On the Comparison of Inhibition Executive Functions and Problem Solving between Adolescents with and without Substance Abuse

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Abstract

Objective: This study aimed at comparing inhibition executive functions and problem solving between adolescents with and without substance abuse. **Method:** In this causal comparative study, 15 adolescents with substance abuse and 15 normal adolescents of Birjand city who were the same in terms of age, gender, and education were selected as the participants. Wisconsin Card Sorting Test (WCST) and Heppner & Petersen’s Problem Solving Inventory (PSI) were used for data collection purposes in this research. **Results:** The results of the study showed that there was a significant difference between substance abusers and normal people in the mean score of inhibition executive functions and problem solving (except approach avoidance style). **Conclusion:** The findings of this research can be used in prevention and training programs.

Keywords: Executive Functions, Inhibition, Problem Solving, Substance Abuse

Research on Addiction Quarterly Journal of Drug Abuse

Presidency of the I. R. of Iran
Drug Control Headquarters
Department for Research and Education

Vol. 8, No. 32, Winter 2015
http://www.etiadpajohi.ir

Introduction

Addiction is a chronic and progressive condition characterized by features such as compulsive behaviors, uncontrollable cravings, and drug seeking behavior and its persistent consumption brings about many deleterious social, psychological, physical, economic, and family consequences (Dawe, Gullo & Loxton, 2004). In today's world, substance abuse, is one of the most regretful tragedies that influences biological, psychosocial dimensions of many people's lives. Long-term use of drugs not only has destructive impact on social and economic situation of people, but has a determining role in all aspects of family life (Narimani, Hashemi, Ghasemzadeh, Mashinchi & Fotouhi Bonab, 2009). The recent theory puts emphasis on the role of executive functions in addiction. Among the factors mentioned in reviews regarding their role in addiction, nerve-psychological factors are of high importance because drug dependence causes some damages in cognitive function including problem solving, planning, organizing, learning new things, spatial-visual abilities, cognitive flexibility, and recall skills (Amini, Alizadeh & Rezai, 2010). Drug dependence is considered as one of the major health psychological, social, and legal problems of the world whose detrimental effects involve families and the entire community in various degrees. Berkeley's study suggests that addiction and substance abuse are among the ten major diseases whose medical and social consequences, such as HIV transmission and development and Berkeley's crime and violence make them more conspicuously felt (Karimiyan Bafghi, Alipour, Zare & Nahravanian, 2010). According to estimates of the United Nations Office on Drugs and Crime, 200 million people worldwide are suffering from substance abuse. In other words, 3.4% of the world's population, or 4.7% of the world's population over 15 years are suffering from this class of disorders (Aslinejad, Alami & Chamanzari, 2003). Drug abuse and dependence is a chronic and recurrent phenomenon with serious bodily, financial, familial, and social injuries. In terms of physical dimension, it results in physiological bodily dysfunction, incidence of life-threatening illnesses such as cancer, asthma, bronchitis, an increase in risk-taking in dangerous situations such as accidents, and an increase in the risk of diseases such as HIV and hepatitis. In psychological perspective, addiction can lead to mental imbalance and, in social perspective, it can lead to abnormalities in various economic, social, moral, political, and cultural aspects. Based on cultural and social conditions, isolation also falls within the consequences of drug abuse (Sahand, 2009). Evidence suggests that long-term consumption of substances such as methamphetamine brings about long-lasting changes in the dopamine neurotransmitter system and this system entails a wide range of behavioral and cognitive patterns since it is involved in cognitive, motor, and processing functions (Robbins, 2005). Long-term use of cocaine is followed by reduction of the function of dopamine receptors and dysfunction of prefrontal cortex, anterior cingulate and cerebellum, and also impairment in memory, cognition and emotions. These factors are associated with craving for and persistence of drug use, in spite of one's reluctance (Hester & Garavan, 2004). For this reason, the consumption of these substances is accompanied by deficiency in executive functions and disorder in cognitive function at high levels such as determination, purposeful thinking, self-awareness, and self-care behavior (Hoffman et al., 2006). Over the past decade, the domain of executive functions has received increasing attention. From a neurological perspective, this term is associated with a wide network of frontal cortex functions and includes a large number of cognitive and metacognitive processes, such as self-regulation of behavior and the growth of cognitive and social skills that are formed during the course of child development (Zelazo, Muller, Marcovitch, Argitis & Sultherl, 2002). Pennington & Ozonoff (1996) view executive functions as a certain area of abilities that includes such organization in space and time, selective inhibition, response preparation, goal-orientedness, planning, and flexibility. The term executive functions refers to the entire complex cognitive processes that are required to exist in doing new or difficult goal-oriented assignments (Hughes & Graham, 2000). It also includes the ability to create some pause (delay) or a specific inhibitive response and, accordingly, planning of action sequences and maintaining mental representations of assignments by working memory (Welsh & Pennington, 1988). Executive functions include the change of set, maintenance of set, control of set, integration of time and place, planning and working memory (Tehranidoost, Radgoudarzi, Sepasi & Alaghehband Rad, 2003). Executive functions are those abilities which children need for school learning in the future (Kirk, Gallagher, Anastasiow & Coleman, 2006). These functions regulate behavioral outputs and usually include inhibition and control of stimuli, working memory, cognitive flexibility, planning, and organizing (Denckla, 1996).

In general, most researchers agree that executive functions are, indeed, those self-regulatory functions that show one's ability in inhibition, self-change, planning, organizing, use of working memory, problem solving, and goal setting for doing homework and school activities (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Research has shown that the growth and increase of executive functions like other abilities are developed in childhood (Daimond, 2000). These functions are the skills that help individuals pay attention to the important aspects of tasks and they plan to complete them. Many studies have pointed out that maladaptation of executive functions is closely related with childhood developmental disorders (Anderson, Wukk & Castiello, 2002). Training and development of executive functions plays an essential role in the development of social skills and promotion of academic and institutional performance (Blair, Zelazo & Greenberg, 2005). In a meta-analysis on comparing methamphetamine users with healthy individuals, Scott et al. (2007), reached the conclusion that methamphetamine users experience some deficiencies in terms of learning, executive function, memory, processing speed, and to a lesser extent, language. Lawton-Craddok, Nixon & Tivist (203) compared three groups of alcohol users, users of stimulants such as caffeine amphetamines, etc., and simultaneous users of alcohol and amphetamines and concluded that substance users were suffering from cognitive impairments, especially in problem solving tests. Mintzer & Stitzer (2002) evaluated the performance of 18 methadone patients and 21 healthy subjects. Methadone users showed significantly poorer performance in working memory, selective attention and decision-making compared to healthy individuals. In comparison with those who use methadone, the participants on abstention showed less neuropsychological impairment. Meanwhile, Chang et al (2005) indicated that there was no significant difference between consumers and the control group in terms of motor function, visual memory, attentional processing speed, working memory, reaction time, and executive function.

Given that drug abuse can lead to damage to the frontal lobe and since the frontal lobe is involved in decision-making, problem-solving and planning; therefore, chronic drug abusers have difficulty in executive functions (Karimiyan Bafghi et al., 2010). Since it is unknown that substance abuse results in the injury of which executive functions; therefore, in this study, inhibition executive function and problem solving have been compared between adolescents with and without substance abuse.

Method

Population, sample, and sampling method

A causal comparative research method was employed for the purpose of this study. All the adolescents with substance abuse of Birjand city constituted the statistical population of the study. The number of 15 adolescents with substance abuse (10 males and 5 females) who had referred to welfare centers and health centers in Birjand University of Medical Sciences to receive educational, health, and welfare services and was willing to cooperate in the study was selected as the participants of the study. Then, 15 normal adolescents (without substance abuse) who were the same as the first group in terms of age, gender, and education were selected from the same residential area of the first group via purposive sampling method.

Instrument

Wisconsin Card Sorting Test (WCST): This test was used to assess inhibition executive functions. Wisconsin Card Sorting Test was designed by Grant and Berg (1948) and Heaton et al (1993) revised it (cited in Oner & Munir, 2005). This test is one of the most well-known neuropsychological tests that measures abstract reasoning, cognitive flexibility, desperation, problem solving, concept formation, set change, the ability to test hypotheses and use error feedback, start and stop strategy, and attentional maintenance (Pirastu et al., 2006). The test consists of 64 cards with one to four symbols which are presented in the form of red triangle, green star, yellow cross, and blue circle and no two cards are the same or duplicate. Based on tester's inference, participants embark on the replacement of cards. Each participant is given a set of 64 cards and should put other cards one by one under four main cards (including red triangle, green star, yellow cross, and blue circle respectively) based on the inference she/he has already gained from the tester's pattern of responses. For example, if the original mentioned item is color, the correct replacement is to put red card beneath a red triangle regardless of the number of symbols. Participants begin replacing the cards and the tester tells them whether any replacement is true or not. After a round of 10 correct replacement cards in a row, the tester changes the rule; in other words, the pattern of "right" and "wrong" statements is changed. Naderi (1994) reported the test-retest reliability of the test as .85 in Iran (cited in Ghadiri, Jazayeri, Ashayeri & Ghazi Tabatabai, 2006).

Heppner & Petersen's Problem Solving Inventory (PSI): This scale was designed by Heppner & Petersen (1982) to measure respondents' understanding of their problem solving behavior. This scale was used in this study to evaluate the executive functions of problem solving which contains 35 items and examines the way people respond to their daily problems. Based on factor analysis, this scale consists of three subscales, namely problem-solving confidence (16 items), approach avoidance style (16 items), and personal control (5 items), which are scored based on a 6-point Likert scale (from 1=totally agree to 6=totally disagree) and lower scores indicate higher levels of problem-solving abilities. To prevent bias in responses, 15 items have been designed with negative expression which are scored reversely. Problem Solving Inventory has been administered and tested on several samples which resulted in high internal consistency with alpha values between .72 and .85 for the subscales and .90 for the total scale (Heppner & Petersen, 1982). Test-retest reliability of the questionnaire within a two-week interval ranged from .83 to .89 that suggests that the questionnaire enjoys standard reliability (Heppner & Petersen, 1982). Reliability of this scale has been reported .68 by Khosravi & Rafati (1998).

Results

Frequency distribution of education for each group is presented in the following table.

Table 1: Frequency distribution of education for each group

Group	***Illiterate and elementary***		***Elementary and above***		***Total***	
	N	***Percentage***	***N***	***Percentage***	***N***	***Percentage***
Non-addict	7	46.7	8	53.3	15	100
Addict	5	33.3	10	66.7	15	100
Total	12	40.0	18	60.0	30	100

Chi-square test results were indicative of the sameness of the two groups in terms of education (P>.05, x2=.56).

Independent t-test along with Bonferroni correction was used to investigate the difference in inhibition executive functions between the two groups as follows.

Table 2: Descriptive and inferential statistics pertinent to inhibition executive functions in addicts and non-addicts

Variable	*Group*	*Mean*	*SD*	*t*	*Df*
Autism error	Non-addict	6.33	5.50	*2.060	28
	Addict	14.33	14.04		
Other errors	Non-addict	10.87	6.16	**6.050	28
	Addict	26.80	8.13		
Total error	Non-addict	23.00	18.07	*2.950	28
	Addict	41.13	15.51		

*P< .05, **P< .001

As it is observed in the above table, there is a significant difference in all the components and the total score between the two groups. As per the descriptive statistics, the addicted group has received higher scores in all the sections.

Independent t-test along with Bonferroni correction was used to investigate the difference in executive functions of problem solving between the two groups as follows.

Table 3: Descriptive and inferential statistics pertinent to executive functions of problem solving in addicts and non-addicts

Variable	*Group*	*Mean*	*SD*	*t*	*Df*
Problem-solving confidence	Non-addict	30.47	10.11	*8.450	28
	Addict	70.33	15.22		
Approach avoidance style	Non-addict	51.67	20.46	.510	28
	Addict	55.53	21.06		
Personal control	Non-addict	13.33	4.10	*6.670	28
	Addict	23.53	4.27		
Total problem solving	Non-addict	95.47	26.47	*5.410	28
	Addict	149.40	28.07		

*P< .001

As it is observed in the above table, there is a significant difference in all the components except avoidance approach style between the two groups. As per the descriptive statistics, the addicted group has received higher scores in all the sections.

Independent t-test along with Bonferroni correction was used to investigate the difference in executive functions and problem solving between the two educational non-addicted groups as follows.

Table 4: Descriptive and inferential statistics pertinent to executive functions and problem solving between the two educationally different non-addicted groups

Variable	*Group*	*Mean*	*SD*	*t*	*Df*
Autism error	Illiterate and elementary	6.00	5.26	.21	13
	Elementary and above	6.63	6.05		
Other errors	Illiterate and elementary	10.00	5.77	.50	13
	Elementary and above	11.63	6.78		
Total error	Illiterate and elementary	17.00	8.68	1.22	13
	Elementary and above	18.25	22.82		
Problem-solving confidence	Illiterate and elementary	31.00	11.42	.18	13
	Elementary and above	30.00	9.61		
Approach avoidance style	Illiterate and elementary	49.00	13.47	.46	13
	Elementary and above	54.00	25.85		
Personal control	Illiterate and elementary	13.71	4.89	.33	13
	Elementary and above	13.00	3.59		
Total problem solving	Illiterate and elementary	93.71	16.55	.23	13
	Elementary and above	97.00	34.06		

As it is observed in the above table, there is a significant difference in the scores of executive functions and problem solving among two normal groups different in terms of educational degree.

Independent t-test along with Bonferroni correction was used to investigate the difference in inhibition executive functions and problem solving between the two addicted groups different in educational degrees as follows.

Table 5: Descriptive and inferential statistics pertinent to inhibition executive functions and problem solving between the two educationally different addicted groups

Variable	*Group*	*Mean*	*SD*	*t*	*Df*
Autism error	Illiterate and elementary	6.60	14.76	1.59	13
	Elementary and above	18.20	12.65		
Other errors	Illiterate and elementary	28.80	2.68	.66	13
	Elementary and above	25.80	9.82		
Total error	Illiterate and elementary	35.40	12.07	1.01	13
	Elementary and above	44.00	16.79		
Problem-solving confidence	Illiterate and elementary	71.20	15.39	.15	13
	Elementary and above	69.90	15.95		
Approach avoidance style	Illiterate and elementary	52.20	16.13	.42	13
	Elementary and above	57.20	23.77		
Personal control	Illiterate and elementary	20.40	2.88	2.29	13
	Elementary and above	25.10	4.07		
Total problem solving	Illiterate and elementary	143.80	24.45	.53	13
	Elementary and above	152.20	30.56		

As it is observed in the above table, there is a significant difference in the scores of inhibition executive functions and problem solving among two addicted groups different in terms of educational degree.

Discussion and Conclusion

The results of the current study showed that the mean score of inhibition executive functions and problem solving (except approach avoidance style) was significantly different between addicts and non-addicts. The results also showed that there was no significant difference in the mean score of inhibition executive functions and problem solving between male and female non-addicts with different educational levels; no significant difference was either found between male and female addicts with different educational levels. In the same way, no significant difference was found within addicts and non-addicts at different age ranges and consumption durations. Substance abuse is the maladaptive pattern of drug use which clinically brings about serious damage to the consumer and is represented via two symptoms of drug tolerance and abstention from that substance (Reber, 1996). Research suggests that disorders such as antisocial personality, types of phobias and anxiety disorders, major depressive disorder, and dysthymia are mostly related with drug abuse and drug dependence. In comparison with the normal population, depressive symptoms in patients with substance abuse or substance dependence are more prevalent. About one third to one half of those who abuse drugs have been qualified with the diagnostic criteria of depressive disorder once in their lifetime (Sadock & Sadock, 2005). People with substance abuse suffer from frontal lobe damage and cognitive neuropsychological functions due to prolonged substance use (Tehranidoost et al., 2003). Verdejo, Toribio, Orozco, Puente, & Perez-Garcia (2005) compared cognitive neuropsychological performance of methadone users with those of heroin users under treatment in terms of visual-spatial attention, information processing speed, and executive functions. The results showed that patients taking methadone had poorer performance in processing speed, visual-spatial attention, and cognitive flexibility tests and also showed lower accuracy in active memory and inductive reasoning compared with heroin users under treatment. Mahmoudi & Asghari (2013) investigated the effects of drug use on cognitive neuropsychological functions of 119 men (including 32 methadone users, 30 Norgesic consumers, 27 opium users, and 30 participants in the control group). They concluded that the groups were significantly different from each other in terms of short-term memory, learning ability, delayed recall, recognition, and goal perseverance. Post hoc test showed that Norgesic use cause the most damage to short-term memory, learning ability, recognition and, goal perseverance compared to other groups. Therefore, the use of opium and Norgesic can cause trouble for psychological functions of the nervous system. This damage, especially in brain areas related to executive functions, memory, and learning is more clearly seen, but methadone can reduce the extent of the damage. Lawton-Craddok et al (2003) compared three groups of alcohol users, users of stimulants such as caffeine amphetamines, etc., and simultaneous users of alcohol and amphetamines and concluded that substance users were suffering from cognitive impairments, especially in problem solving tests. Hester & Garavan (2004) concluded that long-term use of cocaine is followed by reduction of the function of dopamine receptors and dysfunction of prefrontal cortex, anterior cingulate and cerebellum, and also impairment in memory, cognition and emotions. These factors are associated with craving for and persistence of drug use, in spite of one's reluctance. In support of these results, Darke, Sims, McDonald, & Wickes (2000) compared information processing, attention, short-term visual memory, short-term verbal memory, long-term verbal memory, problem solving between 30 patients treated with methadone and 30 healthy subjects and showed that the group under methadone treatment had lower performance than the control group in all the areas. Substance abuse generates psychological damage and nerve damage in the frontal lobe. Thus, neuropsychological damage is directly associated with inhibition and impulsivity control and relapse probability; moreover, obsessive tendencies for persistence in drug use and for high relapse rate can possibly be explained on the basis of specific changes in executive functions (Amini et al., 2010). These pieces of research confirm the effectiveness of chronic use of drugs in the brain's frontal lobe. Since frontal lobe is involved in decision-making, problem solving, and planning; chronic substance abusers are affected in terms of executive functions, particularly problem solving (Karimiyan Bafghi et al., 2010). Abidizadegan, Moradi & Farnam (2008) conducted a study to assess executive functions in patients undergoing methadone treatment (n=25), people with no history of drug use (n=25), and a group on drug use abstinence (n=25). Results showed that patients receiving methadone had lower performance in Wisconsin Card Sorting Test than the other two groups while the comparison of normal and treated groups suggested that their performances were not significantly different from each other. Hamzehlou & Mashhadi (2010) compared the behavioral inhibition in criminal adolescents with and without a history of drug abuse and normal adolescents. The results showed that criminal adolescents had lower performance in behavioral inhibition than normal adolescents. Karimiyan Bafghi et al. (2010) also showed that the mean score of problem solving ability in addicts was significantly weaker than that in normal people. Ghasemi, Kiani, Zerehpoush, Rabii & Vakili (2012) showed that crystal users were significantly different from ordinary people in terms of the number of errors, but they were no significantly different from each other in terms of autism in Wisconsin test. In a meta-analysis, Scott et al. (2007), reached the conclusion that methamphetamine users experience some deficiencies in terms of learning, executive function, memory, processing speed, and to a lesser extent, language. Noël et al (2007) reported the existence of impaired executive functions in alcoholics and showed that lower mental flexibility and inhibition strength are among the effective components of executive function in addiction relapse and inability to keep stable in abstinence period. In addition, Glass et al. (2009) studied the effect of smoking and alcohol use on executive functions and came to the conclusion that alcohol consumption affects a wide range of executive functions and cigarette smoking can have a negative effect on response speed. Gonzalez (2007) and Gruber, Silveri & Yurgelun-Todd (2007) confirmed this finding and showed that high consumption of addictive substances such as alcohol and opium can create a wide range of disorders in cognitive system, learning system, memory, information processing, executive functions, problem solving, and verbal and spatial abilities.

As the results of studies in this field indicate, substance abuse can cause a wide range of disorders in executive functions. Giankola, Alterman, Fureman, Gargi & Rutherford (2007) showed that damage to executive functions is effective in the increase of alcohol consumption and other substances which is indicative of a bilateral relationship between substance use and executive functions. Fishbein et al (2007) compared heroin and alcohol abusers and the control group according to their performance on Stroop test. Their results also showed that there was no significant difference between the consuming groups and the control group.

In accordance with results of this study and the results of other related studies, it can be asserted that substance use affects the executive functions of the frontal cortex. Executive functions are referred to the acts that direct complex behaviors over time through planning, decision making, and response control. This capability makes possible the use of flexible and adaptive cognitive strategies. Studies on the relationship of brain imaging techniques, neural circuitry, and executive functions with substance use suggest that there is more activity in the frontal areas and white matter of the brain (Amini et al., 2010).

Neuropsychological studies show that drug use is associated with lesions of orbitofrontal part of prefrontal cortex. On the other hand, recent studies indicate that chronic use of drugs imposes severe injuries on executive control functions, especially in the areas pertinent to response inhibition and decision making (Rogers & Robbins, 2001). Such injuries are followed by the dysfunction of frontal gyrus and frontal cortex (Erch, 2005). The severity of cannabis use is associated with damage in visual-verbal memory, psycho-motor speed, executive functions, and decision-making (Bulla & Gale, 2005). Another factor that may cause cognitive and neurological damage in drug users is that this group is most exposed to risk factors such as alcohol dependence, AIDS, and brain injuries. The results of Erch's study (2005) proved that those taking opiates show a larger number of high risk behaviors. It seems that the best explanation for the present finding is that psychological damage is frequently available in drug users; therefore, cognitive impairment affects their daily activities. For example, substance users have difficulty in understanding the complicated instructions, automatic suppression of inappropriate behaviors and transfer of learned information to real life situations due to damage to cognitive functions. In addition, executive malfunctions may also endanger the health care system (Aharonovich, Nunes & Hasin 2003).

Due to few number of participants, no control of intervening variables, and conduct of the research in Birjand; it is difficult to generalize the results of the sample population. According to the results of the present study, addicts act more weakly in executive functions and problem solving than non-addicts; therefore, clinic experts are recommended to devise some plans to raise awareness of the public before being caught in the trap of addiction. In accordance with the results of this study, specialists of treatment clinics can employ specific therapeutic strategies to assess and improve levels of executive functions among addicts and change these solutions to a major objective of addiction control and treatment. Given that the current survey showed that drug users have difficulty in the executive function of problem solving and use only one solution in problematic situations; therefore, training problem solving is necessary. It is suggested that future researchers use Tower of London test or Stroop test cards in the assessment of executive functions. It is also recommended that executive functions be investigated in different groups of neuro-developmental disorders, such as learning disorders, autism, and attention deficit hyperactivity disorder with varying intensities so that a better understanding can be obtained from the potential damage in this field. It is suggested that future research also put focus on the role of behavioral brain systems in the prediction of substance abuse.

Reference

Abidizadegan, A., Moradi, A. & Farnam, R. (2008). Executive functions in patients treated with methadone, *Advances in Cognitive Science*, 10 (3), 75-81.

Aharonovich, E., Nunes, E., & Hasin, D. (2003). Cognitive impairment, retention and abstinence among cocaine abusers in cognitive-behavioral treatment. *Drug and Alcohol Dependenc*e, 71(2), 207-11.

Amini, F., Alizadeh, H. & Rezai, O. (2010). On the comparison of executive-neurological functions in adults addicted to opiates compared with normal individuals, *Journal of Substance Abuse Addiction Studies*, 4 (13), 25-38.

Anderson, V., Wukk. & Castiello, U. (2002). "Neuropsychological evaluation of deficits in Executive functioning for ADHD children with or without learning disabilities." *Journal of neuropsychological*, 22 (2), 501-37.

Aslinejad, M., Alami, A. & Chamanzari, H. (2003). On the relationship between substance abuse and academic and family status of male students of Ganaveh, *Proceedings of the conference on primary prevention of drug use.*

Blair, C., Zelazo, D & Greenberg, M. (2005). The measurement of Executive Functions in Early childhood. *Developmental Neuropsychology*, 28(2), 561-571.

Bulla, F., & Gale, A. (2005). Electrophysiological measures of cognition in biological psychiatry: Some cautionary notes. *International Journal of Neuroscience*, 92, 219-240.

Chang, L., Cloak, C., Patterson, K., Grob, C., Miller, E. N., Ernst, T. (2005). Enlarged striatum in abstinent methamphetamine abusers: A possible compensatory response. *Biological Psychiatry*, *57*, 967-974

Daimond, A. (2000). Preschool children, s performance in cognitive functions. *Developmental Neuropsychology, 28,* 689-729.

Darke, S., Sims, J., McDonald, S., Wickes, W. (2000). Cognitive impairment among methadone maintenance patients. *Addiction, 95(5),* 687-95.

Dawe, S., Gullo, M.J., Loxton, N. J., (2004). Reward drive and rash impulsiveness as dimensions of impulsivity: implications for substance misuse. Addictive Behaviors**,** 29(7), 1389-405.

Denckla, M., B. (1996). A theory and model of executive function: A neuropsycholog ical perspective. In G. R. Lyon & N. A. Krasnegor (Eds.), Attention, memory and executive (unction (pp. 263278), Baltimore: Brookes.

Erch, F. (2005). Electrophysiological evidence of two different types of error in the Wisconsin Card Sorting Test. *Neuroreport*, *10(6),* 1299-303

Fishbein, D.H., Krupitsky, E., Flannery, B.A., Langevin, D.J., Bobashev, G., Verbitskaya E. (2007). Neurocognitive Characterizations of Russian Heroin Addicts without a Significant History of Other Drug Use. *Drug & Alcohol Dependence*, *90(1),* 25-38.

Ghadiri, F., Jazayeri, A., Ashayeri, H. & Ghazi Tabatabai, M. (2006). Executive function deficits in schizo-obsessive patients, *Advances in Cognitive Science*, 8 (3), 11-24.

Ghasemi, N., Kiani, A., Zerehpoush, A., Rabii, M. & Vakili, N. (2012). Differences in attentional bias, executive functions, and reaction time performance between amphetamine users and non-users, Research on Addiction, *Quarterly Journal of Substance Abuse*, 6 (23), 53-64.

Giankola, J., Alterman, A. I., Fureman, I., Gargi A.P, & Rutherford, M. J. (2007). the Use of Case Vignettes for Addiction Severity Index Training. *Journal of Substance Abuse Treatment*, *14(5),* 439-443

Glass, J.M., Buu, A., Adams, K.M., Nigg, J.T., Puttler, L.I., Jester, J.M., Zucker, R.A. (2009). Effects of alcoholism severity and smoking on executive neurocognitive function. *Addiction*, *104(1),* 38-48

Gonzalez, R. (2007). Acute and non-acute effects of cannabis on brain functioning and neuropsychological performance. *Neuropsychology Review*, *17(3),* 347-61.

Gruber, S.A., Silveri, M.M., Yurgelun-Todd, D.A. (2007). Neuropsychological consequences of opiate use. *Neuropsychology Review*, *17(3),* 299-315.

Hamzehlou, M. & Mashhadi, A. (2010). On the comparison of behavioral inhibition in criminal adolescents with or without a history of drug abuse and normal adolescents, *Journal of Research on Psychological Health*, 4 (3 & 4), 55-64.

Heppner, P. P., & Petersen, C. H. (1982). The development and implications of a personal problem solving inventory. *Journal of Counseling Psychology*, *29(1),* 66-75

Hester, R., Garavan, H. (2004). Executive dysfunction in cocaine addiction: evidence for discordant frontal, cingulate, and cerebellar activity. *Journal of Neuroscience, 24(49),* 11017–11022

Hoffman, W. F., Moore, M., Templin, R., MacFarland, B., Hitzemann, R. J & Mitchell, S. H. (2006). Neuropsychological function and delay discounting in methamphetamine dependent individuals. *Psychopharmacology*, *188(2),* 162-70

Hughes, C., & Graham, A. (2000). Measuring executive functions in childhood: Problems and solutions. *Child and Adolescent Mental Health*, *7(3),* 131-172.

Karimiyan Bafghi, B., Alipour, A., Zare, H. & Nahravanian, P. (2010). On the comparison of cognitive abilities (attention, problem solving, explicit and implicit memory) between addicts and non-addicts, *Scientific Journal of Social Welfare*, 11 (42), 469-490.

Khosravi, Z., Darvizeh, Z. & Rafati, M. (1998). The role of mood states in assessment of female students' problem-solving abilities, *Journal of Thought and Behavior*, 4 (1), 35-96.

Kirk, S.A.; Gallagher, J.J.; Anastasiow, N.J.; & Coleman, M.R. (2006). *Educating Exceptional Children*, Boston: Houghton Mifflin.

Lawton-Craddok, A., Nixon, S .J., and Tivist, R. (2003). Cognitive efficiency in Stimulant with and without alcohol *dependence .Alcoholism: clinical and experimental research*, *27(3),* 457-464.

Mahmoudi, J. & Asghari, M. (2013). Effects of drug use on neuropsychological functioning of addicts in Shiraz city, *Journal of Birjand University of Medical Sciences*, 20 (3), 295-304.

Mintzer, M.Z., & Stitzer, M.L. (2002). Cognitive impairment in methadone maintenance patients. *Drug and Alcohol Dependence*, *67,* 41-51.

Narimani, M., Hashemi, T., Ghasemzadeh, A., Mashinchi, A. & Fotouhi Bonab, S. (2009). Bowen's Self-Differentiation training and the relapse of substance abuse symptoms, *Journal of Research on Addiction*, 3 (11), 45-65.

Noël, X., Van der Linden, M., d'Acremont, M., Bechara, A., Dan, B., Hanak, C., & Verbanck, P. (2007). Alcohol cues increase cognitive impulsivity in individuals with alcoholism**.** *Psychopharmacology*, *192(2),* 291-298.

Oner, O., & Munir, K. (2005). Attentional and neurocognitive characteristics of high-risk offspring of parents with schizophrenia compared with DSM-IV attention deficit hyperactivity disorder children. *Schizophrenia Research*, *76(2-3),* 293-299.

Pennington, B. F. & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 37(1),* 51-87.

Pirastu, R., Fais, R., Messina, M., Bini, V., Spiga, S., Falconieri, D., & Diana, M. (2006). Impaired decision-making in opiate-dependent subjects: Effect of pharmacological therapies. *Drug and Alcohol Dependence*, *83(2),* 163-168.

Reber, A.S. (1996). *Dictionary of psycho*logy. Penguin Books. New York: USA, 2 ed. 767–8,

Robbins, T. W. (2005). Chemistry of the mind: Neurochemical modulation of prefrontal cortical function. *Journal of Comparative Neurology, 493(1),* 140-6.

Rogers, R. D. & Robbins, T. W. (2001). Investigating the neurocognitive deficits associated with chronic drug misuse. *Current Opinion in Neurobiology*, *11(2),* 250-7.

Sadock, B.J., Sadock, V.A. (2005). *Kaplan and Sadock's comprehensive textbook of psychiatry*. 8th Ed. New York: Lippincott Williams and Wilkins.

Sahand, P. (2009). *On the comparison of the areas relating to early maladaptive schemas among unsuccessful and successful addicts in abstention from opiates and* *non-clinical population in Tehran*, MA Thesis (unpublished), Payame Noor University, Tehran.

Scott, J. C., Woods, S. P., Matt, G. E., Meyer, R. A., Heaton, R. K., Atkinson ,J .H., & Grant, I. (2007). Neurocognitive effects of methamphetamine: A critical review and meta-analysis, *Neuropsychological Review*, *17(3)*, 275-97.

Tehranidoost, M., Radgoudarzi, R., Sepasi, M. & Alaghehband Rad, J. (2003). Executive function deficits in children with attention deficit-hyperactivity, *Advances in Cognitive Science*, 5 (1), 1-9.

Verdejo, A., Toribio, I., Orozco, C., Puente, K. L., & Perez-Garcia, M. (2005). Neuropsychological functioning in methadone maintenance patients versus abstinent heroin abusers, *Drug and Alcohol Dependence*, *78(3)*, 283-8.

Welsh, M. C. & Pennington, B. F. (1988). Assessing frontal lobe functioning in children: Views from developmental psychology. *Developmental Neuropsychology*, *4(3)*, 199-230.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention- deficit/hyperactivity di sorder: A meta-analytic review. *Biological Psychiatry*, *57(11)*, 1336-1346.

Zelazo, P. D., Muller, U., Marcovitch, S., Argitis, G.r Sultherland, A. (2002). The development of Executive Functions in early childhood. *Journal of Learning Disabilities*, *36(3)*, 230-46.