

### Abstract

**Objective:** The aim of this study was to compare sustained attention between three groups of methamphetamine addicts, heroin addicts, and normal people. **Method:** In this causal-comparative study, 30 methamphetamine dependent participants and 30 heroin dependent participants were selected using purposive sampling from among the men who referred to RIBIRTH Center for Addiction of the city of Tabriz. In addition, 30 normal individuals were selected for the control group. These three groups had been matched in terms of age, gender, education, marital status, and socioeconomic status. All three groups were evaluated by means of demographic questionnaire and continuous performance test. **Results:** The results showed that there was a significant difference between methamphetamine and heroin groups and between methamphetamine users and normal people in terms of the reaction time of CPT, as a measure of sustained attention; indeed, the methamphetamine group gained higher mean scores in that regard ( $P < .01$ ). In other indicators of sustained attention, i.e. errors of commission and errors of omission, the difference between the normal group and heroin users was obtained significant ( $P < .01$ ). **Conclusion:** Therefore, it can be argued that the application of sustained attention tasks is lower in methamphetamine and heroin users than that in normal people. In addition to the more accurate understanding of the problem, the better identification and recognition of these factors can pave the way for the higher effectiveness of the current treatment methods and also for the provision of new therapeutic strategies.

**Keywords:** sustained attention, methamphetamine, heroin

## Comparison of Sustained Attention between Methamphetamine Addicts, Heroin Addicts, and Normal People

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## Introduction

Dependence and substance abuse are among the critical biological, psychological, and social problems that are spreading globally; in this regard, the number of victims of drug use is increasing every day (Sargolzayi, 2001). Statistics indicate that the prevalence of the use of different drugs is on the rise. According to the global report in 2014, 243 million people aged 15-64 years have attempted drug use in 2012. The global report issued by the United Nations Office on Drugs and Crime (UNODC) in 2014 shows that the prevalence of drug use and psychotropic drug use in the world population aged 15-64 years has experienced an ascending rate during seven years from 2012 to 2006. The report also noted that consumption of substances such as cannabis, opium and its derivatives, cocaine, and ecstasy has decreased in 2011 and 2012 while human population has experienced an increasing trend in the consumption of opioids and amphetamines in the world (Secretariat of the Anti-Narcotics Headquarters, 2015). Regarding the state of drug use and addiction in Iran, the latest research shows that the prevalence rate of drug use in 15-to-64-year-old population in the country equals 65.2%. The results of the National Project of Prevalence Studies show that opium, crystal, crack, and heroin are the most frequently used narcotic and psychotropic substances in Iran, respectively (Secretariat of the Anti-Narcotics Headquarters, 2015).

Addiction is a complex cycle that, on the one hand, contains a neurophysiological process, and, on the other hand, contains a psychological process where the neurophysiological and psychological changes produce neuropsychological outcomes. The neurophysiological process of addiction in the individuals' brain begins with a pathway from dopaminergic neurons in the Ventral Tegmentum Area toward the Accumbens Nucleus in the limbic system (Asghari, Dejkam & Azad Fallah, 2009). Some substances increase the secretion of dopamine in this pathway. Some substances inhibit the uptake of dopamine into presynaptic neurons and, accordingly, increase the concentration of synaptic dopamine in this pathway, and stimulate opioid receptors. In addition, some substances directly stimulate opioid receptors (Sargolzayi, 2000). Nevertheless, some substances, such as opium and morphine mostly affect Ventral Tegmentum system, and substances such as cocaine, amphetamines, and crystal mostly affect the Accumbens nuclei. Following the repetition of this widespread cycle, neuropsychological injuries, such as attention deficit, concentration disorder, memory malfunctioning, deficit in visual-spatial perception, decision-making weakness, impulsive control, ataxia, and the simple and complex reaction time of vision and hearing are observed in addicts in addition to psychosocial complications (Asghari, Dejkam, & Azadeh Fallah, 2009). In this study, among the various cognitive functions, particular focus has been placed upon sustained attention.

Sustained attention refers to the ability to continue persistent and consistent behavioral responses during continuous and frequent activities (Sarter, Givens, & Bruno, 2001; cited in Alloeay, Wootan, & Deane, 2014). Sustained attention indicates the fundamental attention function that determines the high efficiency aspects of attention (selective attention, divided attention) and cognitive capacity at large. Sustained attention is important for psychologists in that it is the basic condition for information processing; therefore, this type of attention is considered essential to cognitive development. When a person has problems in sustained attention, s/he often faces inabilities in adapting to environmental demands and in modifying his/her behaviors (such as inhibition of inappropriate behavior) (Degangi, & Porges, 1990; cited in Ahmadi, 2014). In comparison with the selective attention and attention transitions, about which there is a lot of information, a limited number of studies have been carried out on this kind of attention.

Degangi, & Porges (1990) have identified three stages in sustained attention that include attention getting, attention holding, and attention releasing. The first stage, which is attention getting, is more than a mere biased reflection. In fact, this stage of attention is the onset of orienting a position and alertness to a particular stimulus. In spite of the fact that the person is able to have automatic concentration, it does require complex intellectual processing. The second stage, which involves keeping or holding attention, occurs when a stimulus is complex or new and novel. In fact, the stimulus that seeks to preserve our attention should have these two characteristics. In this case, it encourages information processing. Basically, this stage is explained through the duration of the involvement in a cognitive activity that includes the pertaining stimuli. Attention holding, like attention getting at the previous stage, is very important because of the pivotal role it plays in learning. If activities or task stimuli are relatively complex, one will spend energy on information processing, or learning. Unfortunately, however, this stage has the potential to be complicated by low and poor motivation and be followed by poor performance.

Attention releasing or moving is the last stage in Degangi, & Porges's processes (1990) in relation to sustained attention. Attention releasing can be simply defined as the displacement or blocking of attention from the target stimuli. This stage of attention can occur for a variety of reasons. For example, a person may be physically and mentally tired and need attention releasing, or some changes may have been made at the levels of arousal. The release of attention provides the individual with the possibility to deal with an activity, assignment or event in a particular way. Most recent studies in the field of addiction emphasize the long-term effects of drugs on neural pathways of the variety of attention and executive functions. For instance, cannabis consumption leads to some disorders in the use of attention resources and mechanisms for the assessment of stimuli, which leads to a reduction in the information processing ability (Solowij, Michie, & Fox, 1991; cited in Nejati & Sharif Asgari, 2012).

The review of the related literature reveals that the use of narcotics, especially stimulants, causes serious damage to the attention ability, which can lead to malformations in a wide range of brain networks, such as the anterior cingulate slot, posterior frontal cortex, insular, and inferior parietal lobule (Carter et al., 2010). Pau, Lee, & Chan (2002; cited in Fishbein et al., 2007) compared the heroin addicts who had stopped heroin consumption with the normal group in terms of sustained attention, divided attention, impulsive control, cognitive flexibility, and abstract reasoning. They concluded that cognitive impulsivity was the only item that the ex-heroin users displayed. Siah Jani, Ouraki, & Zare (2013) examined the duration of methamphetamine use and sustained attention disorders among methamphetamine abusers and reported that there is a correlation between the poor performance of methamphetamine users in the continuous performance test and the duration of use. Attention deficit and alertness in drug addicts include the inability to ignore the unrelated information in the task change test (Salo et al., 2005; cited in Brady, Johnson, Gray, & Tolliver, 2011) and alertness disorder in continuous performance task (London et al., 2005; cited in Brady et al., 2011). A research was conducted to compare cognitive flexibility, attention, and mental processing speed between heroin users, methamphetamine users, and normal individuals, using color trail making test, Stroop color test, and symbol digit modalities test and it was shown that both groups of substance users were weaker in all the executive measurements compared to the normal group. In all cases, people with a long history of drug use had a much weaker performance than those with a short history of drug use (Hekmat, Alem Mehrjerdi, Moradi, Ekhtiari, & Bakhshi, 2011).

Hosak et al. (2011) showed that the error rate of response to non-target stimuli and the response time in the continuous performance test was higher in methamphetamine-dependent patients than that in the control group. Methamphetamine-dependent people were more concerned about responding to all target stimuli than their normal group members, but their concern about whether their responses were correct was lower.

Today, one of the important debates in the field of drug dependence and abuse, there are several neurobiology mechanisms underlying the basis for the treatment of drug dependence and its relapse, especially the cognitive processes that are disrupted as a result of the long-term use of drugs (Nejati & Sharif Asgari, 2012). Therefore, the study of brain damage and cognitive deficits associated with drug use and abuse assumes theoretical and clinical importance. In addition, the assignment of importance to attention and executive functions that may get damaged while using narcotics can be the most critical therapeutic discussion. Regarding the above-mentioned issues and considering the importance of neuro-psychological damage during substance consumption, and the conduct of a limited number of studies in the field of sustained attention; the current research question is to know whether there is a significant difference

between the methamphetamine and heroin consumption groups and their normal counterparts in terms of sustained attention.

## Method

### Population, sample, and sampling method

Considering the nature of data collection in the present study, it falls within the category of causal-comparative studies. The male and female methamphetamine and heroin users (in the age range of 18-35 years) who referred to Tabriz's Rebirth Center and consumed methamphetamine and heroin more than one year constituted the statistical population of this study. From among all the clients who referred to Rebirth Clinic from April 2014 to May 2014, 30 patients with methamphetamine addiction and 30 patients with heroin dependence were selected as the sample units via purposive sampling method. Moreover, 30 non-drug-dependent individuals who were matched with the other two groups in terms of age, gender, marital status, education, and socioeconomic status were selected as the control group. It should be noted that the mean values of age in the normal people, methamphetamine users, and heroin users equaled 26.27, 27.77, and 28.23 years, respectively. In addition, the mean age of onset of addiction for the methamphetamine group was 19.30 years and for the heroin group was 19.50 years. In terms of marital status, 66.7% of the participants in the control group were unmarried and 33.3% of them were married; 66.7% of the participants in the methamphetamine-dependent group were unmarried, 30% of them were married, and 3.3% of them were in a separation status; 63.3% of the participants in the heroin-dependent group were unmarried, 23.3% of them were married, and 13.3% of them were in a separation status. Education level of the participants was considered at five levels, namely elementary, secondary, diploma, associate's, and bachelor's degrees. The majority of them had passed secondary school education (40% of the participants in the control group, and 46.7% in the methamphetamine and heroin groups); and minority of them had an associate's degree (13.3% of the participants in the normal group, 6.7% of the participants in the methamphetamine group, and 10% of the participants in the heroin group) and elementary school education (13.3% of the participants in the normal group and methamphetamine group, and 16.7% of the participants in the heroin-dependent group). In addition, the majority of participants held a moderate socioeconomic status (60% of the normal group, 40% of the methamphetamine group, and 53.3% of the heroin group). As previously mentioned, the three groups had been matched with each other in terms of age ( $P > 0.05$ ,  $F = 1.352$ ), education ( $P > 0.05$ ,  $X^2 = 14.461$ ), marital status ( $P > 0.05$ ,  $X^2 = 5.772$ ), and socioeconomic status ( $P > 0.05$ ,  $X^2 = 7.737$ ).

The criteria for the inclusion of drug addicts into the research were: right-handedness, a minimum of one year's history of daily use of these substances (methamphetamine and heroin), a favorable general health after completing the period of detoxification for the purpose of participating in the test, placement in

the age range of 18-35 years, at least reading and writing levels of education (non-literate individuals were not used in this study because they would not be able to read numbers in the continuous performance test ), not having any psychiatric illnesses, such as psychosis, and not taking other drugs over one year for each group. Addiction-related disorders were also controlled by the general physician at the Addiction Center through the conduct of a clinical diagnostic interview. Therefore, the individuals who did not meet the above conditions were excluded from the study. To this end, after obtaining the participants' consent, the medical records of the patients were examined and they completed a demographic questionnaire and the Edinburgh Handedness Inventory. If the participants had the criteria for entering the study, they would receive an explanation of how the test was to be carried out, and then they were individually assessed through the Continuous Performance Test.

### **Instruments**

1. Edinburgh Handedness Inventory: This questionnaire was constructed in 1970 by Oldfield at Edinburgh University of Scotland and its reliability and validity were verified by Alipour & Agah Harris in 2007. The questions in this questionnaire include writing, drawing, throwing, using scissors, using a toothbrush, using a knife, using a spoon, striking a match, holding a computer mouse, and opening a box. For the evaluation of handedness, the total sum of the right scores in the numerator should be subtracted from the sum of left scores. These two sums should be added together in the denominator, and the quotient should be multiplied by 100. In this way, the individual's score is placed in a continuum range from +100 to -100 where +100 represents the dextrality and -100 represents sinistrality. In this way, left-handers' scores range from -40 to -100, double-handers' scores are between -40 and +40, and right-handers' scores range from +40 to +100. The Cronbach's alpha coefficient of the test has been reported equal to 0.97, Guttman's reliability coefficient has been reported equal to 0.96, and split-half reliability was obtained equal to 0.96 for the first half and 0.94 for the second half. The correlation of this questionnaire with Chapman's Handedness Inventory was obtained equal to 0.75, which is a high discriminant validity (Alipour & Agah Harris, 2007).

2. Continuous Performance Test: For the assessment of sustained attention ability, the computerized version of the Continuous Performance Test (CPT) was used (Resvold, Mirsky, Sarason, Bronsome, & Beck, 1956). CPT is a laboratory model for the measurement of sustained attention. At first, this test was used to measure brain lesion, but its application expanded gradually. The purpose of this test is to measure attention maintenance, care, alertness, and concentrated focus. The conduct of this test leads to the activation of the right part of right frontal lobe and parietal lobe. The Persian version of this test consists of two stimulus sets (Persian numbers or images), each consisting of 150 stimulus. Out of these 150 stimuli, 30 ones (20% of the total stimuli) are the target stimulus that are

expected to be responds to by the participants through observation (by pressing a key). The interval between the two stimuli is one second and the duration of each stimulus is two hundred thousandth of a second. The conduct of the whole test by considering the trial phase takes a total of 200 seconds. The variables that are obtained from the administration of this test include the number of correct responses, the number of non-responses to the target stimulus (omission error), the number of responses to responses to the non-target stimulus (commission error), and the reaction time in milliseconds (Khodadadi, Mashhadi, & Amani, 2009). Validation reviews have not yet been conducted on this test. However, a very similar version of this test, which was previously constructed by Hadianfar, Najarian, Shekarshekan, & Mehrabizadeh (2000) in Iran, was reported to hold a coefficient of 0.93 to 0.95 through test-retest reliability during a 20-day interval (Nazifi, Rasoulzadeh Tabatabaee, Azad Fallah, & Moradi, 2011).

## Results

Descriptive statistics related to reaction time, commission errors, and call National Continuous Performance Test is introduced as indicator of continuous attention.

**Table 1: Descriptive statistics of variables in separated groups**

<i>Variables</i>	<i>Normal Group</i>		<i>methamphetamine Group</i>		<i>Heroin Group</i>	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>
<b>Reaction times</b>	425.87	44.50	485.53	86.32	436.17	46.09
<b>Commission errors</b>	0.93	1.04	2.23	2.43	2.93	2.81
<b>Omission errors</b>	0.33	0.84	2.30	3.36	2.83	4.66

Multivariate analysis of variance should be used to examine the differences in the three groups. One of the assumptions of this analysis, is normal distribution the variables in the group. Results of Kolmogorov–Smirnov test is presented in Table 2, which proves establishment of this presumption.

**Table 2: Results of Kolmogorov-Smirnov test of continuous attention**

<i>Variables</i>	<i>Normal Group</i>		<i>methamphetamine Group</i>		<i>Heroin Group</i>	
	<i>Z statistics</i>	<i>Sig.</i>	<i>Z statistics</i>	<i>Sig.</i>	<i>Z statistics</i>	<i>Sig.</i>
<b>Reaction times</b>	0.143	0.06	0.124	0.200	0.131	0.158
<b>Commission errors</b>	0.136	0.09	0.126	0.153	0.07	0.07
<b>Omission errors</b>	0.135	1.03	0.129	0.162	0.167	0.167

Another assumption of equality of error variances by using Levene's test was evaluated. Based on the results, assumption of error variances in reaction time ( $P>0.05$ ,  $F=0.853$ ), commission errors ( $P>0.05$ ,  $F=3.112$ ), and error elimination ( $P>0.05$ ,  $F=1.876$ ) in the three groups was confirmed. The analysis was conducted and the results showed significant differences ( $P<0.001$ ,  $F=4.823$ , Wilks Lambda=0.730). Univariate analysis of variance was used to evaluate different patterns as follows.

**Table 3: ANOVA test for different patterns of continuous attention**

<b>Variables</b>	<b>Sum of squares</b>	<b>df</b>	<b>F statistics</b>	<b>Sig.</b>
<b>Reaction times</b>	396181.78	89	7.92	0.001
<b>Commission errors</b>	494.90	89	6.20	0.003
<b>Omission errors</b>	1085.15	89	4.61	0.012

As Table 4, there is difference between the groups in the variable of reaction times ( $P < 0.001$ ), commission errors ( $P < 0.01$ ), and omission errors ( $P < 0.05$ ). Tukey HSD test was used for differences between groups. Results showed that the mean scores of methamphetamine are higher than both heroin addicts and normal people in reaction times variable. But there was no significant difference between two groups of addicted to heroin and normal. It also commission errors scores in addicts were higher than normal people. But there was no significant difference among mean scores of other groups. Omission errors scores heroin addicts were higher than normal people. But there was no significant difference among mean scores of other groups.

### **Discussion and Conclusion**

The findings of the present study indicate that there is a significant difference between the three groups in terms of the response time, the number of errors, and the omission response as an indicator of sustained attention. In the response time, the methamphetamine-dependent group's mean value was higher than that of the other two groups. It should be noted that as the mean value of response time increases, there will be a higher degree of error and defect. This finding is consistent with that of previous research conducted by Brady et al. (2011); Thompson et al. (2004); Scott et al. (2007); Baicy & London (2007); Homer et al. (2008); Pau et al. (2002; cited in Fishbein et al., 2007); Siehjani et al. (2013); Meredith, Jaffe, Anq-Lee, & Saxon (2005); Salo et al. (2010); Hosak et al. (2011); Nejati & Sharif Asgari (2012); and Hekmet et al. (2011). These researchers have argued that drug-dependent individuals, especially methamphetamine show some deficiencies in performance tests, particularly in the attention and speed of mental processing. This also suggests the imbalance in the frontal lobe function. Most of the studies carried out in this field lay an emphasis on the role of lesions in different regions of the brain, especially frontal lobe damage and prefrontal lobe lesion in executive function disorders. For example, Rogers & Robbins (2001; cited in Amini et al., 2010) and Verjo & García (2004; cited in Amini et al., 2010) showed that the chronic consumption of drugs causes severe damage to executive control functions and such damage is associated with the dysfunction of the anterior cingulate and frontal cortex (Fishbein et al., 2005; Erch, 2005). In other studies that were similar to the current research, Salo et al. (2010); Meredith et al. (2005; cited in Hosak et al., 2011); Thompson et al. (2004); Scott et al. (2007) showed that methamphetamine addiction reduces the attentional control, which is due to the neuro-chemical changes in the frontostriatal areas, including the anterior



cingulate. In the terms of locating sustainable attention, these areas are also of great importance. As a result, methamphetamine users show a more significant disruption during the response time, which is one of the most important indicators of sustained attention.

The argument that methamphetamine has more harmful effects than other drugs can be explained in another way that methamphetamine contains highly hazardous compounds in comparison with other drugs, such as heroin, and this highlights the disadvantages of dependence on it. The consumption of methamphetamine, in particular its fumigation format (crystal is also used via eating, injection, and inhalation) which is the most common form of consumption, rapidly reaches high concentrations in the brain. Due to its high solubility in fats, this substance easily passes through the brain duct and release dopamine neurotransmitters, norepinephrine, and serotonin, the cardiovascular system and the central nervous system are then activated, and brain cells undergo serious damage. This substance creates dependency much faster than conventional drugs and causes high toxicity (Dezfuli, Mokri, & Ekhtiari, 2009). The omission error and response time, as indicators of sustained attention, have been reported to be associated with attention deficit, commission error, and impulsivity in the research findings reported by Nejati & Sharif Asgari (2012); the American Psychiatric Association has also put drug-related disorders in the category of impulsivity-related disorders. Accordingly, the findings of this research on this hypothesis can also be explained by the term "cognitive impulse". Hence, the time the patient is unable to properly analyze stimuli, and suppress his/her response when the non-target stimulus is presented is noticeable (Hosak et al., 2011). Therefore, the findings of this hypothesis are in line with the theories that emphasize the relationship between poor inhibition control and drug dependence (Koob & Lemoal, 2006). Response inhibition disorder during confrontation with drug-related symptoms remains an obvious attribute of addiction even after many years (Goldstein, Fong, Rosenthal, & Tavares, 2007). Frontal and prefrontal lobe dysfunction and, consequently, impaired processing speed, which was considered as response time in the present study, may have been driven from disorder in focus, divided attention, and the ability to eliminate and detect errors and learn them. In addition, the disruption in processing speed can cause disruptions in decision-making and lead to poor planning. All of these disorders are rooted in brain damage, which has been produced as a result of drug dependency. In general, the slowness of response time in substance dependent individuals may be due to their inappropriate nervous activity due to drug use (Lee et al., 2005; cited in Asghari et al., 2009). According to the previous research findings, it can be stated that the response time may be affected by the type of drug, dose of the consumed drug, and the consumption mode, which, in turn, can cause brain damage in varying degrees that affect the response time.

At the end, the presentation of some suggestions for further research can be useful to future researchers. Considering the increasing diversification of industrial narcotics, it is suggested that further studies be conducted in the field of the cognitive harmful effects of using these types of drugs. In addition, the following researchers are recommended to conduct comparative studies in this regard with other types of drugs. Furthermore, future researchers may be advised to examine the relationship of the duration and dose of drug use with the severity of cognitive disorders. Since the current research was conducted only on males, future researchers can present their comparative research designs in both men and women.

### Reference

- Ahmadi, MH (2014). The Role of continuous attention and working memory capacity is divided in normal and aggressive. Master's degree in the field of General Psychology, University of Zanjan.
- AliPour, A.; Agah Harris, M. (2007). Evaluate the reliability and validity of the Edinburgh Handedness in Iran. *Psychological Journal*, 6 (22), 33- 117.
- Alloway, T.; Wootan, S.; Deane, P. (2014). Investigating working memory and continuous attention in dyslexia adults. *International Journal of Educational Science*, 67, 11-17.
- Amini, F.; Alizadeh, H.; Rezaei, O. (2010). Comparison of executive functions - neurological adults addicted to opiates with ordinary people. *Research on Addiction*, 4 (13), 37-25.
- Asghari, MJ.; Dezhkam, M.; Azadfallah, P. (2009). Comparison of functioning nerve - psychological (reaction time) of addicts and normal people. *Studies University of Education and Psychology*, 10 (1), 61-47.
- Baicy, K.; London, E.D. (2007). Cortico-limbic dysregulation and chronic methamphetamine abuse. *Addiction*, 102, 5-15.
- Bamford, N.S.; Zhang, H.; Joyce, J.A.; Scarlis, C.A.; Hanan, W.; Wu, N.P.; André, V.M.; Cohen, R.; Cepeda, C.; Levine, M.S.; Harleton, E.; & Sulzer, D. (2008). Repeated Exposure to Methamphetamine Causes Long-Lasting Presynaptic Cortico-striatal Depression that Is Renormalized with Drug Re-administration. *Neuron*, 58(1), 89-103.
- Brady, K.T.; Johnson, R.; Gray, K.M.; Tolliver, B. (2011). Cognitive enhancers in the treatment of substance use disorders: clinical evidence. *Pharmacology and behavior*, 99(2), 285-94.
- Carter, J.D.; Bizzell, J.; Kim, C.; Bellion, C.; Carpenter, K.L.H.; Dichter, G.; & Belger, A. (2010). Attention deficits in schizophrenia – preliminary evidence of dissociable transient and continuous deficits. *Schizophrenia research*, 122, 104-12.
- DeGangi, G.; & Porges, S. (1990). *Neuroscience foundation of human performance*. Rockville, MD: American occupational therapy. Association Inc.
- Dezfooli, A.; Mokri, A.; Ekhtiari, H. (2009). Introduction to their pattern of drug use in human samples in order to measure boosting amphetamines. *Journal of Addiction*, 3 (9), 60-55.
- Erch, F. (2005). Electrophysiological evidence of two different types of error in the Wisconsin Card Sorting Test. *Neuro report*, 10, 1299-303.

- Fishbein, M.; Detre, J.A.; Alsop, D.C.; Shin, R.K.; Atlas, S.; & Grossman, M. (2005). The neural basis of the central executive system of working memory. *Nature*, 378, 279-81.
- Fishbein, D.; Krupitsky, E.; Flannery, B.; Langevin, D.; Bobashev, G.; Verbitskaya, E.; & et al. (2007). Neurocognitive characterization of Russian Heroin addicts without a significant history of other drug use. *Drug and alcohol dependence*, 90(1), 25-38.
- Goldstein, V.; Fong, T.; Rosenthal, R.; & Tavares, H. (2007). "A comparison of craving and emotional states between pathological gamblers and alcoholics", *Addictive Behaviors*, 32, 1555-64.
- Hadi far, H.; Najarian, B.; Shokrkon, H.; and Mehrabi Zadeh Honarmand, M. (2000). Procurement and construction of the Persian form of CPT. *Journal of Psychology*, 4 (4), 404-388.
- Hekmat, S.; AlamMehrerjedi, Z.; Moradi, A.; Ekhtiari, H.; Bakhshi, S. (2011). Cognitive flexibility, Attention and speed of mental processing in Opioid and Methamphetamine addicts in comparison with Non – addicts. *Basic and clinical neuroscience*, 2(2), 12-9.
- Homer, B.D.; Solomon, T.M.; Moeller, R.W.; Mascia, A.; De Roleau, L.; Halkitis, P.N. (2008). Methamphetamine abuse and impairment of social functioning: A review of the underlying neurophysiological causes and behavioral implications. *Psychology Bulletin*, 134, 301-10.
- Hosak, L.; Preiss, M.; Bazant, J.; Tibenska, A.; Holub, D.; Cermakova, R.; Cermakova E. (2011). Comparison of continuous performance test results between subjects dependent on methamphetamine and healthy volunteers. *Activitas Nervosa superior Rediviva*, 53(4), 182-6.
- Khodadadi, M.; Mashhadi, A.; Amani, H. (2009). Software Continuous Performance Test. Tehran: Institute for Research in Behavioral Sciences Sinai.
- Koob, G.; & Lemoal, M. (2006). Neurobiology of addiction. *Review of Psychiatry*, 4, 231-44.
- London, E.D.; Berman, S.M.; Voytec, B.; Simon, S.L.; Mandelkern, M.A.; Monterosso, J.; et al. (2005). Cerebral metabolic dysfunction and impaired vigilance in recently abstinent methamphetamine abusers. *Biology psychiatry*, 58, 770-8.
- Meredith, C.W.; Jaffe, C.; Anq-Lee, K.; Saxon, A.J. (2005). Implications of chronic methamphetamine use: a literature review. *Harvard Rev Psychiatry*, 13, 141-54.
- Meredith, Jaffe, Anq-Lee, & Saxon, R.; Buonocore, M.H.; Leamon, M.; Natsuaki, Y.; Waters, C.; Moore, C.D.; Galloway, G.P.; Nordahl, T.E. (2010). Extended findings of brain metabolite normalization in MA- Dependent subjects across continuous abstinence: a porton MRS study. *Drug and Alcohol Dependence*, 113 (2-3), 133-80.
- Nazifi, R. Rasoul Zadeh Tabatabaei, SK.; Azadfallah, P.; Moradi, A. (2011). Continuous attention, response inhibition in children with attention deficit / hyperactivity compared to normal children. *Journal of Clinical Psychology*, 3 (2, row 10), 65-55.
- Nejati, A.; Sharif Askari, N. (2012). A comprehensive study on consumer functions Opium short or long periods of abstinence. *New Journal of Cognitive Science*, 14 (1), 40-31.
- Pau, C.W.H.; Lee, T.M.C.; Chan, S.F. (2002). The impact of heroin on frontal executive functions. *Architecture clinical Neuropsychology*, 17, 663-70.
- Resvold, H.; Mirsky, A.; Sarason, I.; Bransome, E.D.; Beck, L.H. (1956). A continuous performance test of brain damage. *Journal of Consult Psychology*, 20, 343-50.

- Salo, R.; Nordahl, T.E.; Moore, C.D.; Waters, C.; Natsuaki, Y.; Galloway, G.P.; & et al. (2005). A dissociation in attentional control: evidence from methamphetamine dependence. *Biology psychiatry*, 57, 310-3.
- Sar Golzaei, MR (2001). Successful drug addiction. Mashhad: Ferdowsi University Press.
- Sarter, M.; Givens, B.; Bruno, J. (2001). The cognitive neuroscience of continuous attention: where top-down meets bottom up. *Brain research review*, 35, 146-60.
- 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, 275-97.
- Secretariat of the Headquarters for Combating Drugs(2015). The book of year of anti-drug campaign. Tehran: Office of Research and Training Center for Combating Drugs.
- Sieh Joni, Orkaei, L.; Orakei, M.; Zare, H. (2013). Length of methamphetamine glass and continuous attention disorders in methamphetamine abusers. *Research on Addiction*, 7 (27), 66-53.
- Solowij, N.; Michie, P.T.; Fox, A.M. (1991). Effects of long – term cannabis use on selective attention: An event related potential study. *Pharmacology Biochemistry and Behavior*, 40, 683-8.
- Thompson, P.M.; Hayashi, K.M.; Simon, S.L.; Geaga, J.A.; Hong, M.S.; Sui, Y.; & et al. (2004). Structural abnormalities in the brains of human subjects who use methamphetamine. *Journal of Neuroscience*, 24, 6028-36.