The Comparison of Visual Memory Functions between People with Heroin Dependence and Normal People

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Abstract

Objective: The aim of current study was to compare the visual memory functions between heroin dependents and normal individuals. **Method:** The method of the current research was causative-comparative that was carried out on two groups of heroin dependents and normal individuals. The statistical population of the research included the heroin dependent individuals who referred to Drug Addiction Treatment Centers of Gonabad city from March 2013 to August 2013. Finally, 30 patients with heroin dependence were selected through convenience sampling method. The control group consisted of 30 normal individuals who were selected from among the relatives of patients with heroin dependence and were matched in terms of age, gender, and education with the heroin dependent patients. Rey-Osterrieth Complex Figure was used for data collection purposes. The data were analyzed through SPSS v.16 using multivariate analysis. **Results:** The results of the current study showed that the heroin dependent individuals had more difficulties in visual memory and gained lower scores in all three stages of performance compared to the normal group. **Conclusion**: the chronic use of heroin is associated with cognitive defects and damage on visual memory. Therefore, it is necessary to use the rehabilitation programs effective in the improvement of the conditions and treatment of addicts, and to formulate programs for reduce the degree of dependence.

Keywords: dependence, addiction, heroin, visual memory

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Introduction

Addiction and drug abuse are considered as a complex and progressive disorder, which is associated with compulsive behaviors for the re-use of substance despite its negative consequences. With the adaptive changes it makes into the central nervous system, this disorder leads to tolerance, physical dependence, sensitivity, craving, and relapse in the abuser (Buscemi, Turchi, Onori & Ramberti, 2013). The adverse effects of this phenomenon are not only apparent on the person's mental and physical health, but are also imposed on the family and the entire community. This phenomenon in Iran is followed by a high prevalence rate, especially among young people and is considered as one of the most important health problems.

It appears that the consumption pattern of narcotic drugs has witnessed a shift from the traditional narcotics, such as opium or hashish to industrial substances, such as heroin. It is noteworthy that heroin is a substance that makes a person strongly addicted by using it once (Shariat & Elahi, 2010).

The use of this substance has faced a high prevalence around the world (Smyth, Hoffman, Fan & Hser, 2007). At present, heroin, cocaine, and other substances cause more than 200,000 deaths each year, and have extremely adverse effects on families and thousands of other people (World Drug Report, 2012). Heroin, with the chemical name of which is diacetylmorphine, is made in special laboratories from the combination of hydric, acetic acid, and morphine. Heroin passes through the blood-brain barrier much faster than morphine because of the presence of a sterile group, and this has heightened the poisoning and destructive effect of it about five times higher than morphine's poisoning and destructive power (Langston, 2004).

Heroin is ingested, inhaled or injected subcutaneously. Heroin dependence is a major public health problem in Europe and North America (WanSen, YongHui, Lin & Zhu, 2014). The individuals dependent on this substance suffer from numerous problems in cognitive domains, such as inhibition control (Brand, Roth-Bauer, Driessen & Markowitsch, 2008), cognitive flexibility (Fishbein et al., 2007), working memory (Fernandez-Serrano, Perez-Garcia, RioValle &Verdejo-Garcia, 2010), delayed inhibition (Cheng, Lu, Han & GonzalezVallejo, 2012) and decision making (Brand et al., 2008).

These defects not only have adverse effects on the person's daily life, family relations and job position, but also cause many problems in the treatment process designed for these individuals (Bechara et al., 2001). In addition, experts have shown that cognitive deficits will lead to the relapse of drug dependence even in the case of the success of treatment of drug-dependent people, (Teichner, Horner, Roitzsch, Herron & Thevos, 2002). The results of international research have shown that heroin dependence causes extensive damage to the individuals' visual memory (Martinovic Mitrokic et al., 2011).

Memory is the ability of the correct encoding, storage, and retrieval of information (Saed, Roshan & Moradi, 2008) and is one of the main foundations for our learning, thinking, creativity, planning, and everyday activities (Yousefi Loyeh, 2006). Memory, as one of the main cognitive actions, plays an important role in personality, behavior, motivation, emotional processes, and human activities. Any type of deficit in the function of the memory system also causes other cognitive defects (Hassani & Ghaedaniya Jahromi, 2013). In the domain of cognitive psychology texts, various classifications of memory have been made (Sun, 2012). Visual memory is one type of memory that refers to the ability to identify previous topics and events already seen without dependence on the verbal memory because the visual events are subdivisions of specific network images. These images need to be stored in memory. Without an understanding of the perception and recognition of vision, these images are only a collection of events and scenes that cannot be retrieved from memory (Sligte, Scholte & Lamme, 2009). Therefore, visual memory is essential for storing and recording information. A large number of studies have shown the importance of visual memory (Slotnick, Thompson & Kosslyn, 2012). This memory is also divided into three categories, namely sensory visual, short-term, and long-term memories. Sensory memory is described as a message for the preparation of a temporal lobe that allows the extraction of information over a wide period of time (Luck & Hollingworht, 2008). The short-term visual memory holds information from smaller topics in an abstract dependency that is based on abstractions (Jiang, Olson & Chan, 2002). The capacity of this type of memory is very limited in such a way that it has been reported something between 4 and 5 items in most studies (Elmore et al., 2011). Data retrieval in the short-term visual memory is very small, and the data usually disappear after thirty seconds if not transmitted to the long-term visual memory. Unlike short-term visual memory, the long-term memory has a high storage capacity and strong concentration and attention. This type of memory has the capability to correctly store thousands of different items (Luck et al., 2008; Brady, Konkle, Talia & Alvarez, 2011).

In Iran, to the best of the authors' knowledge on addiction research, no research has been conducted on the effect of heroin dependence on the visual memory of the addicted individuals. Severe dependence on this substance is known as a complex brain disease, which not only has extremely adverse effects on individual functions, but also results in long-term damage to brain functions and cognitive functions (Cheng et al., 2013). Despite the existence of the apparent symptoms of the undesirable effects of heroin on various functions, the substance consumer has no idea about these adverse effects on his/her life and has a strong desire for re-use (Warner-Smith, Lynskey, Darke & Hall, 2001).

Research findings have shown that a high percentage of people are involved with addiction. This problem has grown over recent years in many countries, including Iran, and human resources, especially young people, have shown great

tendency towards substance use in comparison with other people (Gennadij, Helena, Irina & Glenn, 2004). The review of related literature shows that heroine consumption in Iran is increasingly growing despite the very adverse effects of heroin on the individual and society. Therefore, it is necessary to make people aware of the destructive effects of heroin on their various activities and functions. Various studies conducted on the effects of heroin use on cognitive processes have shown that this substance will have several damages to human memory. These injuries are sometimes irrecoverable. Memory plays an important role in the effective performance of all human activities, and also the damage to it brings many shortcomings in human life and other cognitive processes. Therefore, it is worthwhile to examine the effects of heroin dependence on memory functioning. In addition, there are few studies that have investigated the effects of drug dependence on cognitive processes in Iran. Considering the above-mentioned explanations, the aim of this study was to compare the function of visual memory between heroin-dependent individuals and normal people.

Method

Population, sample, and sampling method

The method used in the current research was causative-comparative that was carried out on two groups of heroin dependents and normal individuals. The statistical population of the first research group included the heroin dependent individuals who referred to Drug Addiction Treatment Centers of Gonabad city from March 21, 2013 to August 23, 2013. Then, 30 patients with heroin dependence were selected from this population through convenience sampling method. The comparison group consisted of 30 normal individuals who were selected at random and were matched in terms of age, gender, and education with the first group. The criteria for entering the participants in the two groups included being male, aged from 18 to 50 years, and the minimum level of education of third grade of secondary school. In addition to the three criteria mentioned above, certain criteria were considered for the inclusion of participants to the heroin group. These criteria were the match of the participants with the diagnostic criteria of the fifth edition of the Diagnostic Guide for drug use disorder under the diagnosis of clinical psychologists, heroin use for at least one solar year and the history of withdrawal for at most one month, the absence of psychiatric illnesses, such as psychosis, and no consumption of other drugs during a year.

Instrument

Rey-Osterrieth Complex Figure Test: This test was first proposed by Rey in 1942 and was then examined by Osterrieth. This test consists of two cards, i.e.

A and B, each of which is selected and executed separately for the specific occasion. In this research, card A has been used. This card contains 18 perceptual elements and is effective for 7-year-old and older people, especially for adolescents and adults. The test administration is performed after the selection of each card in three steps. The first step is to copy the figure in such a way that the card is placed in front of the person and s/he is asked to draw a similar figure using a pencil on a white paper. The analysis of the subject's method of drawing at this stage specifies his perceptual activity. According to the results of this step, it is possible to evaluate the individual's visual memory. In the second step of the test, the participant is asked to accurately draw the previously observed figure by heart after three minutes of rest while the test card is removed from the eyes of the person. This step is a monomial production stage in which one can measure the extent and accuracy of the visual short-term memory based on the results. In the third step, the examinee may again be asked to produce the figure from memory after a 20-minute delay while no figure is in front of the examinee like the previous step (Yarmohamadian, 2007). The results of factor analysis on this test show that this test includes five areas, namely neuropsychiatric activity, visual-spatial recall memory, spatial-visual-recognition memory, response bias, processing speed, and ability of visual-spatial construction. This test can differentiate the people with brain damage, mental disorders, and normal people from each other. Judgment on the individual's performance is made based on the comparison of his performance in three steps of the test. Usually, the performance in the first step of the test is attributed to the graphic growth ability and perceptual construction of the participant and the immediate memory function. Considering the quantity and quality of the first drawing step, the second step indicates the function level of the participant's visual short-term memory. Finally, the drawing manner in the third step represents the participant's long-term visual memory (Bahrami, 2002). Panahi (2004) reported the criterion validity of this test to be 0.50 and its reliability coefficient to be 0.62. In addition, Nazeri (2004) obtained the criterion validity of this test equal to 0.59 and its reliability coefficient equal to 0.64. In the present study, the reliability coefficient of the test was obtained equal to 0.76. The research was conducted individually. Initially, the participant was asked to copy the figure on an A4 paper while the image card was available to the company so that his sensory memory could be assessed. After drawing the copy, his copy and the sheet pertaining to the first step were taken and the participant was asked to reproduce the figure based on the information in his memory on another sheet of A4. In the last step, the third assessment was carried out to evaluate the function of the long-term memory about 20 minutes after drawing in the second step (short-term memory). The time interval between the second and third steps was filled by using an irrelevant assignment along with reception from the participants. In each of three steps, the assessment of the temporal visual memory was recorded.

Results

The mean value (SD) of the heroin dependent group's age was 34.46 (6.21) years and that of the normal group's age was 34.90 (7.56) years. The independent t-test was used to assess whether the two groups were matched in terms of age and the results showed that the two groups were matched in terms of age (t = 0.26, P> 0.05). In terms of education, the two groups were also matched together in such a way that there were equally 5 participants with secondary school education, 4 participants with high school education, 8 participants with diploma degrees, 7 participants with associate's degree, and 6 participants with bachelor's degree in each group. The descriptive statistics of the scores and reaction time in the three steps of the implementation of the Rey-Osterrieth Complex Figure Test are presented in the following table.

Table 1: Descriptive statistics of the scores and reaction time for each group on Rey-Osterrieth Complex Figure Test

Group	*N*	*Statistics*	*Reaction time (in minute)*			*Memory function*		
			Sensory memory	*Short-term memory*	*Long-term memory*	*Sensory memory*	*Short-term memory*	*Long-term memory*
Heroin	30	Mean	2.68	3.01	5.79	32.06	25	16.90
		SD	0.70	1.08	1.72	3.23	4.82	6.07
Normal	30	Mean	2.53	2.72	4.06	34.26	29.36	25.26
		SD	0.53	0.59	0.79	1.31	2.83	4.10

Multivariate analysis of variance was used to analyze the differences between the two groups. One of the assumptions for this test is the equality of covariance matrices. The results of Box's test indicated that this assumption has been met (P > 0.05; F = 3.61; M Box = 85.45). Another assumption for using this test is the equality of error variances. In this regard, the results of Levene's test indicated that this assumption has been satisfied in the sensory memory's response time (P> 0.05; F = 31.64), short-term memory response time (P> 0.05; F = 3.96), long-term memory response time (P> 0.05; F = 4.53), sensory memory function (P> 0.05; F = 1.39), short-term memory function (P> 0.05; F = 4.50), and finally long-term memory function (P> 0.05; F = 4.23). Therefore, multivariate analysis of variance was performed and the results indicated the existence of a significant difference between the two groups in the linear combination of the variables (Eta-squared = 0.59; P < 0.001; F = 12.73; Wilks's Lambda = 0.41). The statistical power of the present study was obtained equal to 1, which is representative of the acceptability of the sample size for the research.

Table 2. Univariate analysis of variance on the comparison of the research variables between the groups

Variable	*Mean Square*	*F*	*Sig.*	*Eta-squared*
(Time) sensory memory	0.33	0.84	0.36	0.14
(Time) short-term memory	1.27	1.65	0.20	0.24
(Time) long-term memory	44.61	24.71	0.0005	0.99
Sensory memory function	72.60	11.90	0.001	0.92
Short-term memory function	286.01	18.33	0.0005	0.98
Long-term memory function	1050.01	39.07	0.0005	1

As it is observed in Table 2, there is a significant difference between the two groups in terms of the response time in the long-term memory as well as sensory memory function, short-term memory function, and long-term memory function. However, no significant difference was found between the two groups in terms of response time in sensory memory and short-term memory.

Discussion and Conclusion

The contemporary models of human drug addiction have emphasized the neuropsychiatric and neurodevelopmental malformations in complex human brain processes (Robinson & Berridge, 2008; Koob, 2006). Brain imaging studies have shown that there is a relationship between cognitive deficits in substance dependent individuals and malformed prefrontal cortex (especially the upper and lower back dorsal cortex), the anterior belt region, and forefront ring area (Tapert et al., 2007; Paulus, Lovero, Wittmann & Leland, 2008). Cognitive defects are common in substance dependent people, and these shortcomings and deficits are observed even in those who have withdrawn from the use of drugs (McHale & Hunt, 2008; Lundqvist, 2005). Therefore, the aim of this study was to compare the visual memory functions between heroin dependent people and normal people. The results of multivariate analysis of variance showed that there is a significant difference between the two groups in terms of the functions of sensory, short-term, and long-term visual memory in the Rey-Osterrieth Complex Figure Test. According to the tale of mean vales, it is revealed that the mean values of sensory, short-term, and long-term visual memory functions in heroin-dependent group were lower than those of the normal group. Moreover, the results showed that there is a significant difference in terms of response time only in the third stage (long-term memory).

The long-term heroin dependence leads to the production or increase of neurological deficits, including memory loss. The findings of this study showed that there was a significant difference between the heroin-dependent and normal subjects in the functions of long-term visual memory function in such a way that average of the accuracy of the drawings and the reaction time of the subjects in the heroin-dependent group were lower than those in the normal group in the

third step of the Rey-Osterrieth Complex Figure Test, which evaluates the long-term visual memory. This finding is consistent with those of the studies conducted by Ersche, Clark, London, Robbins & Sahakian (2006), Fishbein et al. (2005), Prosser et al. (2006), Fishbein et al. (2007), Martinovic Mitrokic et al. (2011) where it was shown that heroin dependence has devastating effects on long-term visual memory. One of the other findings of this study was the presence of a significant difference between the two groups of heroin users and normal subjects in the sensory and short-term visual memory function. This result is in line with the research carried out by Penk (1981), Pathak, Mandal, Sharma & Rai (2006) where they used Benton visual memory test and concluded that the heroin-dependent group had lower scores than the control group in sensory and short-term visual memory functions. However, this finding is inconsistent with the research done by Martinovic Mitrokic et al. (2011), in which it was shown that there was no significant difference between the heroin dependent individuals and normal group in terms of the functions of immediate and short-term visual memory. To interpret this finding, one may argue that the research findings have shown that heroin dependence causes damage to the core areas of the central nervous system, including the frontal lobe, which results in the malfunction of important and essential cognitive processes, such as visual memory. Imaging studies from the heroin addicts' brains have suggested a decrease in the activity of the neurons in the forearm cortex (Jasmin, Pavlina, Stefan, Eileen & Martin, 2007), and a decline in the density of gray matter in the temporal cortex and gyrus cinguli (Zhu et al., 2009). Heroin leads to the destruction of dopaminergic and serotonergic nerve terminals in the brain and, accordingly, the brain drains from these essential neurotransmitters. In addition, since these systems play an important role in cognitive activities and memory, the destruction of memory and other cognitive functions will come out (Buhot et al., 2003).

In recent decades, the issue of addiction and substance dependency has witnessed considerable changes from the lens of the society. Now this problem is known as a chronic cerebrovascular disease that can cause changes in the structure and functioning of the brain and affects the function of the various brain regions. In fact, the damage to the cerebral area is clearly visible in various activities and functions of the human being. In turn, these deficits will cause great harm to the individuals' daily activities in personal life and social life in relation to others (Pan et al., 2014).

Today, drug dependence has created many social and psychological problems around the world. The occurrence of this phenomenon in Iran has caused many social and family problems. Undoubtedly, it is essential to provide useful solutions to reduce the incidence of this disorder. Due to the frequent medical and psychiatric examinations on drug-dependent individuals, the addicts' psychiatric and physical disorders are quickly identified; however, the damage that substance dependence leaves on cognitive functions remains unknown in a

situation where cognitive disorders have a very negative impact on all areas of human life. According to the above-mentioned points, it is necessary to pay attention to the cognitive damage caused by substance dependence in order to identify these types of injuries and to develop suitable therapeutic programs for the relative improvement of these types of disorders in drug dependent individuals.

Since all the samples in this study were men, the results cannot be generalized to the women in the community. It is suggested that future research focus cognitive functions in heroin-dependent women in order accurately understand the functions of cognitive processes in this group of drug users, as well. In this study, only the visual memory function of heroin dependents was evaluated. Therefore, it is suggested that in other cognitive functions of this group be also evaluated in future research. It is also suggested that the visual memory function in different groups of drug users be examined.

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