A Comparative Study of Drug-Related Attentional Bias: Evidence From Iran

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The Addiction-Stroop test has been widely used to investigate the attentional correlates of alcohol and drug abuse; however, the majority of the studies have been conducted with European and American participants. The present study tested whether Iranian drug abusers show higher attentional bias for drug-related stimuli. Participants included drug abusers (N = 53; 100% male), with a clinical history of opium and heroin abuse, who were in a Methadone Maintenance Therapy program. Only nonabusers (N = 71; 71, 54% male) with a history of having never abused of drugs or alcohol participated in the study as controls. All participants completed a computerized Persian version of classic and addiction Stroop tests. The results of a multivariate analysis of covariance (MANCOVA) showed that drug abusers had a higher attentional bias for drug-related stimuli than nonabusers, after the effects of age and education had been controlled. The results of repeating the MANCOVA (a) limited to men only, and (b) to men and women in the nonabuser sample showed that the observed difference in the drug-related attentional bias of drug-abusers and nonabusers was not an artifact of gender imbalance. Our findings support the idea that drug-related attentional bias is culture-free.

Keywords: addiction, drug, Stroop test, attentional bias

Iran has the highest number of narcotics abusers in the world per capita (2.8% of the population; United Nations, 2005) and regardless of the governmental efforts, drug abuse is still increasing among the population, particularly the young (Sarami & Ghomashchi, 2003). Consequently, the various medical, psychological, and social negative effects of addiction have endangered the health and welfare of the Iranian society. For example, between 1973 and 2002, drug abuse was the second most common (i.e., 24.6%) psychiatric disorder after affective disorders (Movaghar et al., 2005). Despite a fortified effort in the country to tackle the problem, the prevalence and the relapse rates are still very high (Iran Drug Control Headquarters, 2010).

The challenging, multifactorial nature of drug abuse, its various etiologies, and problems associated with it suggest that it is difficult to construct a global and scientifically valid model of drug abuse and its treatment. A comprehensive model, which can encompass various etiologies of the behavior within a unifying framework, would represent progress in the field.

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The original motivational model of drug use that has been suggested by Cox and Klinger (1988) seems to bring together the biological, psychological, and sociocultural factors of drug use and abuse. Recently, formulating the roles that implicit cognitions and attentional factors play in the model brought together motivational and cognitive determinants of drug and alcohol abuse (Cox & Klinger, 2004; Cox, Fadardi, & Pothos, 2006). In this model, distal factors comprise one’s heredity, culture, and past learning in relation to drug-related and unrelated wishes, aspirations, and goals; current factors include people’s expectancies of the consequences of using drugs and the value that they place on the behavior; and the most proximal factors in the model are the person’s attentional hypersensitivities to cues related to drug abuse (Cox & Klinger, 2004). The effects of all factors in the model are channeled through a decision-making process that determines whether the person will use or refrain from using a chemical drug.

Tiffany (1990) suggested that excessive drug abusers’ conscious decisions not to drink often fail due to conflicting influences of nonconscious cognitive processes. In fact, increasing evidence related to alcohol abuse (e.g., Fadardi, 2003; Fadardi & Cox, 2006, 2008, 2009); drug abuse (e.g., Fadardi, Ziaee, & Shamloo, 2009; Franken, Kroon, Wiers, & Jansen, 2000); and other addictive behaviors (e.g., Lancha & Cabaco, 2009; McCusker & Gettings, 1997) suggests that attentional hypersensitivity or attentional bias for stimuli related to the abusive behavior can play an important role in its continuation, treatment success, and relapse. Consequently, attentional bias seems to play an important role in weakening the abuser’s control over drug use. Some researchers have suggested that abusers’ efforts to reduce drug dependence may increase their drug-related attentional imbalance.
bias, hence intensifying their urges to relapse to the habitual behavior (e.g., Cox et al., 2002).

These automatic cognitive mechanisms may lead to a cycle of withdrawal and relapse that usually causes an abuser to experience frequent failures after deciding to quit (Wiers et al., 2002). Brain studies suggest that regions in the limbic system and ventromedial prefrontal cortex selectively respond to drug-related cues and could contribute to the flawed decisions to abuse drugs or to break abstinence (Bernheim & Rangel, 2002; Damasio, 1994). For example, in an functional magnetic resonance imaging study, Park et al. (2007) showed that when drug abusers were exposed to drug cues, activation of specific brain areas (i.e., fusiform gyri, temporal gyri, parahippocampal gyrus, uncus, frontal gyri, and precuneus) was correlated with the level of craving that the participants reported.

Various paradigms have been used in the study of drug-related attentional bias, including expectancy challenge (Musher-Eizenman & Kulick, 2003; Wiers & Kummeling, 2004), visual probe (Schoenmakers, Wiers, Jones, Bruce, & Jansen, 2006; Wiers et al., 2006), eye movement measures and event-related potentials (Field, Munafo, & Franken, 2009).

Williams, Mathews, and MacLeod (1996) suggested that experimental investigation of attentional bias usually is based on one of two broader methods. The first method is based on the facilitation effect; the effect is evident through a reduction in the persons’ attentional and sensory thresholds for salient stimuli. The second method is based on interference effects; the effect arises when one’s performance suffers in the presence of those stimuli that should be ignored during a task. Within the second category, a commonly used paradigm is a modified version of the classic Stroop test (Stroop, 1935) named the emotional Stroop test; the test has consistently been reported to be particularly sensitive to attentional bias for emotionally salient stimuli (Williams et al., 1996).

The emotional Stroop test is a generic name for modifications of the classic Stroop test (Stroop, 1935) that employ at least two categories of stimuli: a control or neutral one and an emotionally salient or valenced category of stimuli (e.g., negative words) that are usually related to the psychopathology being tested. When the modified version contains alcohol, drug or gambling-related stimuli as the salient category (e.g., Fadardi & Cox, 2009; Hogarth, Dickinson, & Duka, 2006), it is called the addiction-Stroop test. The salient findings of this area of research are that alcohol abusers and drug-abusers consistently show higher attentional bias for drug-related stimuli (e.g., they are slower to name the color of the stimulus when its content is drug-related) than do nonabusers or light drug abusers, and the degree of drug abusers’ attentional bias is a significant predictor of their ability to reduce their drug abuse (Cox et al., 2002; Field et al., 2009).

Attentional bias for drug-related stimuli contributes to drug abusers’ preoccupation with the drugs and their lack of confidence in their ability to control their urges to use (Fadardi et al., 2009; Fadardi & Cox, 2006). A meta-analysis conducted by Field et al. (2009) suggests that attentional bias and craving are related phenomena. Even a brief review of the different approaches would be too long for this article here, hence interested readers may refer to Cox et al. (2006) and Pothis, Calitri, Tapper, Brunstrom, and Rogers (2009).

Gardini, Cafrarra, and Venneri (2009) found that drug-related attentional bias in drug abusers depends on their consumption status. Those in treatment programs showed less drug-related attentional bias than active drug users. Although it seems that drug-related attentional bias could be influenced by a variety of factors such as the user’s motivation, craving, classical conditioning and drug availability, Gardini et al.’s (2009) findings support the hypothesis that treatment may contribute to decreases in the attentional bias; this may play a critical role in achieving a positive outcome in the treatment of addiction.

Drug abuse adversely affects the abusers’ executive cognitive functions (ECF), including inhibitory processes that are responsible for selective attention (Fadardi, 2003; Fadardi & Cox, 2006, 2008, 2009; Williams et al., 1996). Al-Zahrani and Elsayed (2009) reported that the functions of specific brain regions underlying cognitive control were significantly impaired in drug abusers; the severity of the impairment was related to the type of drug, duration of the abuse and number of hospitalizations. However, Fadardi and Cox (2006) administered a drug-Stroop test and the classic Stroop test (as a general measure of inhibitory processes) with a sample of drug abusers and reported that attentional bias for drug-related stimuli was not an artifact of the abusers’ faulty inhibitory processes. In the study, the abusers’ drug-attentional bias was proportional to the abusers actual amount of drug consumption.

Searching PsycINFO, PubMed, and Science Direct revealed that during 1993 to 2010, 63 drug abuse investigations were conducted using the Stroop paradigm: 25 on smoking behaviors, 11 on drug dependence, two on the and methodological considerations in the use of the drug Stroop test and 25 studies on alcohol abusers.

Despite the fact that drug abuse has been widely studied in Iran, evidence on the role of implicit cognitions in addictive behaviors is scarce (Nazer, Sayady, & Khaleghi, 2002). Systematic Iranian studies with the addiction Stroop test could be important for testing whether findings by other researchers in other cultures (mostly Western societies) can be replicated in an Eastern country. Moreover, the specifics of developing and administering an addiction Stroop test can strongly affect the validity and reliability of the test. For example, unlike English-language researchers, who can access sources of lexical frequencies of written and spoken words (e.g., Baayen, Piepenbrock, & Van Rijn, 1993; Kucera & Francis, 1967), there is no lexical reference in the Persian (Farsi) language for use by the researchers.

Finally, research on attentional mechanisms involved in drug abuse still need to be expanded, particularly for people from culturally diverse backgrounds. For example, in Iran, drug abuse is highly stigmatized; this usually pushes the abusers to the margins of the society and such marginality may lead to different responsiveness to social contexts, including testing sessions, in different societies (Anderson
& Levy, 2003). Moreover, Iranian drug abusers still fear legal convictions; the fear may adversely affect their honesty when reporting their drug abuse via explicit measures—despite the fact that for more than a decade drug abuse has been seen and treated as an illness in the country.

There is also evidence from brain studies that support the ecological validity of the emotional versions of the Stroop test: (a) studies (see Fadardi & Cox, 2006) have shown that performance on the Stroop tests tap brain structures that are responsible for executive cognitive functions (ECF); (b) Ardila (2008) divided executive functions into metacognitive (responsible for planning, concept formation, strategy development and implementation, controlling attention, working memory, and so on), and emotional/motivational parts (responsible for coordinating cognition and emotion/motivation to fulfill needs in a given context); Ardila argues that the metacognitive part of executive functions is extremely dependent on culture and cultural means of communication; and (c) Ishii, Reyes, and Kitayama (2003) showed that, on an emotional Stroop test, Americans were more distracted by the verbal content of the stimuli than their vocal tone; Japanese showed an opposite pattern from Americans; and Tagalog-English bilinguals showed an attentional bias for vocal tone regardless of the language used—suggesting that the Stroop effects are largely due to cultural differences rather than linguistic differences. Tapper, Pothos, Fadardi, and Ziori (2008) also showed cultural differences on food-related attentional bias across Britain, Iran, and Greece.

Therefore, the goal of this research was to develop an addiction-Stroop test and to compare the drug-related attentional bias of a sample of in-treatment drug-abusers with nonabusers in Iran. We hypothesized that attentional bias for drug-related stimuli as assessed by the addiction-Stroop test developed in this study will discriminate drug-abusers from nonabusers.

Method

Participants

Nonabusing participants were students, academic staff, and other personnel of Ferdowsi University of Mashhad and people from the local community who were visiting the university (N = 71, 54% male). Their mean age was 26.62 (SD = 8.40); 63% were married and 73% had completed their undergraduate studies or a higher education degree. Participation in the study was voluntary. The study was publicized through advertisements displayed on the university's departmental notice boards. It was advertised as a project investigating people’s reaction times and response precision in reaction to a series of colored words that would appear on a computer screen. Potential participants were informed that they would also be required to anonymously answer a number of questions regarding their use of non-prescribed drugs.

Drug-abusers (N = 53, 100% male), who responded to the same ads mounted in a local drug-use services clinic were required to be under Methadone Maintenance Therapy. The abusers who participated had been using methadone for an average of 48 (SD = 1.86) months. Their mean age was 36.57 (SD = 9.00); 75.5% were married; and 64.7% had at least a high school diploma. All participants gave their informed consent prior to participation in the study. There was no monetary reward for participation in the study. Upon completion of the experiment participants were debriefed and thanked for taking part.

Instruments

Substance Use Questionnaire. The Persian Substance Use Questionnaire (P-SUQ; Fadardi, 2005; Fadardi et al., 2009) measures nonaddicts’ frequency of using 11 nonprescribed substances with no overt reference to Class A to C drugs. The test was used to exclude from the study those participants in the control group who were suspected of having a past or current history of substance abuse.

Stroop tests. The classic and drug-related Stroop tests’ construction was the same as described in Fadardi et al. (2009) except for the exclusion of the concern-related stimuli from the test. Therefore, four types of words were used in the Stroop tests utilized in this study. To compose the classic Stroop test (Stroop, 1935), congruent (e.g., yellow printed in yellow ink) and incongruent (e.g., green printed in blue ink) color words were used. Four color words appeared four times with an ink color consistent with their meaning to make 16 congruent color words; the set was repeated three times. The same color words appeared three times each (skipping the congruent stimulus for each color) to make 12 incongruent color words; the set repeated four times. The third category of words was drug-related (crystal, opium, heroin, tablet, syringe, straw, lighter). The fourth category of words comprised seven control words (i.e., emotionally neutral/not salient to the respondents) that were related to building items (door, window, stair, fence, cupboard, key, ceiling). The latter category of words is necessary to provide a baseline for calculating the interference scores—an index of attentional bias for drug related words. The drug-related and control words were repeated as 7 (words) × 4 (colors) × 2 (series), making 56 stimuli in each of the two latter lists. In sum, a total of 208 stimuli were presented on the screen (i.e., 48 congruent color words; 48 incongruent color words; 56 drug-related words; 56 control words).

The drug-related and control word lists were balanced for their number of letters, syllables, and semantic relatedness (e.g., Kucera & Francis, 1967 in American English and CELEX; Baayen et al., 1993 in British English). However, because there is no reference on the frequencies of usage in the Persian language, it was not possible to control for the words’ frequencies. There is persuasive evidence on the reliability and validity of the emotional versions of the Stroop tests (e.g., Fadardi, 2003; Siegrist, 1995, 1997).

Apparatus

SuperLab Pro (SKD; Cedrus-Corporation, 1999) was used to make the computerized Stroop tests. A PC and a 17” display (located 40–55 cm away from the participant’s
eyes) were used for presenting the stimuli. The input device was a standard keyboard with four keys marked as response keys.

Procedure

Upon giving their informed consent and prior to the main computerized test, all participants were given 50 practice stimuli with color patches to familiarize them with the computerized test procedure. Only during the practice phase, the computer gave feedback for correct, incorrect and late responses. If necessary, the practice session could be repeated until the participants had learned the necessary key-pressing skills.

Each word stimulus was presented at the center of the display for a maximum of three seconds. The stimuli were separated by a cross (+) that appeared for 500 ms upon pressing a key and prior to presentation of the next word. All stimuli from each category were presented on a mixed, randomized basis. The computer recorded error responses and reaction times to each individual word. After completing the Stroop tests, participants were asked to complete the P-SUQ and brief demographic questionnaire. All data were collected individually in an experimental room. At the end participants were debriefed and thanked for taking part.

Results

The individuals’ drug-related Stroop interference scores were calculated as the difference between individuals’ mean reaction times to the neutral stimuli and their mean reaction times to the drug stimuli (Williams et al., 1996). The P-SUQ scores ranged between zero and 77. On the questionnaire, the mean score for the nonabusers was 8.49 ($SD = 6.05$). Only two participants in the control group were eliminated from the data analysis because they scored greater than 22 on the P-SUQ or identified themselves as users of hard drugs. A score equal to or less than 22 on the P-SUQ indicates mild or occasional use of nonprescribed but legal substances such as tea, coffee, analgesics, herbal infusions, and so on. The control participants’ mean score on P-SUQ was 8.49 ($SD = 6.05$).

The average methadone dose in the drug-abusers group was 75 ($SD = 27.81$) milligrams per day. The result of a series of $t$ tests comparing drug-abusers and nonabusers showed that the groups were significantly different in age, $t(120) = 6.32, p = .001$, with drug-abusers ($M = 36.5, SD = 9.007$) being older than nonabusers ($M = 26.62, SD = 8.40$), and in education, $t(120) = –8.31, p = .001$, $d = 1.52$, with drug-abusers ($M = 10.25, SD = 2.93$) reporting fewer years of formal education than nonabusers ($M = 15.07, SD = 3.37$).

As Table 1 shows, the two groups differed from each other on the number of errors made on the congruent words, $t(120) = 2.085, p = .039, d = 0.38$, with drug-abusers making more errors on the congruent words than the non-abusers. The drug-abusers also had higher numbers of errors on the incongruent words than nonabusers, $t(80.87) = 2.25, p = .027, d = 0.78$. Moreover, the number of errors on the neutral words in the drug-abuser group was higher than for the nonabusers, $t(92.05) = 2.48, p = .015, d = 0.47$ and their total errors on the drug-Stroop, $t(120) = 1.92, p = .057, d = 0.23$ was higher than for the nonabusers. But the participants’ differences regarding the number of errors on drug-related word categories were not significant.

Calculating a correlation matrix showed that education was negatively correlated with age ($r = –0.46, p = .001$), and drug-related interference scores ($r = –0.21, p = .009$).

To test the hypothesis that drug-abusers and nonabusers differ on the classic and drug-related interference scores, a multivariate analysis of covariance (MANCOVA) was calculated. In the MANCOVA model, interference scores from the classic and drug Stroop tests were entered as the dependent variables, Group (drug-abusers vs. nonabusers) as the independent variable (Factor), and education and age as covariates. The covariates were included because of their potential effects (e.g., Verhaeghen & De Meersman, 1998) on the participant’s performance on the Stroop tests. Moreover at the baseline, abusers and nonabusers significantly differed in terms of age and education. Such differences could mean collinearity among the independent variables; therefore, we calculated the tolerance (Min: 0.60) and VIF (Max: 1.73) as collinearity diagnostic statistics, which showed that collinearity was not a problem.

Considering the classic Stroop interference scores, there was no significant effect for age [$F = (1, 122) = 0.22, p = .63, \eta^2 = 0.002$] and education [$F = (1, 122) = 0.013, p =$

| Number of Errors and Interference Scores on the Stroop Tests, Separately for Drug Abusers and Nonabusers |
|---------------------------------------------------------------|----------|----------|----------|----------|
| Drug-abuser                                                   | Non-abuser |
|---------------------------------------------------------------|-----------|----------|
| Number of errors on congruent category of classic Stroop      | 4.58      | 3.14      | 3.80      |
| Number of errors on incongruent category of classic Stroop    | 7.40      | 2.85      | 4.47      |
| Total number of errors on classic Stroop                      | 11.98     | 7.99      | 7.35      |
| Number of errors on drug-related category of addiction Stroop | 3.11      | 2.44      | 2.84      |
| Number of errors on neutral category of addiction Stroop      | 2.89      | 1.99      | 2.24      |
| Total number of errors on addiction Stroop                    | 3.11      | 2.44      | 2.84      |
| Interference score on classic Stroop                          | 88.44     | 75.87     | 83.24     |
| Interference score on addiction Stroop                        | 90.40     | 24.15     | 97.90     |
nor was there a significant effect for Group \([F = (1, 122) = 0.62, p = .43]\), though no significant effect was found either for age \([F = (1, 122) = 0.65, p = .42]\) or for education \([F = (1, 122) = 0.14, p = .70]\).

To assure that the results from the MANCOVA model described above (Model A) are not artifacts of gender imbalance across the samples, we repeated the model two more times: in Model B, we omitted females from the data set and included only male nonabusers and male abusers in the analysis; and in Model C, we ran the model on the nonabusers only with gender entered into the model as Factor. The results obtained with Model B replicated those of Model A; that is, when only men from both samples were included, only the effect of Group on drug interference was significant \([F = (1, 87) = 4.81, p = .031]\). For Model C, the results showed that there was no significant effect on drug interference for either the age and education covariates or for Gender \((p > .05)\). The results suggest that the significant effect for Group in the first MANCOVA was not an artifact of the samples’ gender imbalance.

**Discussion**

The main goal of the present study was to compare the attentional bias of drug-abusers and none-abusers as measured by a Persian version of the addiction-Stroop test. The result showed that the drug-abusers had higher interference scores than nonusers for drug-related Stroop stimuli. This finding shows that the Persian addiction-Stroop test that was developed for this study has differential validity; the finding is important because the target population was culturally different from those in the Western studies, and the effect was observed despite the lack of lexical controllability for the frequency of usage of the written and spoken words in the Persian language. The test can be used in future Persian studies that aim to study drug-related attentional bias in Iranian drug abusers. For example, one question that awaits future research is whether Iranian female drug abusers show the same attentional bias as Iranian male drug abusers.

The finding was consistent with evidence that, compared with nonusers, drug-abusers show higher interference scores for drug related stimuli (e.g., Asgaard, Gilbert, Mal-

**Figure 1.** Drug Abusers’ and Controls’ Mean Reaction Times on Classic and Drug Stroop Tests.
References


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