a lower performance in executive functions. Therefore, to provide therapeutic interventions for conduct disorder, more attention should be paid to the role of deficits in executive functions.

**Keywords:** Adolescents, Conduct Disorder, Executive Function

## 1. Background

During adolescence, the risk of emotional and behavioral problems increases and it can greatly affect character maturity and functions of a person (1). The results of some longitudinal researches show that long-term consequences of child and adolescent behavior problems, especially issues often involve a wide range of social maladjustment in adult life such as drug addiction, immoral family relations and illegal activities (2-4). As a result, the factors that contribute to the development of a healthy adolescent, or affect it negatively, need more exploration.

The conduct disorder is a disorder of adolescence period, that was recognized very long ago, and this is partly due to the social impact of its constituent behaviors (5). Herpertz et al. (6) acknowledged the fact that about 50% of boys with conduct disorder, show anti-social behavior in adulthood and the risk of antisocial personality is very high for them.

Researches showed that certain types of behavior disorders, such as conduct disorder and oppositional defiant disorder, among other emotional disorders, increases quickly during school years. This type of disturbing behav-

ior is shown in a number of repeated conflicts with teachers, friends and others at school (5). Causing trouble to others, destroying people properties and disobeying unique individuals, such as parents and teachers, are some characteristics of these youngsters. Although this kind of behavior is shown randomly, it gradually expands to other situations, especially those that require social cooperation (7).

Cohen (8) introduced a number of dangerous factors which are effective in the emergence of such behavioral disorders. These dangerous factors include biological and socio-cultural factors and life experiences. Cohen emphasized that none of these factors alone can be responsible for conduct disorder in children, and the impact of various factors on the emergence of such disorders should be analyzed and new experiments are needed. Morrell (9) had a bio-social approach to behavioral disorders such as conduct disorder. He believes that social and biological factors alone cannot explain behavioral problems in conduct disorder. However, the interaction between biological and social factors leads to this disorder.

Executive function is a general term that encompasses all complex cognitive processes which are critical in doing difficult or serious goal directed jobs (10). Executive

functions change during the growth process and with the growing of the child and gradually help individual to carry out harder and more complicated jobs and school works. A defect in executive functions can cause remarkable consequences on the individual's social, emotional and cognitive performance (11).

From the neuropsychological point of view, the term is associated with a wide network of frontal cortex functions and includes a number of cognitive and meta cognitive processes such as self-regulation of behavior and the development of cognitive and social skills formed throughout children's course of evolution (12, 13).

One of the executive functions is sustained attention. Attention or awareness has an important role in facilitating the regulatory process and voluntary control over actions, in a way that training programs of attention process are increased due to brain plasticity, managerial attention and voluntary control (14). Attention can act as an operation that helps other cognitive functions such as encoding and retrieval (13); therefore, the output and quality of attention processes can have a great influence on the quality of other cognitive functions and their products.

Suggested evidence links the deficits of maintenance and attention focus to children's aggression (11, 15). In a 10-year follow-up of a sample population, Mirsky (16) prepared various attention scales that included continuous performance test for teenagers. Aggressive adolescents compared with other adolescents had some problems in concentrating and keeping attention on the continuous performance test. These deficiencies in attention create shortcomings in the data switching and in turn individuals do not understand some of the appropriate pieces of information (omission errors) and they perceive the information that is not provided; Therefore, it seems that the solutions of boys with disorder for social problems are affected by the significant effects during long-term memory retrieval and the learned patterns stored in memory (17).

Working memory is another kind of cognitive functions. Working memory is the thinking center. Working memory is a system that is responsible to process and temporarily store the information and is also crucial for high levels of cognitive functioning (18). Producing new strategies, generating solutions in conflicting situations, perceiving motivations, etc. all take place in the working memory. Incoming information from sensory memory and stored information in long-term memory are combined and make a new form (19). Memory forms one of the foundations of learning, thinking, creativity, planning and daily behaviors. All social behaviors need memory.

A number of researches found evidence for memory deficits in children and adolescents with conduct disorder (11, 20, 21). These researches suggest that attention injuries

may lead to a distinct pattern of deficits in retrieval memory for aggressive children. In addition to the retrieval injury of short-term memory which is a harm to assessment processes, aggressive children have special styles of retrieval strategies from long-term memory that involve in deficits associated with social problem solving.

The other executive function is fluid reasoning. Fluid reasoning is known as relational reasoning, i.e., the ability to manipulate representation between stimuli for reasoning and planning and problem solving by attention, working memory and perceptual and cognitive skills (22, 23) and consists of a combination of relations, inhibition control and distinction of interactions and is considered as a core component of fluid intelligence (22, 24). In fact fluid reasoning is essential for all tasks that are known with executive functions (23) and may comprise a source of executive functioning which is effective in self-regulation, cognition and behavior (25).

Both executive functions and fluid reasoning are two aspects of intelligence and are related due to frontal lobe function. While both structures significantly overlap, the distinction between them is indiscrete and unclear. Based on an empirical consistency, a significant correlation was found between these two structures. Factor analysis also provided evidence about the similarity of these structures (22).

A number of studies showed that the prevalence of conduct disorder is growing among adolescents (1, 26, 27) and in recent years it doubled among young girls and boys (28). Therefore, the need for such researches to increase the knowledge about the factors involved in the pathogenesis of the disorder becomes clearer. Therefore, the current study aimed to compare the development of executive function in adolescents with conduct disorder and the normal ones in an Iranian sample population.

## 2. Materials and Methods

### 2.1. Participants

It was a causal-comparative study. The research subjects included all the boys with conduct disorder (12-16) in the center for rehabilitation and training in Isfahan, Iran, in 2013. The participants consisted of 30 teens with conduct disorder and 30 normal teens matched with patients, according to demographic features such as age and gender. Sampling procedure in the conduct disorder group was done by intact group method. First by going to the rehabilitation and training center, the child survey inventory (CSI)-IV and teacher form was filled by the center's psychologist. In this study, 40 subjects were diagnosed with conduct disorder, which 10 out of them also had attention

deficit hyperactivity disorder (ADHD); therefore, they were excluded from the study. Also, to select the control group, among 100 students in a school in district three of Isfahan 30 subjects were selected arbitrarily by random selection method to participate in the research. Exclusion criteria for both groups were: age (12 - 16 years), gender (only male) and having ADHD.

The following instruments were used in the study to collect data:

### 2.2. Subscales of Similarities and Digit Memory of the Wechsler Intelligence Scale

Working memory function was evaluated by the subscale of digit memory and the reasoning function was evaluated by the subscale similarities of the Wechsler intelligence scale. Wechsler intelligence scale for children was approximately an analytical test, and its grading is done according to the amount of subject's success. This test is appropriate to test children aged 6 - 16 years old. The reliability of these subtests were reported through retesting digit memory subscale 0.78 and similarities subscale 0.86 (29).

### 2.3. Continuous Performance Test

Continuous performance task is used to measure the focused attention (30). In the present study, the test stimuli were the numbers zero to nine. Numbers appeared randomly on the computer screen for half a second and the time of next number appearance was one second. Totally, numbers were presented to subjects in six blocks that contained 66 numbers each. The subjects task was to press the ENTER key quickly as soon as he saw the number and he should not respond to the number 5. Variables of this analysis included: 1) Omission errors: If the subject won't press the key, when confronted with the target stimulus, 2) False alarm error: If the subject pressed the key when saw a non-target stimuli, 3) Reaction time for correct responses: Mean reaction time for correct responses to the target stimuli, in milliseconds. Omission errors and reaction time are associated with attention deficit and false alarm is associated with impulsivity (31). The test reliability through retesting for different parts was 59% - 93% (32).

### 2.4. Child Survey Inventory

The questionnaire is a behavioral rating scale and includes two parent and teacher forms and contains nine main categories of behavioral disorders. In this study, the teacher form was completed by the institution's psychologist for all subjects. Each of these groups had its own subsets and special questions. Conduct disorder is one of

these groups that questions 27 - 41 in the questionnaire relate to this disorder. Responses provided to each of the test materials are scored on a Likert- 4-option scale. Reliability of CSI-IV, as a screening tool for emotional and behavioral disorders of Iranian children, was reported as fairly good based on re-test method (33). In the present study, the reliability coefficient of task disorder scale measure, using Cronbach's alpha, was 0.87, and this high coefficient indicated internal consistency of the questions that compose the scale. Also the results of expert judgment approved that the marking complied with the assessed CSI-IV content areas (33).

Finally, the collected data were analyzed by multivariate analysis of variance (MANOVA).

## 3. Results

Table 1 shows the scores of the two groups in the following components sustained attention, working memory and fluid reasoning.

**Table 1.** Mean and Standard Deviation of Total Errors variations and Preservative Errors in Wisconsin Test and Working Memory in Normal Subjects and the Ones With Conduct Disorder

Variables		Subjects With Conduct Disorder	Normal Subjects
The dimensions of sustained attention	Omission errors	19.71 ± 26.28	7.46 ± 14.84
	False alarm errors	21.5 ± 3.41	23.46 ± 10.1
	Mean response time	387.8 ± 50.7	404.9 ± 47.8
Fluid reasoning		2.80 ± 0.55	8.13 ± 0.55
Working memory		5.3 ± 1.91	10 ± 2.1

Before using parametric multivariate analysis of variance test to comply with its assumptions, the Box test and Levin test were used. Based on the Box test that was not significant for any of the variables, the condition of homogeneity of matrices variance/covariance was properly observed.

As can be observed in Table 2, according to Levin test and its insignificance for all variables, the condition of homogeneity of variance between groups was observed. Therefore, the MANOVA test was applicable.

The Wilks Lambda statistic characteristics showed that the effect of the group on the combined components of sustained attention, fluid reasoning and working memory was significant. This test confirmed the usability of multivariate analysis of variance (MANOVA). The results showed

**Table 2.** The Results of Levine Test for Equality of Variances Assumption Between the Two Groups in Total Errors and Preservative Errors in Wisconsin Test and Working Memory

Variable Comparison	Subcomponents	F	Degrees of Freedom 1	Degrees of Freedom 2	Significance Level
Sustained attention	Omission errors	3.23	1	38	0.08
	False alarm errors	30.97	1	58	0.21
	Mean response time	0.51	1	58	0.48
Fluid reasoning		0.139	1	58	0.712
Working memory		0.24	1	58	0.62

that at least one of the parameters between the two groups was significantly different (Table 3).

Results of multivariate analysis of variance showed no significant difference between the mean scores of the components of sustained attention, including omission errors ( $P > 0.131$ ) and false alarm errors ( $P > 0.498$ ), and the mean response time ( $P > 0.35$ ) between the two groups, but the means of fluid reasoning ( $P > 0.001$ ) and working memory ( $P > 0.001$ ) in normal adolescents were significantly greater than those of the ones with conduct disorder (Table 4).

#### 4. Discussion

The current study compared the executive functions of sustained attention, current reasoning and working memory in adolescents with and without conduct disorder. Based on the previous statements the research hypotheses can be examined.

The first hypothesis of the study suggested that adolescents with conduct disorder compared with their normal counterparts show significant deficits in sustained attention, and this point contrasts with the findings of Urazan-Torres et al. Giancola et al. and Mirsky (11, 15, 16) that stated no difference between the two groups, regarding sustained attention.

Since children and adolescents of this study resided in a juvenile institution and their parents were inaccessible, it was impossible to realize whether the age of onset of conduct disorder was in childhood or in adolescence, and it was likely that the disorders of most of the current sample had begun in adolescence that usually had fewer neurological deficits (8). Moreover, since these people were residing in a juvenile institution several months of medical interventions had been done on them, it is possible that these medical interventions and treatments lead to reducing the severity of the symptoms and also significantly decrease the severity of attention defects in individuals.

The second hypothesis of the study suggested that adolescents with conduct disorder compared with normal peers, showed significant deficit in fluid reasoning and it

was in accordance with the findings of Morrison et al. and Cho et al. (22, 23).

The research findings showed that adolescents with conduct disorder, had deficiency in fluid reasoning, and to understand this deficiency it should be noted that similarities subtests need the ability of verbal conceptualization and abstract reasoning. Similarities subtest requires the ability of verbal conceptualization and abstract reasoning. These functions act as a mediator for the individual awareness of taking everyday objects and events in the world. A fundamental aspect of individual adaptation to their environment is to apply these abilities to clarify, reduce and classify the manner in which it responds. This requires inductive reasoning since the subject should move from special facts to a particular rule or principle.

People with good introspection capabilities, usually obtain a high score in these subtests; also, people with low score, have weak abstraction ability and inflexible thinking. This subtest is sensitive to the left hemisphere lesion, especially to the left temporal or frontal damage (24); in addition, adolescents with conduct disorder have no cognitive flexibility (11) and damage to the frontal lobe (8, 11); therefore, poor performance in this executive functions is because of the frontal lobe damage and cognitive inflexibility.

The third hypothesis of this study suggested that children and adolescents with conduct problems compared with normal children and adolescents show significant deficits in working memory and it is in agreement with the findings of Urazan-Torres et al. (11), Abolghasemi and Kiamrasy (21).

The third hypothesis suggested that adolescents with conduct disorder had significant deficits in working memory; therefore, it should be noted that working memory is a system responsible for information processing and temporary storage of information and is also necessary for high-level cognitive performances (18). Working memory is a system responsible for processing and temporary storage of information and is necessary for high levels of cognitive functioning (18). Working memory is the ability to hold information in mind while performing complex tasks. The

**Table 3.** Results of MANOVA Tests of Significance for the Main Effect of the Group Variable on the Dependent Variables

Variable	Test	Value	F	Significance Level
Group	Pillai trace	0.926	27.90	0.001
	Wilk's Lambda	0.074	27.90	0.001
	Hotelling trace	12.55	27.90	0.001
	Roy's largest root	12.55	27.90	0.001

Abbreviation: MANOVA, multivariate analysis of variance.

**Table 4.** Results of Multivariate Analysis of Variance on the Mean of Working Memory, Total Errors and Preservative Errors in Wisconsin Test of Normal Adolescents and the Ones With Conduct Disorder

	The Dependent Variable	Sum of Squares	Df	Mean Square	F	Significance Level
Group	Omission errors	1086.23	1	1086.23	2.43	0.131
	False alarm errors	28.008	1	28.008	0.47	0.498
	Mean response time	2119.66	1	2119.66	0.87	0.35
	Fluid reasoning	213.13	1	213.13	46.61	0.001
	Working memory	163.33	1	163.33	39.65	0.001

study used Wechsler digit memory test to assess working memory. Digit span is a test for short-term memory. Subjects should remember auditory information in a right order and repeat it (24). Marnat (24) stated that right answers require a two-step process. First, the information should be received accurately, which requires attention and switching. Those who are easily distracted may have problems at this stage. Second, the participant should remember the information correctly consider its sequence and also express it. Sometimes, when the subject wants to express the current number, the previous number is forgotten. However, the direct numbers are easier tasks and require a longitudinal memory. Reverse numbers are more complicated. It seems that individuals who are active and have no anxiety receive the best score in this test. It requires an effortless relation that is almost inextricably linked to the fact, and is characterized by the adoption of open and free information. Increased anxiety or stress reduces function and the digit span subtest is the most vulnerable in times of anxiety. Since anxiety is much more widespread than expected in adolescents with conduct disorder (24), about one-third of these people have depression with anxiety (1), and also adolescents with conduct disorder have frontal lobe damage (8, 11), and additionally one of the most persistent pathological changes after frontal lobe damage is a phenomenon called antisocial syndrome (24); hence, defect in working memory may be attributed to high anxiety and damage to the frontal lobe of the adolescents.

The studies suggest that attention damage may lead to distinct pattern of deficits in retrieval memory in aggressive children. In addition to the recovery deficit of working memory that beats the evaluation processes, aggressive children have special styles of recovery strategies that involve in deficits associated with social problem solving.

Certainly any special study or research activity has some challenges and troubles. The current study was not an exception and faced a variety of constraints and problems. Some of these limitations were the small volume of the sample and a sample of just the boys; therefore, it is recommended that other researchers have larger volume of samples and take the gender variable into consideration; hence, the generalization of the results can be more confident.

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### Footnotes

**Authors' Contribution:** Hasan Sabori Moghadam, Abbas Bakhshipour, Yousef Jamalpour and Mohamad Ali Nazari conceived and designed the study. Yousef Jamalpour collected the data. Hasan Sabori Moghadam,



Abbas Bakhshipour, Yousef Jamalpour and Mohamad Ali Nazari interpreted the data. Yousef Jamalpour drafted the manuscript. Abbas Bakhshipour, Yousef Jamalpour and Mohamad Ali Nazari Performed the statistical analysis. All authors read and approved the final manuscript.

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