IPA
International Journal of Psychology
Vol. 7, No. 1, Winter & Spring 2013
PP. 27-48

Iranian **P**sychological
Association

Attentional Performance in Boys with Autism Spectrum Disorder

Hassan Shahrokhi, PhD
Child and Adolescent Psychiatrist

Leila Mehdizade Fanid, PhD*
Department of Animal Biology
University of Tabriz

Toraj Hashemi, PhD
Department of Psychology
University of Tabriz

Majid Mahmood Aliloo, PhD
Department of Psychology
University of Tabriz

Abbas Bakhshipour, PhD
Department of Psychology
University of Tabriz

Neda Yadegari, MA
Department of psychology
University of Tabriz

Shahrokh Amiri, PhD
Department of Psychiatry
Tabriz University of Medical Science

Attentional dysfunction has been shown as a core deficit in autism spectrum disorder (ASD). Attention and concentration affect children with autism in many ways. Impairment in these areas influences learning, memory, daily living skills, and cognitive ability. For instance, the abilities to inhibit responses, discriminate relevant from irrelevant information, utilize system of rules, and solve problems, which are dependent on a child's memory and concentration. Therefore, in the present study, the possibility of deficit in attention in 15 high functioning children with autism spectrum disorder aged between 6-13 years old were evaluated. The assessment procedure included sustained attention using a Continuous Performance Test; and shifting attention using a Wisconsin Card Sorting Task involving different categories for sorting; focusing and selective attention, using the Stroop Test; working memory, using Digit Span, Coding-Digit Symbol and Arithmetic subtests of the Wechsler Intelligence Scale for Children (WISC-R). The results indicated that attentional impairments in high functioned autistic children, where they were observed, are at the conceptual level, with implications for executive functions and the monitoring of novel information, and for the ability to organize information along with monitoring ongoing events and making rapid adjustments.

***Keywords*:** autism spectrum disorder, attention deficit, memory, neuropsychology.

Autism spectrum disorder is a developmental disorder, which is characterized by impairments in social interaction, communication, behavior, and executive dysfunction. The symptoms of autism fall on a variety of severity referred to as autism spectrum disorder (ASD), which include autistic disorder, asperger syndrome, and pervasive developmental disorder not otherwise specified (PDD-NOS) (American Psychiatric Association, 2000). In addition to the core features of autism, deficits in executive function (EF) have been widely reported (e.g., Geurts, Verte, & Oosterlann, 2004; Hughes, 1994; Pennington & Ozonoff, 1996).

Executive dysfunction in autism is evident in limited, repetitive, and stereotyped behaviors. However, it seems that executive dysfunction in individuals with ASD is quite extensive. For instance, some individuals pay attention to minor details, but fail to see how these details fit into a bigger picture. Others struggle with complex thinking that requires holding more than one train of thought simultaneously. Others have difficulty maintaining their attention, or organizing their thoughts and actions (Hill, 2004).

Over the past twenty five years several executive functions such as attention, verbal fluency, and working memory have been studied (Turner, 1997; Ozonoff, 1995a; Happé, Booth, Charlton, & Hughes, 2006). Attentional processes in autism have also been of interest for several decades (Courchesne, Townsend, Akshoomoff, et al 1994; Goldstein, Johnson, and Minshew, 2001). Attention and concentration affect children with autism in many ways. Deficits in these areas influence learning, memory, daily living skills, and cognitive ability (Kilinçaslan, Motavalli Mukaddes, Küçükyazici, & Gürvit, 2010). The abilities to inhibit responses, differentiate relevant from irrelevant information, utilize system of rules, and solve problems, are dependent on a child's memory and concentration. As a result, in most studies attention dysfunction has been indicated as a core deficit in this disorder, and that is because of the crucial role attention plays in information processing (Goldstein, et al., 2001).

Various attentional components and dimensions have been described in the literature. Here, to evaluate attention and its components, a four-factor neuropsychological model was employed. The four factor model proposed by Mirsky is potentially the most useful since it is based on a wide variety of clinical and experimental evidence (Mirsky, Fantie, and Tatman, 1995). Moreover, his model is based on data from many different subject groups, and thus has the potential to generalize to different patient populations more so than the other models. In this model, attention is subdivided into the ability to concentrate on a target object and carry out a task in the presence of distracting objects, to maintain focus over a sustained period of time, to shift focus of attention, and finally to efficiently receive and interpret incoming information (Mirsky, Anthony, Duncan, Ahearn, & Kellam, 1991). As a result, the factors derived from this model were termed Sustain, Shift, Focus- Execute, and Encode.

Sustained attention is a self-directed process, in which a person sustains a mindful, conscious processing of stimuli, whose repetitive, non-arousing qualities would otherwise lead to habituation and distraction (Nyden, Gillberg, Hjelmquist, & Heiman, 1999). Sustained attention is mostly measured by Continuous Performance Test or CPT where the person should press a computer space bar every time a given shape or number appears on a computer screen.

On the other hand, deficits in shifting attention have frequently been reported in autism disorder. Set shifting or cognitive flexibility refers to the ability to shift to a different thought or action according to changes in a situation (Pierce, Glad, & Schriebman, 1997). To study deficit in shifting attention, Wisconsin Card Sorting Test (WCST; Ozonoff, 1995b; Ozonoff, Pennington, Rogers, 1991) is generally employed, where the subject must sort a series of cards containing geometric forms according to color, shape, or number.

A further component of attention is focusing. To assess focusing and selective attention, Stroop test can be applied, which provides a measure of cognitive inhibition or the ability to control something learned tightly

before in favor of an uncommon response (Stroop, 1935). In addition, Stroop test has been used for several cognitive evaluations (Stuss, Picton, Alexander 2001; Ehlis, Herrmann, Wagener, & Fallgatter, 2005; Stroop, 1935).

The final factor of Mirsky's model is Encoding. Encoding allows the item of use or interest to be converted into a form that can be stored within the brain and called back later from short term or long term memory (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996). Relationship between attention and working Memory has been studied for sometimes, but the nature of the relationship between these concepts is not well understood (Sinzig, Morsch, & Brunning, 2008). However, it has been established that the ability to selectively process information (attention) and to retain information in an accessible state (working memory) are critical aspects of person's cognitive capacities (Fougnie, 2008; Chun & Turk-Browne, 2007). Many researchers believe that an item must first be attended before it can be encoded into working memory (e.g. Mack and Rock, 1998a; Mack and Rock, 1998b). In this study, to measure encoding, Digit Symbol-Coding, Digit Span, and Arithmetic subtests of the Wechsler Intelligence Scale for children-Revised (WISC-R) were utilized. The Digit Span task measures short-term memory, attention, and concentration. Digit Symbol/Coding is a useful tool to measure processing speed and Arithmetic measures concentration and systematic problem-solving ability (Wechsler, 1991).

However, the aim of this study was to determine whether high functioned autism spectrum children, diagnosed according to DSM-IV criteria, exhibit deficit in attention compared to age, intellectual level, and level of education matched controls, and if so to identify those aspects of impairments that are affected most. Subsequently, the goal of the present study was to examine a wide range of attentional functions in young children with ASD. Testing different attentional functions allows us to detect any differences in the development of different aspects of attention in ASD.

Methods

Participants

All subjects with ASD were selected from Tabriz Autism Association, which is the only organization available in the east of Iran. Only 19 boys out of 85 autistic children were initially selected as high functioned. They were then diagnosed with ASD following a detailed psychiatric assessment, developmental history, and a review of the data provided by their teachers and parents. This was followed by the screening questions using the K-SADS. The K-SADS is a viable interview schedule to assess current, past, and lifetime diagnostic status in children and adolescents, which has the potential to further aide in the validation of psychiatric disorders (Sorensen, Thomsen, Bilenberg, 2007). Consequently, only 15 boys fulfilled the DSM-IV criteria for ASD (American Psychiatric Association, 2000). Inclusion criteria for all participants consisted of having an IQ $\geq$70, an absence of Fragile X or other serious neurological (e.g., seizures), psychiatric (e.g., Bipolar disorder) or medical conditions. Both oral and written informed consents were obtained from at least one parent of all participants, and the research protocol was approved by the ethics committee of Tabriz University of Medical Sciences.

For control group, 15 volunteers recruited from local school (15 boys) in the same age range. They were also examined to rule out any neurological, psychiatric, or learning problems. Furthermore, none of these children was on medication and this information was gathered from one of their parents.

The full Wechsler Intelligence Scale for Children-Revised (WISC-R) was used to obtain IQ scores of all subjects (Wechsler, 1989). Only ASD children who had the total IQ score above 70 were chosen. The participants were group-wise matched on the basis of gender, chronological age, education and full-scale IQ. WISC-R was adapted and standardized for Iranian children by Shahim (2009).

Measures

In this study, the Continuous Performance Test (CPT), Wisconsin Card Sorting Test (WCST), Stroop test, Digit symbol- coding, Digit span, and Arithmetic from subtests of the WISC-R were administered to all participants. All attention procedures were carried out by child psychologist and cognitive neuroscientist with over 3 years of experience in working with ASD patients and under supervision of clinical psychologists and specialized child psychiatrists. The measures of attention used in this study were selected based on the work of Mirsky et al. (1991). Neuropsychological measures that corresponded to each attentional factor are described below.

Continuous Performance Task (CPT). In CPT, the participant responded whenever a particular symbol repeats in successive trials of an ongoing train of shapes by simply pressing a space bar key on computer key board. The task requires sustained attention and immediate memory. Total number of correct responses, errors of commission (pressing the key before seeing the target letter), and omissions (failure to press after the appearance of the target letter) were evaluated. Computer version of CPT (Dougherty, Marsh, & Mathias, 2002) was applied to each participant by the same researcher in the same order. The Standardization study of this test for Iranian population and children was done by Hadianfard, Najarian, Shokrkon, Mehrarabizadeh Honarmand, 2000).

Wisconsin Card Sorting Test (WCST). To study deficit in shifting attention, Wisconsin Card Sorting Test (WCST; Ozonoff, 1995b; Ozonoff, Pennington, & Rogers, 1991) was employed. In this task, the subject needed to sort a series of 128 cards containing geometric forms according to color, shape, or number. Unknown to the subject, the relevant concept is changed several times during the course of the test. Here, the computer adapted version of this test was utilized (Tien, Spevack, Jones, Pearlson, Schlaepfer, & Strauss, 1996), where the participant should match the card displayed in the bottom of the screen to one of the four cards displayed on

top of the screen. As a result, number of completed categories, number of preservative responses, percentage of preservative errors, failure to maintain set score, and conceptual level response score were evaluated. Standardization studies of this test for Iranian population and children were conducted by Mashhadi at al., (2010).

Stroop test. In our study, this test is based on the variables of computerized version of Stroop (Stroop, 1935). Naming the colors was the first stage of the test in which the examinee was asked to click on the labeled key of the same colored circle shown frequently in red, blue, yellow, and green on the screen. The second stage was the main Stroop test performance. At this stage, 48 congruent colored and 48 incongruent colored words were revealed. Congruent words are those which their color and meaning are the same and incongruent is referred to the written words which are not similar in color and meaning. Totally, 96 congruent and incongruent colored words were shown randomly on the screen and the examinee had to click on the relevant tagged keys just by considering the colors regardless of the meaning. The translation and Standardization of this test for Iranian population and children was done by Mashhadi et al., (2011).

Focus- execute and encoding. Focus- Execute and Encoding (Working memory) of all participants were assessed using Digit Symbol-Coding, Digit Span, and Arithmetic subtests of the WISC-R (Wechsler, 1991). This test required the person to copy nine different geometric symbols that correspond to nine numbers. Each symbol was paired with a number. The test was timed and the number of correct symbols produced in 120 seconds was recorded.

In Arithmetic, 20 math problems were asked orally by examinee and the subject had to solve them without using paper and pencil. In Digit Span, each subject was asked to repeat 3 - 9 digits forward and 2-9 digits backwards. Total score from both the forward and backward trials were used in the analyses. Both, these tests were adapted and standardized for Iranian children by Shahim (2009).

Statistical Procedures

All data were numerically coded and entered into SPSS 10.0 for statistical analyses. To compare control measures (Age, IQ) between ASD and control subjects, multivariate analysis of variance or MANOVA was utilized. To compare the level of education in both ASD and control group, Chi-Square Test was applied. Furthermore, MANOVA was computed to determine significant differences between ASD and control groups on attentional measures.

Results

Demographic information for the samples is provided in Table 1. The sample included 15 boys with ASD. In addition 15 control boys were selected to match children in ASD group for age, sex, IQ, and education. MANOVA results showed that there weren't any significant differences between the ASD and control groups in terms of age (F =.01, P >.05), and IQ (F =.07, P >.05).

Table 1

Demographic Data for the Autism and Control Groups

	N	Autism group		Control group		F	P VALUE
		M	SD	M	SD		
Age	15	103.85	26.38	104.92	26.58	.011	.918
IQ	15	83.92	9.03	84.23	9.20	.07	.91

** significant at the 0.01 level ($p<0.01$)

* significant at the 0.05 level ($p<0.05$)

To compare the level of education in both ASD and control group, Chi-Square Test was applied, which is shown in Table 2. No significant variation in the level of education ($\chi^2=1.27$, $p>0.05$) between both groups was observed.

Table 2

The Comparison of Education Level in ASD and Control Groups

	Autism group		Control group		Chi-Square Tests	
	Count	%	Count	%	Value	P VALUE
0	4	26.67	4	26.67	1.27	.866
1	3	20.00	3	20.00		
2	7	46.67	6	40.00		
3			1	6.67		
5	1	6.67	1	6.67		
Total	15	100	15	100		

0: preschool, 1: first grade, 2: second grade, 3: third grade, 5: fifth grade (elementary school grades in Islamic republic of Iran)

The measures of attention were administered individually and randomized before administration. The CPT, the STROOP, and the WCST were administered using a computerized testing format. The other attentional measures were administered orally by the principal investigator (e.g., Arithmetic, Digit-Span) or in a paper-pencil format (e.g., Trail Making Test, Digit-Symbol). These data are presented in the following parts.

To determine whether the performance on CPT test was associated with autism spectrum disorder, group differences were compared on four measurements using group independent F-tests. According to MANOVA, the results obtained from CPT task for both ASD and control groups indicated that in ASD group, errors of commission ($F= 4.93$, $p<0.05$) and omission ($F= 6.38$, $p<0.05$) were significantly higher than the control group. Moreover, the total number of correct responses were ($F= 6.41$, $p<0.05$) also significantly lower in ASD group. However, there was no significant difference in reaction time (RT) between the two groups.

Table 3

Continuous Performance Task for Autism Spectrum and Matched Control Groups

	N	Autism group		Control group		F	P VALUE
		M	SD	M	SD		
Errors of Commission	15	44.83	36.13	16.73	22.25	4.93	.04*
Omission	15	8.42	4.94	3.73	3.82	6.38	.02*
Total correct response	15	96.75	36.53	129.55	23.52	6.41	.02*
Reaction time (ms)	15	490.50	163.99	543.00	94.98	.86	.36

** significant at the 0.01 level ($p<0.01$)

* significant at the 0.05 level ($p<0.05$)

The results obtained from the assessment of cognitive flexibility and shifting attention are summarized in Table 4. Table 4 shows the mean scores, standard deviations, F scores and p values for computer scores of Wisconsin Card Sorting Test (WCST) obtained from ASD and control groups. Scores were based on (1) preservative errors (2) total number correct, (3) total number incorrect, (4) other errors, (5) number of trials to complete the first category, (6) conceptual level responses, (7) percent conceptual level response, (8) failure to maintain set. According to MANOVA, in ASD group, preservative errors ($F= 4.88$, $p<0.05$), incorrect responses ($F= 4.54$, $p<0.05$), total time for completion of test ($F= 3.94$, $p<0.05$) were significantly higher than the control group. Moreover, total correct number ($F= 4.51$, $p<0.05$), conceptual level responses ($F= 4.6$, $p<0.05$), and percent conceptual level response ($F= 4.72$, $p<0.05$) were significantly lower in ASD group in comparison to the control group. However, there were no significant differences on number of trials to

complete the first category and failure to maintain set between both groups.

Table 4
Wisconsin Card Sorting Test (WCST) Performance in ASD and Control Groups

	N	Autism group		Control group		F	P VALUE
		M	SD	M	SD		
Preservative errors	15	17.27	6.97	12.00	3.74	4.88	.041*
Number of correct responses	15	23.00	4.47	28.27	6.92	4.51	.043*
Number of incorrect responses	15	37.00	4.37	31.73	6.96	4.54	.042*
Other errors	15	20.27	5.00	23.55	3.45	3.19	.09
Time for task completion(Sec)	15	633.64	280.14	473.55	258.74	3.94	.042*
Number of trials to complete the first category	15	41.64	22.48	22.36	16.60	5.23	.03*
Conceptual level response	15	.27	.90	1.00	.89	4.60	.038*
Percent conceptual level response	15	4.55	15.08	17.00	15.21	4.72	.037*
Failure to maintain set score	15	.27	.47	.09	.30	1.18	.29

** significant at the 0.01 level ($p<0.01$)

* significant at the 0.05 level ($p<0.05$)

The MANOVA procedure was also applied with all Stroop parameters. In Congruent response, as illustrated in Table 5, significant differences between groups on the number of correct responses ($F= 10.85$, $p<0.001$), number of errors ($F= 8.41$, $p<0.05$), and reaction time ($F= 32.51$, $p<0.001$) was observed, which means ASD group performed rather poorly in this

part of the task. However, on some parameters such as number of no response and total time for task completion, no significant differences were found.

However in Incongruent response, there was a significant variation amongst both groups on number of errors ($F= 8.95$, $p<0.05$), and number of no response ($F= 10.66$, $p<0.001$). But, no significant difference was found on total time of the experiment, number of correct responses, and number of incorrect responses. Furthermore, according to MANOVA procedure, a significant difference was found on interference time ($F= 5.43$, $p<0.05$) amongst both groups.

The results of encoding tasks were also analyzed using MANOVA procedure and the outcome (Table 6) revealed the significant difference on Symbol-Coding ($F= 8.26$, $p<0.05$) and Arithmetic ($F= 4.25$, $p<0.0$) tasks between ASD and control groups, which meant the ASD group were performed poorly on these test. However, there was no significant variation between both groups on Digit Span test. Although ASD group performed poorly on calling series of numbers backwards in digit span task, but the overall results did not point out a substantial difference between the two groups.

Table 5

Comparison of Stroop Test Results in ASD and Control Groups

		N	Autism group		Control group		F	P VALUE
			M	SD	M	SD		
Congruent	Time (Sec)	15	75.17	9.97	74.18	6.10	0.08	.78
	Error number	15	22.92	10.10	32.36	3.96	8.41	.01*
	No response	15	21.58	10.09	15.36	4.03	3.64	.07
	Correct number	15	3.25	2.96	.27	.47	10.85	.00**
	Reaction time	15	927.08	303.01	158.73	343.32	32.51	.00**
Incongruent	Time (Sec)	15	76.58	7.99	76.82	6.27	.01	.94
	Error number	15	20.08	7.49	28.45	5.72	8.95	.01*
	No response	15	25.50	7.49	17.18	4.07	10.66	.00**
	Correct number	15	2.83	2.08	3.27	3.98	.11	.74
	Reaction time	15	880.92	466.18	841.27	719.83	.03	.88
Interference Number		15	.42	2.71	-3.00	4.22	5.43	.03*

** significant at the 0.01 level ($p<0.01$)

* significant at the 0.05 level ($p<0.05$)

Table 6

Results of Encoding Tasks (Symbol Coding, Arithmetic, Digit Span) for ASD and C ontrol Groups

	N	Autism group		Control group		F	P VALUE
		M	SD	M	SD		
Symbol-coding	15	2.92	.67	6.10	3.78	8.26	.01*
Arithmetic	15	4.92	1.98	6.82	2.44	4.25	.042*
Digit span	15	6.42	1.98	6.82	2.71	.17	.69

** Significant at 0.01 level (p <0.01)

* Significant at 0.05 level (p <0.05)

Discussion

Autism is a developmental disorder that frequently manifests itself in disturbances of different aspects of attention, as well as other symptoms, such as social inadequacies, behavioral stereotypy, and communication delays. Attentional processes are fundamental to human behavior because they determine which sources of information will be processed (Zarghi**,** Zali, Tehranidost, Zarindast, & et al., 2011). Deficits in attention influence learning, memory, daily living skills, and cognitive ability. Therefore, attentional dysfunction has been shown as a core deficit in this disorder (Goldstein, et al., 2001).

In this study, a variety of neuropsychological measures reflecting four factors of attention were administered based on the work of Mirsky et al. (1991). As previously mentioned, the factors derived from this model were termed Shift, Sustain, Focus- Execute, and Encode.

The Shift Factor was comprised of variables from the WCST test, which measures the ability to disengage one's attention from a stimulus and shift it to another stimulus (Mirsky et al., 1991). The Sustain factor measured the ability to sustain attention over a long period of time and required a readiness to respond to a target at any time. Here, this factor

was comprised of scores from the CPT. Another component of attention is Focus-Execute. The Focus-Execute factor is the ability to identify relevant targets and then respond to them (Mirsky et al., 1991). To assess focusing and selective attention, Stroop test was applied. The final factor, Encode, was comprised of scores from the Arithmetic, symbol coding, and Digit-Span subtests. Symbol coding is a useful tool to measure processing speed. Arithmetic and Digit-Span subtests measure the person's attentional span and the amount of information that the person can hold and manipulate in their attentional focus. Motor responses are minimal and limited to a verbal output of the answer. However, it can be argued that this factor is actually measuring the person's working memory capacity instead of attention, but there has been little empirical work to differentiate the two constructs. For example, this similarity between attention and working memory was also evident in the memory conceptualization of Baddeley (1981).

Nevertheless, significant differences between individuals with autism and controls have been reported in previous studies on experimental measures of attention, which assess such processes as conceptual reasoning, executive function, rapid decision making, and problem solving, abilities that are widely believed to be impaired in autism (McEvoy, Rogers, & Pennington, 1993; Minshew, Goldstein, & Siegel, 1997; Ozonoff, 1995a; Ozonoff et al., 1991). In current study, measures of the mentioned elements were assessed in children with ASD and matched control group. The present study confirmed the deficient performance of the patients with ASD in some executive functioning areas such as attentional processing. This study observed deficient areas by showing higher CPT omission and commission errors, Stroop interference scores, and poor WCST performance in ASD group.

For instance, the result from WCST showed that individuals with autism spectrum disorder had more preservative responses and errors and fewer conceptual level responses and generated fewer categories than the control group. Therefore, significant deficits in shifting attention or in

other word, disengaging attention were demonstrated in ASD subjects. Other studies (McEvoy et al., 1993; Ozonoff et al., 1991), have also found significant differences in shifting attention and planning between children with autism and controls. One particular obstacle for the autistic group was sorting into categories (i.e. formation of concepts). Even when they were aware of making errors, these children were unable to change their behavior to achieve correct responses, and many went on with incorrect strategies (McEvoy et al., 1993). As mentioned above, set shifting refers to the ability to shift to a different thought or action according to changes in circumstances, and this can also be seen in the difficulties that individuals with autism experience with respect to change.

Moreover, the ASD group performed somewhat poorer in terms of all the CPT variables than the controls, although the differences were not statistically significant in reaction time. It seemed that children with autism have unusual attentional capacities. They have difficulty in attending to stimuli on demand (e.g. CPT test), but they may have the ability to focus for hours on unusual aspects of their surroundings (Ehlers, Nydén, & Gillberg, et al., 1997).

Another executive functioning in autism, which has been studied quite extensively, is selective attention and it has generally been found to be unaffected in autism using a Stroop task (Eskes, Bryson, & McCormick, 1990; Ozonoff & Jensen, 1999; Christ, Holt, White, & Green, 2007). However, according this study, ASD children performed poorly in some components of the Stroop test. Nevertheless, it seemed that ASD subjects were able to ignore writing of the words and concentrate on naming the color of the ink and this was more apparent in older ASD participants. Moreover, ASD subjects were slower in their response, and this could have contributed to some differences that were seen between the two groups. But, overall control group performed better in Stroop test. However, complicated results have been reported on measuring inhibition and selective attention using various tasks. It has been suggested that the difference in performance between autistic and control groups on some

inhibition tests supposedly measuring the same ability might lie in whether a test has an apparent rationale or whether rules of a test could be viewed as arbitrary (Russell, 2002).

Moreover, to evaluate encoding, Digit Symbol-Coding, Digit Span, and Arithmetic subtests of the WISC-R were utilized. The results of Digit Symbol-Coding test indicated that ASD participants were slower in completing the task compared to control group. It seemed they had a difficulty concentrating and at the same time completing the task speedily or rapidly. In addition, ASD subjects performed poorly in Arithmetic, but there was no significant differences in the result of digit span amongst both groups.

However, Failure to encode all the information, may therefore contribute to dysfunction in the social, communication, and reasoning domains. Evidence of the normality of certain memory capacities, at least in individuals with moderate autistic symptomatology, is encouraging for adaptive improvements in cognitive functioning.

Therefore, it appears that if individuals with autism seem to have attentional impairment, they would be at the conceptual level, possibly involving executive abilities and monitoring of novel information, as has been suggested in other studies (Ozonoff & Strayer 2001; Pascualvaca, Fantie, Papageorgiou, & Mirsky, 1998). Such deliberation as the ability to organize information and the capacity to monitor ongoing events and make rapid adjustments are likely to be relevant considerations. This assumption is also supported by other experimental literature (e.g., Burack, Enns, & Johannes, 1997; Goldstein et al., 2001).

Acknowledgement

This work was supported by a research grant from Tabriz University of Medical Sciences and University of Tabriz. We would like to thank all the participants, social workers, clinical psychologists, Psychiatrists, and teachers for their work and effort in Autism Association, Poyesh centre, and Fayazbakhsh School.

References

American Psychiatric Association (2000). Diagnostic criteria for 299.00 Autistic Disorder. *Diagnostic and statistical manual of mental disorders*: DSM-IV (4th Ed.). Washington, DC: American Psychiatric Association.

Baddeley, A. (1981). The concept of working memory: A view of its current state and probable future development. *Cognition*, 10, 17-23.

Burack, J. A., Enns, J. T., & Johannes, E. A. (1997*). Attention and autism: Behavioral and Electrophysiological Evidence*. In D. J. Cohen & F. R. Volkmar (Eds.), Handbook of autism and pervasive developmental disorders (2nd ed. pp. 226–247). New York: J. Wiley.

Christ, S., Holt, D., White, D., & Green, L. (2007). Inhibitory control in children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorder*, 37, 1155-1165.

Chun, M. A., & Turk-Browne, N. B., (2007). Interactions between attention and memory. *Current Opinion in Neurobiology*, 17:177–184.

Craik, F. I., Govoni R, Naveh-Benjamin, M., Anderson, ND. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *J. Exp Psychol Gen*, 125, 159-180.

Courchesne, E., Townsend, J., Akshoomoff, N., et al. (1994). Impairments in shifting attention in autistic and cerebellar patients. *Behavioural Neuroscience*, 108, 848-865.

Dougherty, D. M., Marsh, D. M., & Mathias, C. W. (2002). Immediate and delayed memory tasks: A computerized measure of memory, attention, and impulsivity. *Behavior Research Methods, Instruments, and Computers*, 34, 391-398.

Ehlers, S., Nydén, A., Gillberg, C., Dahlgren-Sandberg, A., Sahlgren, S. O., Hhjelmquist, E., & Odén, A. (1997). Asperser Syndrome, Autism and Attention Disorders: A Comparative Study of the Cognitive Profile of 120 Children, *Journal of Child Psychology and Psychiatry,* 38, 207–17.

Ehlis, A. C., Herrmann, M. J., Wagener, A., Fallgatter, A. J. (2005). Multi-channel near-infrared spectroscopy detects specific inferior-frontal activation during incongruent Stroop trials. *Biol Psychol*, 69(3):315-31.

Eskes, G., Bryson, S., & McCormick, T. (1990). Comprehension of concrete and abstract words in autistic children. *Journal of Autism and Developmental Disorders*, 20, 61-73.

Fougnie, D., (2008). *The relationship between attention and working memory*. Chapter-1: New Research on Short-Term Memory. ISBN 978-1-60456-548-5. Nova Science Publishers, Inc.

Geurts, H. M., Verte, S., Osterlann, J., Roeyers, H., & Sergeant, J. A. (2004). How specific are executive functioning deficits in attention deficit hyperactivity disorder and autism? *Journal of Child Psychology and Psychiatry Allied Disciplines,* 45, 836–854.

Goldstein, G., Johnson, C. R., & Minshew, N. J. (2001). Attentional processes in autism. *Journal of Autism and Developmental Disorders,* 31, 4, 2001.

Hadianfard, H., Najarian, B., Shokrkon, H., & Mehrarabizadeh Honarmand, M. (2000). Standardization and adaption of continuous performance test in Iran. *Iranian Journal of Psychology*; 388-404:4.

Happé, F., Booth, R., Charlton, R., & Hughes, C. (2006). Executive function deficits in autism spectrum disorders and attention-deficit/hyperactivity disorder: Examining profiles across domains and ages. *Brain and Cognition,* 61, 25–39.

Hill, E., L. (2004). Executive dysfunction in autism. *Trends in Cognitive Sciences*. 8(1).

Hughes, C., Russell, J., & Robbins, T. W. (1994). Evidence for executive dysfunction in children with autism. *Psychological Medicine,* 32, 209–220.

Kilinçaslan, A., Motavalli Mukaddes, N., Küçükyazici, G. S., & Gürvit H., (2010). Assessment of executive/attentional performance. In Asperser's Disorder. *Turkish Journal of psychiatry*, 21(4), 289-299

Mack, A., & Rock, I. (1998a). *Inattentional Blindness*. Cambridge, MA: MIT Press

Mack, A., & Rock, I. (1998b). Inattentional blindness: Perception without attention. In R. Wright (Ed.), *Visual attention* (pp. 55-76). New York: Oxford University Press.

Mashhadi, A., Hamidi, N., Soltanifar, A., & Teimori, S. (2011). Evaluation of inhibition in children with Autism Spectrum disorder: Application of computerized Stroop test in Iran. *Iranian Journal of clinical psychology and counselling*, 2, 34-39.

Mashhadi, A. Rasoulzade Tabatabaie, K., Azad Fallah, P., & Soltanifar, A. (2010). Planning and shifting attention in children with attention disorder. *Study of psychology and Educational Science*. 11(1), 151-170.

McEvoy, R. E., Rogers, S. J., & Pennington, B. F. (1993). Executive function and social communication deficits in young autistic children. *Journal of Child Psychology and Psychiatry, 34*, 563–578.

Minshew, N. J., Goldstein, G., & Siegel, D. J. (1997). Neuropsychologic functioning in autism: Profile of a complex information processing disorder. *Journal of the International Neuropsychological Society, 3*, 303–316. Minshew, N. J., Luna, B., & Sweeney, J. A.

Mirsky, A. F., Anthony, B. J., Duncan, C. C., Ahearn, M. B., & Kellam, S. G. (1991). Analysis of the elements of attention: A neuropsychological approach. *Neuropsychology Review*, 2, 109–145.

Mirsky, A. F., Fantie, B. D., & Tatman, J. E. (1995). Assessment of attention across the lifespan. In: Mapou, R. L., and Spector, J., (Eds.) *Clinical Neuropsychological Assessment: A Cognitive Approach.* New York, NY: Plenum Press, 17-18

Nyden, A., Gillberg, C., Hjelmquist, E., & Heiman, M. (1999). Executive function/attention deficits in boys with Asperger Syndrome, attention disorder and reading/writing disorder. *Autism*, 3, 213-28.

Ozonoff, S., Pennington, B. F., & Rogers S. J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, 32, 1081–1105.

Ozonoff, S. (1995a). *Executive functions in autism*. New York: Plenum Press.

Ozonoff, S. (1995b). Reliability and validity of the Wisconsin Card Sorting Test in studies of autism. *Neuropsychology, 9,* 491–500.

Ozonoff, S., & Jensen, J. (1999). Brief report: Specific executive function profiles in three neurodevelopmental disorders. *Journal of Autism and Developmental Disorders*, 29, 171-177.

Ozonoff, S., & Strayer, D. (2001). Further evidence of intact working memory in autism. *Journal of Autism and Developmental Disorders*, 31, 257-263.

Pascualvaca, D., Fantie, B., Papageorgiou, M., & Mirsky, A. (1998). Attentional capacities in children with autism: Is there a general deficit in shifting focus? *Journal of Autism and Developmental Disorders*, 28, 467-478.

Pennington B. F., & Ozonoff, S., (1996). Pennington and S. Ozonoff, Executive functions and developmental psychopathology, *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 37, 51–87.

Pierce, K., Glad, K. S., & Schriebman, L. (1997). Social perception in children with autism: An attentional deficit. *Journal of Autism and Developmental Disorders*, 27, 265–282.

Russell, J. (2002). Cognitive theories of autism. In J. Harrison & A. Owen (Eds.), *Cognitive deficits in brain disorders* (295-323). London: Martin Dunitz.

Sinzig, J., Morsch, D., Brunning, N. et al. (2008). Inhibition, flexibility, working memory and planning in autistic spectrum disorders with and without comorbid ADHD-symptoms. *Child Adolesc Psychiatry Ment Health*, 2:4.

Shahim, S. (2009). *Adaptation and Standardization of Wechsler Intelligence Scale for Children: Revised (WISC-R),* Fifth edition. Pub: University of Shiraz.

Sorensen, M. J., Thomsen, P. H., & Bilenberg, N. (2007). Parent and child acceptability and staff evaluation of K-SADS-PL: a pilot study. *Eur Child Adolesc Psychiatry*, 16, 293-297.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.

Stuss, D. T., Picton, TW., & Alexander, MP., (2001). *Consciousness, self awareness and the frontal lobes*. In: Salloway S., Malloy P., Duffy J., editors. The frontal lobes and neurochiatric illness. Washington (DC): American psychiatry press.

Tien, A. Y., Spevack, T. V., Jones, D. W., Pearlson, G. D., Schlaepfer, T. E., & Strauss, M. E. (1996). Computerized Wisconsin Card Sorting Test: Comparison with manual administration. *Kaohsiung Journal of Medical Sciences*, 12, 479-485.

Turner, M. (1997). Towards an executive dysfunction account of repetitive behaviour in autism. In J. Russell (Eds.), *Autism as an executive disorder*. (pp. 57–100). Oxford, NY: Oxford University Press.

Wechsler, D. (1989). *Wechsler Preschool and Primary Scale of Intelligence–Revised.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1991). *The Wechsler intelligence scale for children*, Third edition. San Antonio, TX: The Psychological Corporation.

Zarghi, A., Zali, A., Tehranidost, M., Zarindast, M. R., Ashrafi, F., Doroodgar, S., & Khodadadi, S. M., (2011). Demographic variables and selective, sustained attention and planning through cognitive tasks among healthy adults. *Basic and clinical Neuroscience*, 2, 3.

Received: 12 / 6/ 2012
Revised : 16/ 6/ 2013
Accepted: 29 / 6/ 2013