Assessment of Memory Performance and Memory Biases in Iranian and Indian Opium Dependents: A Cross Cultural Study

Mahdieh Rahmanian[1*], S.P.K. Jena[2]

[1.] Department of Psychology, Payame Noor University, Tehran, Iran
[2.] Department of Applied Psychology, University of Delhi, Delhi, India
mahdiehrhmn@yahoo.com

Abstract: ***Background:*** According to cognitive models, biases in information processing play a vital role in the etiology and maintenance of psychological disorders. Several researches have been done on cognitive biases in drug dependence disorders, which suggested that drug related stimuli are able to influence most of cognitive processes such as attention, perception, learning and memory. ***Aim:*** The main aim of the present study was to investigate memory performance and implicit and explicit memory biases toward opiate related stimuli, in Indian and Iranian opiate dependent individuals. ***Method:*** As this study was cross-cultural in nature, so 100 opiate dependent and 100 non-drug dependent individuals were selected from India and Iran using cluster and simple random sampling, respectively. The primary data collection was conducted using memory recognition task and "word-stem completion" test. ***Results:*** The results reflected that explicit and implicit memory bias scores were different between opiate dependents and non-drug dependent individuals significantly, as opiate dependents had greater explicit and implicit memory bias than non-drug dependent individuals. In contrast, non-significant main effect for nationality showed that explicit and implicit memory bias scores were not different between Iranian and Indian subjects regardless of opiate dependence variable. In addition, the results showed that explicit memory impairments in opiate dependent individuals were greater than non-dependent subjects. In contrast implicit memory performance in opiate dependent individuals was better than non-dependent subjects.
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Introduction:

In cognitive psychology, memory bias is a cognitive bias that results in memory's enhancement or impairment for remembering special subjects or events. Indeed, when information is encoded or retrieved selectively, memory bias would be happened. The main focus of most researches related to memory bias has been on two memory bias i.e. explicit memory bias and implicit memory bias (Williams, Watts, MacLeod, & Mathews, 1997). Explicit memory bias refers to the process in which emotionally related information is retrieved better than neutral information on conscious recollection test (Graft & Schachter, 1985). Implicit memory bias occurs when emotionally related information is retrieved better than neutral information on an unconscious recollection test (Graft & Schachter, 1985).In the recent years, several studies have examined the possibility of memory biases in various mental disorders such as depression (Barry, Naus & Rehm, 2004; Ruiz-Caballero & Gonzalez, 1997; Beeney & Arnett, 2008; Watkins, Martin & Stern, 2008) anxiety (Scott, Mogg & Bradley, 2001; Dowens & Calvo, 2003; Dewhurst & Marlborough, 2003; Russo, Whittuck, Roberson, Dutton, Georgiou & Fox, 2006), obsessive compulsive disorder (Radomsky & Rachman, 1999; Radomsky, Rachman & Hammond, 2001), posttraumatic stress disorder (Brewin, Kleiner, Vasterling & Field, 2007), general anxiety disorder (Coles & Heimberg, 2002; Russo, Fox, Bellinger & Nguyen-Van-Tam, 2001; Friedman, Thayer & Borkovec, 2000) and eating disorders (Hermans, Pieters & Eelen, 1998; Sebastian, Williamson, & Blouin, 2005).

Furthermore, a number of studies have used different techniques to evaluate memory impairments in substance abuser/dependent individuals. For example, Krank and Kreklewetz (2003) assessed the effects of alcohol advertising on implicit and explicit memory in young adolescents. They found that exposure to five alcohol commercials, which mixed with other commercials, increased alcohol-related responses on implicit but not on explicit memory tests in drinkers, immediately after exposure. The authors suggested that personal experience may be a critical factor in the development of implicit alcohol related cognitions. In another study, Seifert and colleagues (Seifert, Seeland, Borsutzky et al., 2003) investigated memory functions of alcohol dependent patients during the early days of acute alcohol

withdrawal. Their results suggested that acute alcohol withdrawal impairs memory functions, especially free recall. Seifert and colleagues (Seifert, Peters, Jahn et al., 2004), in another study, showed a higher verbal memory performance state could be favorable for a psychotherapeutic approach.In addition, some of scientific studies have investigated the effects of Ecstasy on memory performance and all of them showed the memory deficits in Ecstasy users (e.g. Parrott & Lasky, 1998; Morgan, 1999; Wareing, Fisk & Murphy, 2000; Verkes, Gijsman, Pieters et al., 2001; Rodgers, 2000). Some studies investigated prospective memory in the substance dependence disorder. For example, Heffernan and colleagues (Heffernan, Ling, Parrott, Buchanan, Scholey & Rodgers, 2004) assessed impairments in prospective memory performance and everyday memory performance in nonsmokers, light smokers (1-4 cigarettes/day), moderate smokers (5-14 cigarettes/day) and heavy smokers (15 or more cigarettes/day). The results showed that heavy smokers reported significantly greater impairment in long-term prospective memory performance than either nonsmokers or light smokers. In another study Heffernan, Moss and Ling (2002) examined the influence of heavy alcohol use on impairments in prospective memory performance. The results showed that heavy drinkers reported significantly greater levels of impairment in prospective memory compared to a light drinking and non-drinking control groups.

Another approach that researchers are interested to evaluate in drug dependent individuals is memory bias toward drug related information. Associative learning mechanisms, such as the encoding and retrieval of memory, may play an important role in the maintenance of addictive behaviors (White, 1996). Some theorists and researchers discussed that a conditioned stimulus related to drugs can activate a specific neural network and manipulate the original memory (Grant, London, Newlin, et al., 1996; Robbins & Everitt, 1999). For example, Goldman and his colleagues (Goldman, Brown, Christiansen & Smith, 1991) proposed a model related to memory bias in alcoholic individuals. According to them, alcohol expectancies are representative of individuals' experiences about alcohol, both direct and alcohol consequences based on individual's biological characteristics and environmental exposure. This model proposed that "unique expectancy concepts (images, memories of sensory-motor and affective experiences) are nodded in an information network. Activation of particular nodes occurs in a predictable fashion once the individual encounters stimuli that match previously encoded material relevant to drinking". Goldman (1999) believed that information processing memory system acts as a repository of the potential to consume alcohol and other drugs, and this potential is then manifested in certain stimulus circumstances.

According to the knowledge of researcher, there are a rare number of researches related to memory bias in substance dependence and the results of these researches are varied among different kind of dependency. For example, Litz, Payne and Colletti (1987) found that the smokers showed memory bias for positive information about smoking and it was more consistent with their actual smoking behavior than what they said they believed. In another study, Leung and McCusker (1999) used a free association task with smoker and non-smoker samples. The results showed that both groups generated more negative than positive associations to a smoking cue. However, while the ratio of positive/negative associations was constant across free association time intervals in non-smokers, smokers generated proportionately more of their positive associations in the early time interval and proportionately more of their negative associations in the later time period. The authors suggested that associations generated in the early time period maybe have an automatic nature, whereas those generated later reflected more effortful and unconscious processes, and they interpreted these findings as evidence for an accessibility bias for positive smoking associations in smokers.Furthermore, Franken, Rosso and van Honk (2003) assessed explicit memory bias for alcohol-related pictures in alcoholics compared to nonalcoholic (light) drinkers and in this study the cognitive processing of alcohol cues was compared to general incentive cues (food) and neutral cues. The results indicated that alcoholics showed enhanced memory for alcohol cues compared to neutral or general incentive cues.

Some researchers have focused on implicit memory for addiction related information. Implicit memory bias toward drug related words and also toward positive vs. negative outcomes related to the addiction, have been observed in gamblers, heavy drinkers and smokers (Armstrong, 1997; McCusker & Gettings, 1997). Stacy (1995; Stacy, Leigh & Weingardt, 1994) has suggested that memory activation (an implicit memory component) represents the effects of associative memory that is activated by motivational and situational factors, automatically. Stacy, Arnes and Dent (1996) showed that implicit positive memory associations for alcohol or marijuana predict the amount of alcohol or marijuana use in at risk adolescents for substance abuse. In another study that conducted by Stacy (1997), the effect of drug related memory associations on drug taking behavior was examined.

They used a semantic priming measure of implicit cognition in which participants were ask to create activities associated with positive/negative outcomes or states. They revealed that positive outcomes not linked explicitly in the task to alcohol, nevertheless automatically primed representations of alcohol as a function of drinking history and behavior and also showed that the memory association measures significantly predicted subsequent drug use.

In addition, Jarvik and colleagues (Jarvik, Gross, Rosenblatt & Stein, 1995), using a perceptual identification task, showed that nicotine deprived smokers identified more smoking related words than food related or neutral words. They also used a categorization task, in which smoking or food related words were rapidly presented and participants were required to categorize the word as being either food or smoking related. The results showed that abstinent smokers more quickly categorized the smoking related words than food related words. A same pattern of nicotine deprivation's effect has been reported by Zeitlan, Potts and Hodder (1994). Using a word stem completion task, they showed that abstinent smokers recalled more smoking related words than non-abstinent smokers or nonsmokers.

In another study Zwaan and Truitt (1998) showed that smokers' sentence comprehension was reduced during recall of a smoking script compared to a neutral script, whereas non-smokers' sentence comprehension was equivalent during recall of the two scripts. Based on Hogarth and colleagues (Hogarth, Mogg, Bradley, Duka & Dickinson, 2003) one explanation for these results could be that the smoking cues elicited an attentional bias, which interrupted processing of the information, which are necessary for the performance of the other tasks. However, they suggested that it could be explained based on MacLeod (1991) that "the smoking cues elicited a motor response, which interfered with the production of responses necessary for the performance of the ongoing tasks" (Hogarth et al., 2003). In a different study Fehr, Wiedenmann and Herrmann (2006) assessed memory function in smokers and non-smoking controls by obtained EEG data during a modified Stroop task and a color matching task (nicotine Stroop). The behavioral data from nicotine Stroop didn't show a comparable interference effect related to the use of drug-related words in both groups. However, in smokers the smoking-related words elicited ERP activation patterns comparable to those evoked by the Stroop interference task. According to the authors, the results showed interference effect of smoking-related words in smokers that may be associated with memory bias and enhanced sensitivity for drug-cues.

Taking together,a lot of studies have evaluated implicit and explicit memory biases in different disorders, but based on researcher's knowledge study on memory in substance dependence disorder is very scarce. As above review has revealed, the most of previous studies in this field have demonstrated that drug taking behaviors result in various memory impairments and memory biases toward addiction related stimuli in drug dependent population. Furthermore, any research hasn't considered that which type of memory biases for drug related information is associated with opiate dependence disorder and as yet it doesn't determine whether opiate dependent individuals show implicit and explicit memory biases or not. According to these limitations, the main aim of present study was to investigate memory impairments and explicit and implicit memory biases toward opiate related stimuli, in Indian and Iranian opiate dependent individuals.

Hypotheses

We attempted to examine the following hypotheses in this paper:

- Opiate dependent individuals show significantly greater impairment in explicit memory performance than non-dependent group.
- Opiate dependent individuals show significantly greater impairment in implicit memory performance than non-dependent group.
- Opiate dependent individuals demonstrate greater explicit memory bias toward drug related stimuli compared to non-dependent individuals.
- Opiate dependent individuals demonstrate greater implicit memory bias toward drug related stimuli compared to non-dependent individuals.

Method:

Present study's research method was an Ex-post facto or Causal-comparative research. As this study was cross-cultural in nature, so it was included two groups from each country, i.e. experimental group (opiate dependent subjects) and control group (non-dependent subjects). As the opiate dependent sample were selected from male inpatient and outpatient opiate dependent individuals, who had DSM-IV-TR (APA, 2000) criteria for opiate dependence, in Delhi, India and Tehran, Iran, it was easier to access them through de-addiction centers (as clusters), so in the present study the cluster random sampling was used. Participants in the control group were recruited among Indian and Iranian male students and staff of universities that located in Delhi, India and Tehran, Iran, without any current or previous substance dependence of any kind using simple random sampling. This group was matched as closely as possible with the experimental group for

demographic characteristic, such as age, education, marital status and monthly income. Descriptive analyses showed that Iranian opiate dependent subjects had a mean age of 33.58 years and a mean education of 12.50 years. They have used drugs for an average of 11.86 years. Mean amount of drug that they used was 236.20 mg per day and their mean onset age of drug taking was 21.7. The Indian opiate dependents consisted of50 men with a mean age of 33.64 years and a mean education of 12.66 years. Dependent participants have used drugs for an average of 10.62 years. Mean amount of drug that they used was 236.60 mg per day and their mean onset age of drug taking was 22.90. The analyses also showed that the Iranian control group consisted of 50 non dependents with a mean age of 31.54 years, a mean education of 13.32 years. In addition, Indian control group had a mean age of 31.70 years and a mean education of 13.40 years. In present study, to assess explicit memory bias, recognition memory task and to measure implicit memory bias, word-stem completion test was conducted.

Recognition memory task: To measure explicit memory bias, a computerized recognition task has been used that was designed by researcher. In this test subjects is presented with previously seen words (old), and with length matched distractor words (new), and instructed to determine those words that they recognize as having been exposed previously. Indeed, this task asks subjects to consciously recognize previously presented stimuli items. Explicit memory is revealed by increased accuracy with which previously seen words, relative to previously unseen words.

Materials and stimulus: The materials for the task were 60 words consisting of 20 opiate related words, 20 neutral words and 20 fruit related words. The fruit words used in this memory task as general intensive cues, for comparison between effects of opiate related words as stimulus intensive cues and fruit words as general intensive cues on memory process. The pilot study was conducted to select the appropriate words for recognition memory task. To eliminate an effect for word length on encoding and recognition, the stimuli in the fruit related and the neutral categories were matched as closely as possible for the mean number of letters in each word and syllables with opiate related words. These total words were divided in to two presentation sets, each consisting of 10 opiate related words, 10 neutral words and 10 fruit related words. Only one of these sets was presented in the first stage of the task (encoding) for any subject, while another set provided the distractor items in the second phase of the task given to that subject.

Apparatus: The present explicit memory task was designed and presented by Authorware Runtime Macromedia (version 6.0). This experimental task starts with the appearance of a set of words on the screen one by one and each word is presented for 500 milliseconds and participates are asked to look at the words carefully. In this phase, 10 words from each category (total 30 words) are presented twice. The appearance of the words is random; the only restriction is that the same words could not appear subsequently. After first presentation, second phase would be started wherein the previous words (old) are combined by thirty new words that were not presented previously and act as distractor and all sixty words appear in center of screen one by one. In this stage, the subjects are asked to distinguish whether they have been exposed to the word during the first stage or not as quickly as possible. A button box with two keys labeled “Yes” or “No” allowed them to response to each word. The word stayed on the screen until a response is made or after 1000 milliseconds. After completion the task, the report sheet records which is including of the number of correct and out time responses for each words’ category separately.

Word-Stem Completion Test: In the present study for measuring implicit memory bias, “word-stem completion” test was used which is an indirect measure of memory. In this test, the participants were given a list of incomplete words (word stems) and asked to complete each stem with the first word that comes to their mind. Implicit memory was assessed by counting the number of stems that were completed to make stimulus words and comparison with the number of stems that were completed to make neutral words.In this study, if the number of completing stems with opiate related words was more than neutral words, the probability of implicit memory bias to drug related stimuli has being increased. In the other word, opiate dependent individuals may be unintentionally offered drug related words as first word triggered, rather than the many other possible alternatives. In this task, 24 words consisting of 12 opiate related words and 12 neutral words were applied.

Results:

Explicit Memory Performance:

In order to evaluate performance on the explicit memory task, the number of opiate related words, neutral words and fruit related words (as general intensive cues) that each subject recognized

from both presentation statuses were calculated. As were explained earlier, in this task two sets of words were presented in two stage, the presented words in encoding stage as main words (i.e. Old words) and the word set that had not been presented in encoding stage but presented in the recognition stage as distractor words (i.e. New words). To compare means number of recognized words based on their type and presentation status among Indian and Iranian opiate dependent and non-dependent groups, mean number of recognized words were entered into a 2 × 2 × 2 × 3 mixed design analysis of variance (ANOVA) with group (opiate dependents and non-dependents) and nationality (Indian and Iranian) as the between subjects variables and presentation status (old and new words) and word type (opiate related, neutral and fruit related words) as within-subjects variables. The results of ANOVA have been shown in Table 1.

Several significant effects came out from this analysis. First there was a high significant main effect of presentation status $F(1,196) = 3884.67$, $p<0.001$, which was expected and reflected that all participants, regardless of nationality and dependence status, recognized more old words (6.49) than new words (1.28), irrespective of word type.

Table 1. ANOVA outcomes on means number of recognized words among groups

Source of variations	F	Sig.
F (Present status)	3884.66	.000
F (Word type)	136.08	.000
F (Group)	124.60	.000
F (Nationality)	17.70	.000
F (Present status × Word type)	2.80	.062
F (Present status × Group)	202.48	.000
F (Present status × Nationality)	.004	.952
F (Word type × Group)	183.13	.000
F (Word type × Nationality)	.951	.387
F (Nationality × Group)	2.29	.132
F (Present status × Word type × Group)	.426	.654
F (Present status × Word type × Nationality)	.240	.787
F (Present status × Word type × Group × Nationality)	6.49	.002

The results also showed that there were significant main effects for word type, $F(2,196) = 136.83$, $p<0.001$, group $F(1,196) = 124.60$, $p<0.001$ and nationality $F(1,196) = 17.70$, $p<0.001$. Significant main effect for group reflected that irrespective of nationality, non-dependent group (26.30) recognized more number of words in average (regardless of presentation status and kind of the word) than opiate dependent group (20.33). Also, significant main effect for nationality reflected that irrespective of dependence status, there was significant difference between Iranian and Indian participants on mean number of recognized words, regardless of presentation status and kind of the word, as Iranian subjects (24.44) recognized more number of words than Indian subjects (22.19).

This analysis also demonstrated a significant group × word type interaction $F(2,196) = 183.13$, $p<0.001$, which displayed that there were significant differences between opiate dependent and non-drug dependent groups, irrespective of nationality, on the numbers of recognized words based on their type. In order to clarify differences between opiate dependent and non-drug dependent participants, three independent samples t-test were used for each kind of recognized words regardless of their presentation status, separately. The results showed that opiate dependent individuals recognized more number of opiate related words in compare with non-drug dependent subjects (10.17 vs. 8.52) and this difference between two groups was significant [$t(198) = 6.65$, $p<0.001$] (Figure 1).In addition, as have been shown in Figure 1, the differences between two groups on the numbers of recognized neutral words [$t(198) = -13.10$, $p<0.001$] and fruit related words [$t(198) = -14.80$, $p<0.001$] were found to be significant; as non-drug dependent subjects recognized more number of neutral (8.87 vs. 5.10) and fruit related words (8.91 vs. 5.06) in compare with opiate dependent participants.

These results reflected that drug dependent participants recognized more number of opiate related words than neutral words and this is representative of greater explicit memory bias in this group.

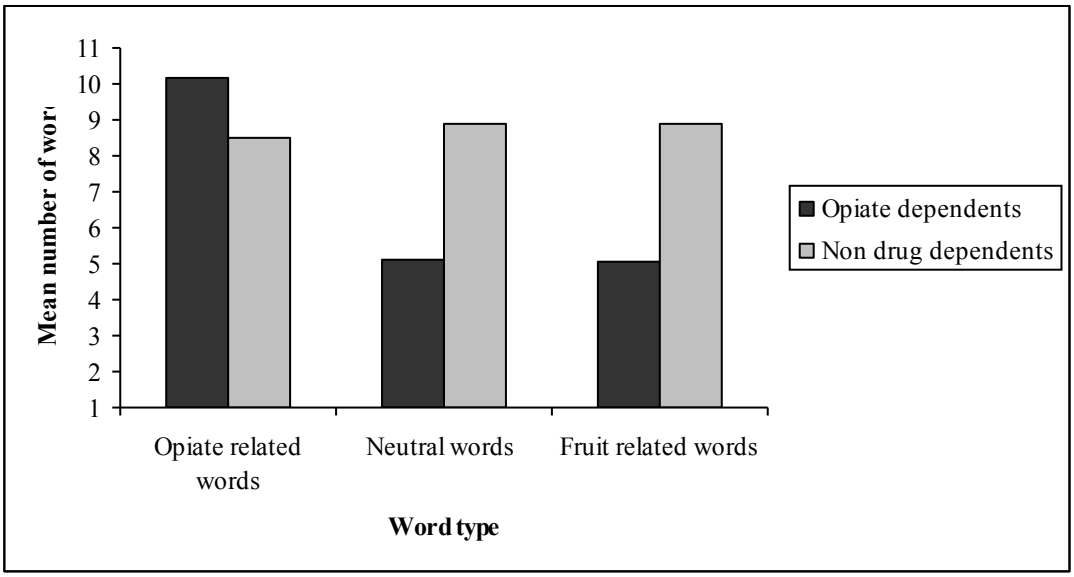

Figure 1. Comparisons between means number of words based on their type between groups

Significant interaction effect for group × presentation status F(1,196) = 202.48, p<0.001 displayed that there were significant differences between opiate dependent and non-drug dependent groups, irrespective of nationality, on the mean number of recognized words based on their presentation status and regardless of word type. In order to compare explicit memory performance between groups, independent samples t-test was used and the mean number of total words (without considering type of words) that recognized by participants correctly (old words) was entered into independent sample t-test. Also, the mean number of total words (without considering type of words) that recognized by participants incorrectly (new words) were calculated in order to compare amount of error on recognition of words between two groups. The results showed that non drug dependent individuals recognized more number of correct words (old words) in compare with opiate dependent subjects (22.74 vs. 16.19) and difference between two groups was significant [t(198) = -14.11, p<0.001]. In addition, the difference between two groups on the numbers of incorrect (new) words [t(198) = 2.27, p<0.05] was found to be significant; as opiate dependents recognized more incorrect (new) words (4.14) in compare with nondependent group (3.56). The explicit memory performance of opiate dependent and non-dependent groups has been shown in Figure 2.

Based on above Figure non-opiate dependents recognized more numbers of correct (old) words in compare to opiate dependents, so their explicit memory performance was better than opiate dependent individuals. In contrast amount of error was greater in opiate dependents than non-dependent individuals.

In addition, the presentation status × word type interaction F(2,196) = 2.80, NS was not significant, which revealed that participants had ability to discriminate old words from new words in all type of words (opiate related, neutral and fruit related words), but as a four way interaction for presentation status × word type × group × nationality F(2,196) = 6.49, p<0.01 was significant, so this discrimination was different across four groups.In order to clarify these differences in details, two 2 × 2 × 3 mixed design analysis of variance (ANOVA) with group (opiate dependents and non-dependents) and nationality (Indian and Iranian) as the between subjects variables and word type (opiate related, neutral and fruit related words) as within subjects variables were used for each presentation status (old and new), separately.

First analysis for old (correct) words showed significant main effect of word type F (1,196) = 74.27, p<0.001 and interaction effect of group × word type F (2,196) = 86.42, p<0.001. Significant effect for group × word type interaction displayed that there were significant differences between opiate dependent and non-drug dependent groups, irrespective of nationality, on the mean numbers of correct (old words) recognized words based on their type. In order to clarify differences between opiate dependent and non-drug dependent participants, three independent samples t-test were used for each kind of correct recognized words, separately. The results showed that the differences between opiate dependent individuals (7.22) and nondependent group (7.51) on the mean number of correct recognized opiate related

words were found to be non-significant [t(198) = -1.70, NS]. In contrast, the differences between two groups on the mean number of correct recognized neutral words [t(198) = -13.63, p<0.001] and fruit related words [t(198) = -13.67, p<0.001] were significant; as non-drug dependent subjects recognized more number of correct neutral (7.65 vs. 4.52) and fruit related words (7.58 vs. 4.45) in compare with opiate dependent participants. Totally, non-dependent group recognized all type of words more than opiate dependent individuals, correctly, but only differences between two groups were significant only in case of neutral and fruit related words. In the other word, non-dependents' explicit memory was better than opiate dependents subjects.

Second analysis for new (incorrect) words showed significant main effect of word type F(1,196) = 86.69, p<0.001 and interaction effect of group × word type F(1,196) = 135.86, p<0.001. Significant effect for group × word type interaction displayed that there were significant differences between opiate dependent and non-drug dependent groups, irrespective of nationality, on the mean number of incorrect (new words) recognized words based on their type. In order to clarify differences between opiate dependent and non-drug dependent participants, three independent samples t-test were used for each kind of incorrect recognized words, separately. The results showed that opiate dependents had greater error on recognition of opiate related words than non-dependent groups [t(198) = 11.34, p<0.001]; as opiate dependent individuals (2.95) recognized more numbers of incorrect opiate related words in compare to non-dependent group (1.01).

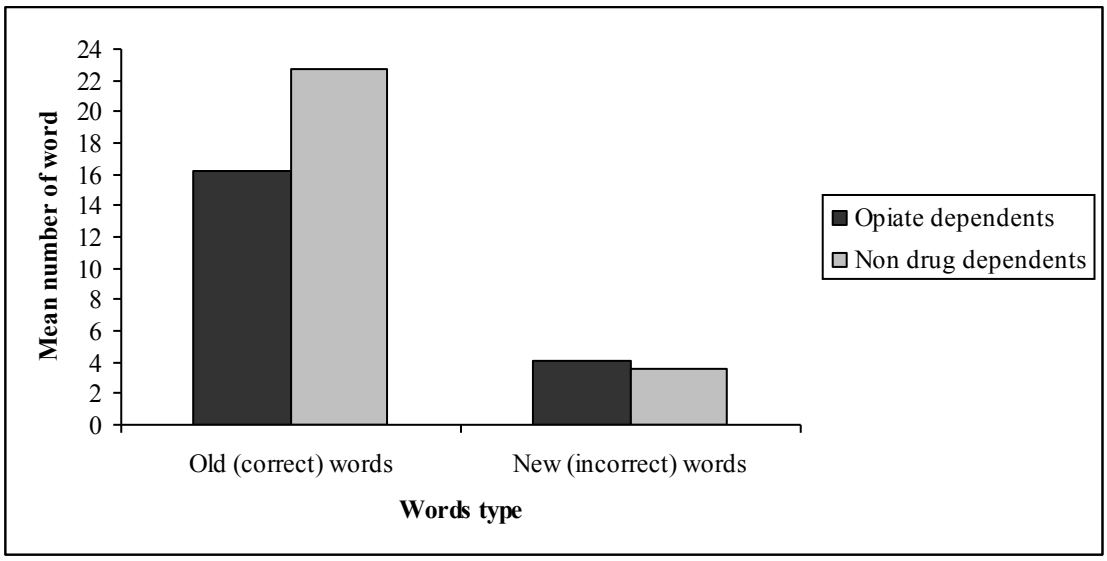

Figure 2. Comparisons between means number of words based on their presentation status (old (correct) and new words (incorrect)) between groups

Implicit Memory Performance:

In order to evaluate implicit memory performance, the number of stem that had been completed to make a stimulus (opiate related) words and the number of stem that had been completed as a neutral words on word-stem completion task were calculated. The meaningless, incorrect and incomplete words were not entered into calculations. The means and SD number of the stems, which were completed as stimulus (opiate related) and neutral words, stratified by group and nationality have been presented in Table 2.

To evaluate implicit memory task performance among Indian and Iranian opiate dependent and non-dependent groups, a 2 × 2 × 2 mixed design analysis of variance (ANOVA) with group (opiate dependents and non-dependents) and nationality (Indian and Iranian) as the between subjects variables and completed stem type (opiate related (stimulus) and neutral words) as the within subjects variable was used. The results showed that there were significant main effects for completed stem type, F (1,196) = 545.68, p<0.001 and group F (3,196) = 38.90, p<0.001. Also, interactions for completed stem type × group F (1,196) = 378.94, p<0.001, and nationality × group F (1,196) = 7.34, p<0.01, were found to be significant.

Table 2. Means (and SD) number of completed stems as stimulus and neutral words by four groups in word-stem completion task and the results of ANOVA

		completed stems as stimulus words		completed stems as neutralwords	
Nationality	**Groups**	Mean	SD	Mean	SD
Indian	Dependents	9.12	1.21	9.82	2.08
	Non dependents	5.30	1.47	12.52	1.50
	Total	7.21	2.34	11.17	2.26
Iranian	Dependents	9.74	1.27	10.32	2.15
	Non dependents	5.18	1.17	12.04	1.75
	Total	7.46	2.60	11.18	2.13
Total	Dependents	9.43	1.27	10.07	2.12
	Non dependents	5.24	1.33	12.28	1.64
	Total	7.33	2.47	11.18	2.19
F (Stem type)		F(1,196) = 545.68**			
F (Group)	F(1,196) = 38.90**				
F (Nationality)	F(1,196) = .67, NS				
F (Stem type×Group)		F(1,196) = 378.94**			
F (Stem type×Nationality)	F(1,196) = .533, NS				
F (Nationality×Group)	F(1,196) = 7.34*				
F (Stem type× Nationality × Group)	F(1,196) = .13, NS				

Note: * p< .01, ** p< .001

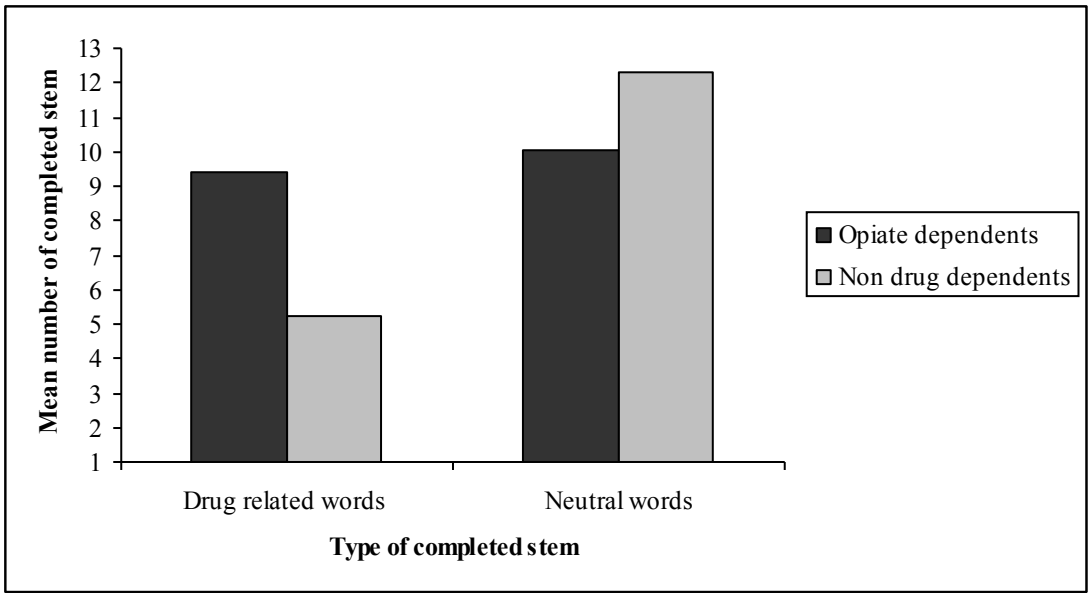

Figure 3. Comparisons between groups mean number of completed stems as drug related and neutral words

Significant main effect for group reflected that irrespective of nationality, there was difference between opiate dependent (19.50) and non-drug dependent (17.52) individuals on mean number of completed stems regardless of their kind (opiate related or neutral); as generally opiate dependent individuals completed more number of stems than non-drug dependent subjects. Significant interaction for completed stem type × group showed that differences between groups on mean number of completed stems were different based on kind of completed stems. In order to clarify differences between opiate dependent and non-drug dependent participants, two independent samples t-test were used for each kind of completed stem, separately. The results showed that opiate dependent individuals completed more number of stems as drug related words in compare with non-drug dependent subjects

(9.43 vs. 5.24) and this difference between two groups was significant [$t(198) = 22.79$, $p<0.001$] (Figure 3).

In addition, the difference between two groups on the mean number of completed stems as neutral words was found to be significant [$t(198) = -8.25$, $p<0.001$]; as non-drug dependent subjects completed more number of stems as neutral words in compare with opiate dependent participants (12.28 vs. 10.07). These results reflected greater implicit memory bias in opiate dependent individuals compare to non-drug dependent subjects. In the other hand, non-significant main effect for nationality and stem type × nationality interaction revealed that regardless of opiate dependence variable, generally there was not difference between Indian and Iranian subjects on mean number of completed stems as drug related words (7.21 vs. 7.46) and as neutral words (11.17 vs. 11.18).

Conclusion and Discussion:

The main aim of the present study was to compare explicit and implicit memory performance between opiate dependent and non-dependent individuals and also assess explicit and implicit memory biases in opiate dependent individuals. In order to evaluate effect of opiate dependence disorder on explicit memory performance, first hypothesis was introduced: Opiate dependent individuals show significantly greater impairment in explicit memory performance than non-dependent group. The results showed that there were significant differences between opiate dependent and non-drug dependent groups on the mean numbers of correct (old words) recognized words on explicit memory task; as non-opiate dependents recognized more number of words (all type of words) than opiate dependents, correctly, in contrast amount of error in opiate dependents was greater than non-dependent individuals. These results reflect that explicit memory performance in non-dependent group is better than opiate dependent individuals. In the other word there is greater impairment in explicit memory performance in opiate dependent individuals compare to non-dependents and opiate dependence disorder impairs explicit memory function, especially recognition. These findings support the results of previous researches that all have reported memory deficits in drug dependent individuals (e.g. Rodgers, 2000; Seifert et al., 2003; Seifert et al., 2004; Heffernan et al., 2004). Memory impairments in opiate dependent individuals could be explained in this way that performance on explicit memory task needs to attention and concentration in order to store the information in encoding phase and subsequently, retrieve them in recognition phase. But as the opiate dependents' concentration and attention has been impaired by consuming the drug, so this attention deficit could effect on explicit memory and disrupt its performance.

In order to evaluate implicit memory impairments in opiate dependent individuals, the second hypothesis was introduced as follow: Opiate dependent individuals show significantly greater impairment in implicit memory performance than non-dependent group. The results showed that there was difference between opiate dependent and non-drug dependent individuals on mean number of completed stems regardless of their kind (opiate related or neutral); as generally opiate dependent individuals completed more number of stems than non-drug dependent subjects. These results reflect that not only opiate dependents don't have impairment in implicit memory performance, but also implicit memory performance in this group is better than non-dependent individuals. This result could be explained in this way that enhanced attention and memory bias to drug related cues and personal experience in the field of drug can increase implicit drug related cognitions in opiate dependent individuals, therefore these people have more ability to complete stems that adjusted for drug related words in word-stem completion task than non-dependent subjects and this ability may be an important factor that cause to increase the total numbers of completed stems by opiate dependent subjects and subsequently their better performance on implicit memory task.

The third hypothesis, i.e. opiate dependent individuals demonstrate greater explicit memory bias toward drug related stimuli compared to non-dependent individuals, was introduced to find out whether opiate dependence disorder effects on explicit memory in opiate dependent individuals or not. The results showed that there were significant differences between opiate dependent individuals and non-drug dependent group on the numbers of recognized words based on their type, as opiate dependent individuals recognized more number of opiate related words in comparison with non-drug dependent subjects in both status of word presentation old (correct) and new (incorrect) words. Also, the differences between two groups on the numbers of recognized neutral words and fruit related words were found to be significant; as non-drug dependent subjects recognized more number of neutral and fruit related words in comparison with opiate dependent participants. In addition, within group comparisons were made by taking responses of opiate dependent group and that of non-dependent group pertaining to (a) drug related words (stimulus words), (b) neutral words and (c) fruit related words

(general stimulus words). It revealed that opiate dependent group recognized more stimulus (drug-related) words than neutral and fruit related words, in contrast non-dependent group, who recognized all type of words almost with similar rate. The overall result reflected greater explicit memory bias toward drug related cues than general incentive cues (fruit) and neutral cues in opiate dependent individuals. A small number of researchers have investigated explicit memory bias for drug related information in substance dependent individuals. These researches have shown mixed results among different dependency, but most of them have supported the presence of explicit memory bias in drug dependent individuals (e.g. Zeitlan et al., 1994; White, 1996; Franken et al., 2003), so findings of present study are consistent with previous studies. There are several possible explanations for explicit memory bias in opiate dependent individuals. According to the cognitive theories information related to the disorder will be more readily encoded in memory and more easily accessed in recall (Williamson, Muller, Reas & Thaw, 1999), therefore one possibility is that as opiate dependent individuals are more familiar with drug related cues than non-dependent individuals, so when opiate dependents exposure to drug related cues, these information would be encoded easier than neutral cues in their memory and then simply would be recognized by them. In addition, explicit memory bias could be explained in this way that, opiate related cues have positive effect on opiate dependent individuals' mind and as usually people are able to encode and recall positive information better than neutral data, therefore, memory bias for drug related cues (as positive information) could appear in these individuals. Another possibility could be explained by using Robbins and Everitt's (1999) theory. According to them, a conditioned stimulus can activate a specific neural network that consolidate the original memory, therefore, it is possible that drug related cues as conditioned stimuli could trigger a specific neural network that leads to change the normal process of memory and subsequently facilitates the encoding and recognition of drug related information.

The last hypothesis was mentioned as follow: Opiate dependent individuals demonstrate greater implicit memory bias toward drug related stimuli compared to non-dependent individuals. The results showed that opiate dependent individuals completed more number of stems as drug related words on word-stem completion task in compare with non-drug dependent subjects, significantly. In contrast, non-drug dependent subjects completed more number of stems as neutral words in compare with opiate dependent participants. Totally, opiate dependents showed greater implicit memory bias than non-drug dependent individuals. Biases in implicit memory for drug related words have been observed in some previous researches (e.g. Stacy, 1995; Stacy et al., 1996; Stacy, 1997; Jarvik et al., 1995; Zeitlan et al., 1994), which are consistent with results of present study and this study support their results. There are several probabilities to explain implicit memory bias in opiate dependent individuals. One possibility could be explained in this way, as activation of implicit memory is unconscious, it may be influenced by attention that has been activated automatically by motivational factors such as drug related cues. Therefore, as opiate dependent individuals have attentional bias to drug related cues, so this bias automatically effect on implicit memory and increase implicit memory bias in these people. In addition, another possibility could be explained by Goldman's model (1999). According to Goldman (1999), memory system of drug dependent individuals acts as a repository of the drug related information and these potential concepts are manifested in certain stimulus circumstances, automatically. Based on this model, as opiate dependent individuals encode drug related stimuli better than neutral stimuli, amount of these kind of concepts become very huge in their information network; so when they want to match some new information with previously encoded material, those which were relevant to addiction would be activated very fast and that is why they complete more stems as drug related words in stem completion task than non-drug dependent individuals. Another explanation of these results is that attentional bias to opiate related cues interrupt processing of the information and enhance sensitivity for drug cues, so it maybe influence on implicit memory performance and automatically lead to increase bias toward drug related words in implicit memory task. Also, based on MacLeod (1991) it is possible that attentional bias to opiate related cues may elicit a specific motor response, which interfere with the production of responses for the performance of the memory tasks.

Overall, the results of present study indicated that opiate dependent individuals were able to process information related to drugs faster and better than neutral data that reflected the presence of great explicit and implicit memory biases in these individuals. In addition the results showed that explicit memory impairments in opiate dependent individuals were greater than non-dependent subjects; as in performance on explicit memory task amount of error in opiate dependents was greater than non-dependent individuals. But implicit memory performance in opiate dependent individuals was better than non-dependent subjects. Regarding to the

growing evidence related to this fact that implicit and explicit cognitions are influenced by substance abuse/dependence disorders, it could be considerable that understanding cognitive processes in drug dependence and cognitive interventions may be very effective in treatment of these disorders and also it could have some implications for the prevention of substance abuse/dependence disorders. For example, evaluation of implicit processes may help therapist to determine why addicted individuals continue drug taking behaviors despite knowing the disadvantages of drug using. Also, increasing awareness of drug dependent individuals about their cognitive processes could lead to successful treatment outcomes.To strengthen and support the current results, further studies are required that identify the effect of other psychoactive substances (e.g. cannabis, ecstasy, cocaine and etc.) on cognitive processing. In addition, to evaluate whether the current results could be extended to other cultures, duplicated studies are required to assess the present research design among other countries.

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