# The Influence of Consciousness on Inhibition of and Attentional Bias to Stimuli Associated with Drugs among Heroin Users

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## Abstract

**Objective:** This study aimed to examine the effect of consciousness on inhibition of and attentional bias to the stimuli associated with drugs among heroin users and their counterparts. **Method:** In this study, a causal-comparative research method was used. All the persons dependent on opiates in Abhar city constituted the study population. The number of 120 participants containing two 60-person groups of heroin users and their counterparts (i.e. non-users) were selected through convenience sampling method. The two groups had been matched for age and sex and were compared through conducting the two neurological tests, namely Dot Probe and Stroop tests. **Results:** The results showed that there was a significant difference between the two groups on Dot Probe test where the normal group outperformed the other one. In Stroop test, drug stimuli whether provided consciously or unconsciously are identified; then, drug users show bias towards them. **Conclusion:** Given the devastating effects of addiction on cognitive ability, cognitive problems should be considered in treating patients.

**Keywords:** Addiction, Consciousness, Attentional Bias

## Introduction

Addiction is a disorder which affects substantial cognitive functions such as learning, memory, concentration, reasoning, and control (Ornstein, Iddon & Baldacchino, 2000). According to the findings of neurology on the grounds of cognitive processes, there are profound relations between substance-related stimuli and preliminary responses from participants to these substances from one side and following behavioral responses, such as dependence on these substance or relapse (Toatez, 1998). Among these cognitive processes, awareness-raising about these substance-related stimuli plays a central role. Studies have shown that people dependent on heroin, cocaine, and alcohol process the stimuli in a defective way (Altman, Everitt & Glautier, 1996). One of the cognitive processes in which excessive focus on substance-related symptoms gets changed is attentional bias. Attentional bias is a change in attentional concentration into a particular substance which can be at play both subconsciously and consciously (Ryan, 2002). Different studies have shown the availability of attentional bias in different kinds of substances such as alcohol (Franken, 2003) and nicotine (Anton, Moak & Latham, 1996) in which individuals intentionally focus on some indications that are directly related to their distinct emotional subjects. The stimuli that are available in connection with substances are involved in the process of drug preparation and consumption and result in attentional bias to these stimuli. These stimuli and this attentional bias direct the behavior towards a particular goal in relation with them (Robinson &Berridge, 1993).

Attentional bias to substance-related stimuli is somehow related to an exciting disorder in the processing of emotional stimuli. In this way, the role of consciousness has been largely taken into account. Stimuli loaded with emotional qualities divert the attentional bias into themselves. A substance-related stimulus is the subject about drug dependent people. Interestingly, the existence of this attentional bias has been reported in subliminal stimuli. It is, however, thought that some particular aspects of behavior are subconsciously activated. On the other hand, the content and consequence of this behavior could be reflected in conscious experiences of people. Accordingly, we can understand the type of our thinking, feeling and behavior in our close relations and consciously get informed about the reasonability and appropriateness of our feelings, concerns, expectations and behaviors in particular situations; however, we cannot understand such processes. Perugini & Banse (2007) emphasize that deliberative factors play an important role in actions of individuals. This shows that the processing of information and behavior not only has automatic determinants, but also it has subconscious determinants and a range of factors can relatively determine the interactive effect of these processes (Bargh, 1997). Therefore, according to the above-mentioned discussion and the review of cognitive functions such as attention which leads to the concentration of an individual on substance-related stimuli, it will be

helpful to recognize related factors to the approach of substance dependent people. The aim of this study is to examine the effects of consciousness on inhibition and attentional bias towards related stimuli.

## Method

The present study is a causative-comparative one. The population of this study included all the addicts of Abhar city from April to June, 2012. Using convenience sampling method, 60 people who had referred to medical clinics for treatment were chosen. Entrance criteria for the study included: 6 months history of substance consumption, no head trauma, being educated, and substance abuse except heroine. Subjects were allowed to step away from the study if they wished. After the selection of the sample, the number of 60 non-addicted people who were homogenous with the experimental group in age, gender, and educational factors was chosen as the control group.

## Instrument

1. Test of Stroop: This test has been extensively used as an instrument for measuring deliberative attention mechanisms and it is used as a standard source in measuring attention. In recent studies, the modified version of Stroop test has been used for reviewing attentional deviance of people facing substance-related stimuli or the stimuli related to pathology (Williams, Mathews & McLeod, 1996). Emotional Stroop test indicates the attentional deviance by comparing the time lags in responding to the case related words and neutral cards. In many studies, colorful words are seen among cards and the time lag between referring to the words with desired colors and the words with the neutral cards, or say, Stroop effect represents attentional deviance. Since card models needs simple equipment and facilities (cards and a chronometer), it is very easy to use it in clinical and non-clinical cases. Two different forms of presenting stimuli have been used. In the first form, words in each group (for instance desired and neutral cases) are presentable in separate blocks (parochial methods). In this form, like card model of test, the order of completing the neutral and desired words is generally balanced. Parochial model conceptually is similar to card model and it can facilitate the comparison of the studies, with this advantage that it can collect the data separately for each case. In the second form, the collection of neutral and case desired words can be presented by accidental or compound or semi-accidental order (non-parochial or mixed method). The advantage of this model is that it does not require balance. It is possible to assess special aspects of attention deviation with appropriately designed parochial and mixed models. As an example, parochial Stroop test of addiction can model attention towards symptoms of substance in an environment particularly occupied with symptomatic signs, like a scene that a sniffer enters in an environment full of

smoke. It is so while the addiction Stroop test can make a model of attention deviation in an environment in which the related symptoms with low abundance are indicated, for example, a sniffer as walking in the street occasionally encounters people sniffing (Cox, Pothos, Johnsen & Laberg, 2001).

After all, emotional Stroop test as an indirect measuring instrument for emotional processes is extensively used. That its different models with exchangeable possibility are used in contexts is important for two reasons: this model takes into consideration psychometric differences in different models and it finds the psychological processes which are based on the different findings context. It has been already reported that in mixed Stroop test of sniffing, smokers are slower in mentioning the color of the words that are associated with the sniffing compared to the words which are associated with neutral words (Waters, Sayatte& Wertz, 2003). In the present study, a mixed type of assignment has been used. The other issue in Stroop test is the role of consciousness in stimulus presentation. Although, Stroop test is usually used consciously, for using it subconsciously there have been a lot of struggles. In the subconscious presentation of Stroop stimuli, the time gap of stimulus presentation is reduced or the words are masked. In the present study, reduction of time gap was used. Measuring the participant's reaction time in 0.001 second and recording the true or false responses are among the indicators of this instrument.

2. Dot Probe test: this software test is the revised version of the main test developed by Mac Lowed et al (1986). In this test, related images were used instead of words. The image and point were presented in 2 rectangle cadres at the distance of two centimeters from the central recording point of screen. For running this test, the participant sat before the computer at a distance of 50 centimeters. First, the empty cadre and recording point (+) were presented for 0.005 seconds. Then two portrays were presented on the right and left sides of the screen for 0.500 seconds for the conscious state and 0.200 seconds for subconscious state. The participant was asked to show the direction of point (star) on the screen and, accordingly, the computer recorded the responding time in the extreme of 0.001 second. A laptop was used for running the test. First, after picking the participants up and checking the entrance criteria, the severity test of drug consumption rate was run by counterbalance test, under threshold test, and threshold dot probe. Measurement of Participant's Reaction Time to the extreme of 0.001 seconds and recording of the true and false responses are among the indicators of this instrument.

## Results

Descriptive statistics of demographic variables are presented in the following table for each group.

**Table 1: Descriptive statistics of demographic variables according to groups**

| | *Experimental* | | *Control* | |
|---|---|---|---|---|
| ***Variables*** | ***Mean*** | ***SD*** | ***Mean*** | ***SD*** |
| Age | 27.83 | 4.24 | 27.48 | 4.16 |
| Period of use | 2.70 | 1.12 | - | - |
| Education | 8016 | 2.51 | 9.43 | 2.18 |

Descriptive statistics for stimuli presentation in Dot Probe test are shown in the following table for each group.

**Table 2: Descriptive statistics of stimuli presentation in Dot Probe test according to groups**

| ***Method of presentation*** | ***Time of presentation*** | ***Groups*** | ***Speed of response*** | | ***Accuracy of response*** | |
|---|---|---|---|---|---|---|
| | | | ***M*** | ***SD*** | ***M*** | ***SD*** |
| homogenous | Conscious | Drug dependent | 0.85 | 0.30 | 0.97 | 0.08 |
| | | Normal | 0.51 | 0.13 | 0.99 | 0.01 |
| | subconscious | Drug dependent | 0.83 | 0.30 | 0.97 | 0.03 |
| | | normal | 0.52 | 0.11 | 0.98 | 0.02 |
| heterogeneous | Conscious | Drug dependent | 0.89 | 0.31 | 0.93 | 0.03 |
| | | normal | 0.54 | 0.15 | 1.00 | 0.03 |
| | subconscious | Drug dependent | 0.82 | 0.29 | 0.95 | 0.05 |
| | | Normal | 0.52 | 0.11 | 0.97 | 0.04 |

One-way, two-way, and three-way univariate analysis of variance tests were used to explore the score differences concluded from Dot Probe test as follows:

**Table 3: ANOVA results representing differences in speed and accuracy variables in Dot probe test**

| ***Sources*** | ***Variables*** | ***Mean square*** | ***F*** | ***Sig.*** |
|---|---|---|---|---|
| Group (normal/ dependent) | Accuracy | 32.83 | 32.31 | 0.0005 |
| | Speed | 5046.48 | 229.55 | 0.0005 |
| Type of presentation (homogenous/ heterogeneous) | Accuracy | 11.63 | 11.45 | 0.0005 |
| | Speed | 8.76 | 0.39 | 0.52 |
| Time of presentation (conscious/ subconscious) | Accuracy | 0.64 | 0.63 | 0.42 |
| | Speed | 25.26 | 1.14 | 0.28 |

| *Sources* | *Variables* | *Mean square* | *F* | *Sig.* |
|---|---|---|---|---|
| Group* type of presentation | Accuracy | 9.82 | 9.66 | 0.002 |
| | Speed | 0.001 | 0.0001 | 0.99 |
| Group*time of presentation | Accuracy | 7.85 | 7.73 | 0.006 |
| | Speed | 13.08 | 0.59 | 0.44 |
| Time of presentation* type of presentation | Accuracy | 0.02 | 0.02 | 0.88 |
| | Speed | 15.49 | 0.70 | 0.40 |
| Group*time of presentation*type of presentation | Accuracy | 2.57 | 2.53 | 0.11 |
| | Speed | 2.97 | 0.13 | 0.71 |

As it is shown in the above table, according to speed and accuracy of responses there is a significant difference between two groups ($p<0.001$). The interactive effect of group-type of presentation and group-time of presentation for accuracy of subjects is significant ($p<0.001$).

Descriptive statistics pertaining to the results of Stroop test are presented in table below for each group.

**Table 4: Descriptive statistics of Stroop test for each group**

| *Method* | *Time of presentation* | *groups* | *Speed* | | *Accuracy* | |
|---|---|---|---|---|---|---|
| | | | *Mean* | *SD* | *Mean* | *SD* |
| Non-substance stimulus | Conscious | Substance dependent | 17.04 | 4.78 | 44.75 | 0.72 |
| | | Normal | 12.19 | 3.21 | 44.93 | 0.52 |
| | Sub-conscious | Substance dependent | 16.24 | 11.14 | 40.76 | 3.64 |
| | | Normal | 11.92 | 8.76 | 41.25 | 2.72 |
| Substance stimulus | Conscious | Substance dependent | 20.30 | 7.17 | 55.13 | 1.34 |
| | | Normal | 14.21 | 6.01 | 55.18 | 0.77 |
| | Sub-conscious | Substance dependent | 14.94 | 13.12 | 34.66 | 4.46 |
| | | Normal | 11.60 | 9.91 | 34.74 | 2.72 |

One-way, two-way, and three-way univariate analysis of variance tests were used to explore the score differences concluded from Stroop test as shown in the following table.

As it is shown in table 5, there is a significant difference between two groups in terms of the speed of response to stimuli ($p<0.001$). There was a

significant interactional effect in terms of accuracy ($p<0.001$) and speed ($p<0.05$) between conscious/subconscious stimuli presentation and the type of stimuli; in other words, if the substance stimuli are presented consciously or subconsciously, they are identified.

**Table 5: ANOVA results representing differences in speed and accuracy variables in Stroop test**

| *Sources* | *Variables* | *Mean square* | *F* | *Sig.* |
|---|---|---|---|---|
| Groups (Normal/addicted) | Accuracy | 4.78 | 0.74 | 0.38 |
| | Speed | 2571.40 | 34.63 | 0.0005 |
| Type of stimulus (substance- non substance) | Accuracy | 679.63 | 74.56 | 0.0005 |
| | Speed | 99.64 | 1.34 | 0.24 |
| Time of presentation (conscious – subconscious) | Accuracy | 1754.17 | 20.72 | 0.0005 |
| | Speed | 606.32 | 8.16 | 0.004 |
| Group * type of stimulus | Accuracy | 2.14 | 0.33 | 0.56 |
| | Speed | 0.53 | 0.007 | 0.93 |
| Group * time of presentation | Accuracy | 0.81 | 0.12 | 0.72 |
| | Speed | 79.16 | 1.06 | 0.30 |
| Time of presentation * type of stimulus | Accuracy | 822.08 | 10.27 | 0.0005 |
| | Speed | 354.37 | 7.06 | 0.02 |
| Group*time of presentation*type of presentation | Accuracy | 0.58 | 0.09 | 0.76 |
| | Speed | 36.58 | 0.49 | 0.48 |

## Discussion and Conclusion

This study was an attempt to explore the effect of consciousness on attentional bias and control in relation to substance-related stimuli in heroin dependent persons. Findings of this study showed that there is a significant difference in speed of response to stimuli in Dot Probe test between the groups. In this respect, dependent persons are less speedy. In terms of the accuracy of responses, the control group is advantageous to the experimental and, in this respect, homogeneity and heterogeneity of the target stimuli with presented image played a key role in the accuracy of responses. Thus, when there was no star behind the image related to substance, the addicts had a tendency towards the key in line with the drug-related stimulus. This error could be somehow representative of the tendency towards drug-related stimuli. In Stroop test that words were used as stimuli, the time of response to drug-related stimuli was lengthier. This difference in conscious state stimulus was higher than that in subconscious state one; however, there was no statistically significant difference between two groups for both indexes of speed and accuracy. In other words, even if addicts do not understand the stimulus consciously, they will have a bias towards it. Using under threshold stimuli in Stroop test, Wikstrom, Lundh & Westerlund (2003) showed that there was an attentional bias in patients with anxiety; however, this bias was

not seen in depression and anger. Persons with anxiety disorder are all ears to get the environmental stimuli and show a fast reaction to them for surviving. At the same time, depressed persons build a relationship between negative stimulus and their own negative information in a longer time elapse after understanding the negative stimulus. Drug dependent stimuli provide relatively higher attitudinal values for drug dependent persons which, in turn, leads to attentional bias and excessive mental processes against these stimuli and is followed by a craving for drug consumption. Studies have shown that attentional bias is known as a predictive factor for relapse into heroin consumption in treated heroin addicts. Particularly, the people who have a higher attentional bias and also those who have more problems in escaping from attention to substance-related stimuli in initial assessment before treatment face a higher risk for relapse. In other studies, the relationship between attentional bias and relapse into alcohol and smoking has been confirmed (Waters et al, 2003; Kouks, Hogan, Kristian and Race, 2002).

Attentional bias to subliminal stimuli has also been shown in people suffering from anxiety and somehow suffering from attentional bias towards threatening stimuli. This is somehow a symptom of subconscious tendency towards threatening stimuli in people suffering from anxiety, even though, the threatening words are masked they have a bias towards them. Covering the words is somehow a way to make the stimuli subliminal by reducing their significance. In the present study, time of presentation was used to make the stimuli subliminal. In Stroop test, it was seen that if substance stimuli are consciously or subconsciously presented, they are identified. The results of this study are consistent with the results of the study done by Ornestine et al (2000) and Rahmanian, Mirjafari & Hasani (2006) on bias towards the substance-related words that are presented consciously. The studies carried out on Stroop test have shown that unrelated exciting information consequently leads to attentional bias and the pause in responses, and reduction of accuracy. Investigations in this area have shown the functional exhaustion of addicts against substance-related stimuli in Stroop test. Franken, DeHan, Van der Meer, Haffmans & Hendriks (2000) investigated the attentional bias in heroin addicts by Stroop test and showed that heroin dependent persons were slower in expressing the color of heroin-related words (sheet, tipsy, tissue) compared to the expression of neutral words (bicycle, ticket, train, road) that indicates an attentional bias towards heroin. Using Dot Probe test of words Rahmaninan et al (2006) compared attentional bias towards substance-related indications between drug dependent persons and normal persons. A significant difference for attentional bias towards substance symptoms was reported while presenting words in 0.500 seconds (apparent attentional bias). In contrast, no meaningful difference was reported in the state of presenting words for 0.020 seconds. A study was carried out by Waters, Nitz, Craske and Johnson (2007) entitled “The effects of anxiety

upon attention allocation to affective stimuli" wherein three groups participated: group one consisted of nonsmokers, group two consisted of smokers, and group three consisted of smokers who were banned from smoking for 12 hours. The results of this study showed that banned smokers had a higher attentional bias towards smoking-related stimuli than the other two groups. Also, banned smokers compared to the non-banned smokers showed a higher attentional bias.

Although other studies have shown attentional bias towards substance abuse-related and alcohol-related words as stimuli, the present study investigated this finding under a condition in which subliminal words as stimuli were presented to individuals. According to the findings, conscious stimuli take longer time to be responded by participants; however, the difference between the two groups in terms of time of subconscious presentation of stimulus was proved to be significant. Phaf & Kan (2007) showed the effect of Stroop in subliminal presentation of stimuli, but the effect of Stroop in threshold presentation was higher. The present study also confirms this result. Probably, one of the cognitive reasons supporting this subject is the reliance of Stroop test on word's reading and this subject needs longer time compared with image observing. With an evolutionary approach, also observing exciting or threatening images leads to a faster reaction by Amygdale as a substructure. However, reading requires cognitive processes of layer centers. Generally speaking, studies on the ground of cognitive abilities of drug dependent persons present some evidence that disorders in many cognitive processes are related to dependence on substance consumption. The results of the studies on attentional bias of drug dependent persons towards environmental stimuli confirm their weak control and their failure in assessing risky behaviors. Paying attention to these issues can improve significantly the processes of treatment. One of the limitations of this study was the non-inclusion of female participants in the sample. Thus, it is suggested that future researchers take into account this issue in their studies.

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