The Diagnostic Role of Delayed Reward Discounting and Sensation Seeking in People with Stimulant and Opiate Use Disorders

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Abstract

Objective: The aim of this study was to evaluate the diagnostic role of delayed reward discounting and sensation seeking in people with stimulant and opiate disorders. **Method**: This study employed a causal-comparative research design. The target population of this study included all patients with stimulant and/or opiate disorders who referred to medical centers where 90 persons (45 stimulant users and 45 opiate users) were selected by convenience sampling method and completed Monetary-Choice Questionnaire, Sensation Seeking Scale Form-V. **Results:** The results of the diagnostic function showed that delayed reward discounting and sensation seeking variables have grouped 86.66% of stimulant users and 84.44% of opiate correctly. In other words, generally, 85.60% of the sample units were classified correctly. **Conclusion:** Delayed reward discounting and sensation seeking played a significant role in the differentiation and diagnosis of stimulant and opiate disorders. Therefore, it is recommended that these two disorders be given special attention in the pertinent prevention and treatment programs.

Keywords: delayed reward discounting, sensation seeking, opiate and stimulant disorders

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Introduction

One of the biggest problems that has been affecting human societies over time is the phenomenon of addiction. According to the definition presented by the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders, the main feature of each type of addiction and substance-related disorder, which consists of ten classes, is a set of cognitive, behavioral, and physiological symptoms that indicate that an individual continues to use drugs despite the important problems that may happen to him/her. From among the 10 classes available in substance abuse disorders, opioid addiction is one of the oldest and, at the same time, the most common type of addiction. The 12-month period of opioid prevalence is observed about 37% among adults aged 18 years and over. The comorbidity of other psychiatric disorders with opioid use, including mild depression, disordered depression, major depression, and antisocial personality disorder is common. Other types of drug abuse are related to stimulant drugs. The high prevalence of stimulant use has become one of the most important health problems in recent years worldwide. The 12-month period of the prevalence of amphetamine-type stimulants in the United States has been estimated to be 2% among the adolescents aged from 12 to 17 years and has been similarly estimated about 2% among the people aged over 18 years. Its comorbidity with psychological disorders, such as post-traumatic stress, antisocial personality disorder, attention-deficit/hyperactivity disorder, and gambling disorder is common (American Psychiatric Association, 2013).

One of the factors that plays an important role in addiction and can affect the vulnerability, exacerbation, relapse, and craving of substance abuse and addiction is a phenomenon called "delayed reward discounting" (MacKillop et al., 2011). Delayed reward discounting was actually produced by the observation of people's decisions in different situations when they had different values. People are always faced with choices to make in everyday life between the current time alternative with a lower value and the future time alternative with a higher value. This phenomenon, influenced by various cognitive and emotional factors, has a great influence on individual performance in all aspects of life as well as in the field of psychiatric disorders. This component obviously exists in drug dependence, gambling disorders, obesity, attention-deficit/hyperactivity disorder, schizophrenia, and a wide range of health behaviors (Sheffer et al., 2012). Delayed reward discounting is a behavioral economic indicator for impulsive decision-making (Madden, & Bickel, 2009). In fact, people with addiction are defective in ignoring and neglecting immediate rewards and they sacrifice the larger and better rewards that are to receive in the future f smaller for the sake of and instant rewards. In this regard, no domestic research has been conducted, but international research findings in this area indicate that delayed reward discounting is one of the variables that is highly available in addicts. This

variable implies the concept that they take precedence over the receipt of smaller instant rewards than larger delayed rewards (MacKillop et al., 2011).

Delayed discounting shows that the value of getting reward ceases with an increase in delay. This is in line with the findings of human and non-human research where people sacrifice larger, but delayed rewards for immediate and smaller rewards, and label such a choice as impulsiveness and label its opposite choice as self-control (Ainslie, 1974). Delayed reward discounting is also used in medical treatment (Bickel, Odum, & Madden, 1999). This variable is an indicator for determining the degree of willingness to impulsiveness, self-control, disinhibition, arousal, and experience level or delayed emotions. Delayed reward discounting can be considered as one of the consequences of emotion regulation or the level of sensation seeking in individuals because the proper management of emotions and the inappropriate control of sensation seeking can have a direct effect on individuals' delayed reward discounting (Kopstein, Crum, Celentano, & Martin, 2001).) Considering the important role of delayed discounting in the development, prevention, and treatment of a wide range of substance use disorders (MacKillop et al., 2011), as well as its high correlation with sensation seeking in opiate and stimulant use disorder, which have a high comorbidity with each other, the investigation of the diagnostic role of delayed reward discounting in stimulant and opioid use disorders and the determination of the similarities and differences between these two disorders based on this variable assume significant importance.

Another effective factor in the process of substance abuse is sensation seeking (Wagner, 2001). Zuckerman defines sensation seeking as a trait that is characterized by diverse, fresh, new, and complex emotions and experiences, and a willingness to address the physical, social, and financial risks of these experiences (Desilva, 1999). Sensation seeking is considered to have four dimensions (Zuckerman, 1971; Zuckerman, 1994), which include: 1. Thrill and adventure seeking: the desire for doing the physical activities that have speed, danger, and freshness; 2. Experience seeking: It refers to the search for new experiences by means of travel, music, art or heterogeneous lifestyle with the individuals who have similar tendencies; 3. Disinhibition: It refers to the tendency to impulsiveness, rebelliousness against social norms, and preference of unpredictable situations; and 4. Boredom susceptibility: It refers to the hatred of repetitive experiences, routine affairs, and predictable people. The high level of sensation seeking is not inefficient, but its ineffectiveness appears to be found in substance abusers (Mitchell, 1999). In addition, Zuckerman describes sensation seeking as the individuals' need to achieve an optimal level of arousal and its preservation. According to Zuckerman, the optimal level of arousal in sensation seekers is higher than those who do not have this feature (Aleston, 1994). Zuckerman believes that a biological model of sensation seeking is correlated with an optimal level of catecholamine activity. In addition, he highlighted the role of dopamine in the primary reward system and reported the

presence of a link between sensation seeking and this system. In sensation seekers, the dopaminergic system is less active; therefore, some people use drugs to search for new stimulants that increase the activity of this system (Loas et al., 2001). The three characteristics of thrill seeking, experience seeking, and disinhibition (which are the important dimensions of sensation seeking) are in fact the dimensions that Madden, & Bickel (2009); Green, Fisher, Perlow, & Sherman (1989) described in the description of delayed reward discounting with such titles as non-self-control, impulsiveness, and experience of immediate emotions. Therefore, considering the important role of sensation seeking in people's tendency to a wide range of substance abuse disorders (Michel, 1999), the diagnostic and differential role of this component in the disorder of drug and opioid use, and the determination of similarities and the differences between these two disorders assumes significant necessity.

As it was stated above, delayed reward discounting and sensation seeking have a considerable role in the process of substance use disorder, including development, treatment, and prevention. These factors have been investigated in numerous studies on various types of substance use disorders, and it has been shown that the malfunction of these factors plays a major role in drug use disorder. Previous studies confirm the existence of delayed reward discounting and sensation seeking in both groups considering the high comorbidity of opioid and stimulant use. It was also shown that these two disorders are characterized by delayed by a high level of delayed reward discounting (MacKillop et al., 2011) and inappropriate sensation seeking (Alipour, Sa'eedpour & Hassani, 2015). However, the discrete and joint role of these variables in opiate and stimulant use disorders has not been studied. Therefore, the purpose of this study was to investigate these factors in drug and opiate use disorders so that the better recognition of these two disorders can be reached and, ultimately, this research h questions can be responded to: Do sensation seeking and delayed reward discounting have a diagnostic role in these disorders?

Method

Population, sample, and sampling method

The present study was a causal-comparative research. The population of this study consisted of the men with opiate and stimulant use disorders who had referred to one of the treatment centers and addiction treatment clinics in Tehran and Marivan during the period of 2014-15. According to the inclusion criteria, 45 opioid patients and 45 patients with stimulant use were selected as the sample units. The entry criteria included informed consent, minimum reading and writing literacy, no physical diseases, no use of psychiatric drugs, the age range of 18 to 45 years, and diagnosis of stimulant and opioid drug abuse based on expert opinion of the center and semi-structured interview of SCID-I.

Instruments

1. Semi-structured clinical interview of ISCID: This interview is used to diagnose major axis I disorders based on the Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition) (American Psychiatric Association, 1999). One of the objectives of constructing and expanding this structured interview was to provide an efficient and user-friendly instrument so that the clinical assembly could benefit from the advantages of structured interviewing. This interview has been designed to meet the research and therapeutic needs. After the release of DSM-IV-TR, some amendments were made on it each year (by 2010) based on research findings and clinical experience to adapt the instrument in the best way. These amendments have also been compiled, translated, and implemented in the Persian version. In recent pieces of research, the diagnoses used in this structured interview have been proved to enjoy a higher validity than the standard clinical interviews (Mohammadkhani, Jokar, Jahani Tabesh & Tamanayifar, 2010).

2. Monetary-Choice Questionnaire: This questionnaire was developed by Kirby, Petry, & Bickel (1999), and is a valid self-report tool for measuring delayed reward discounting. The respondents need to respond to 27 two-choice items with smaller immediate rewards and larger delayed rewards. This is a one-factor test and does not have any sub-scale. The responsive patterns of temporal discounting specify the performance in individuals. The known K value consists of three levels of measurements from 25 to 35 dollars (small), 50 to 60 dollars (average), and 75 to 85 dollars (large). Participants in this questionnaire select the hypothetical rewards that are planned to measure delayed reward discounting (Johnson & Bikel, 2002; Lagorio, & Madden, 2005; Robbins, Curran, & de Wit, 2012). The K values of delayed reward discounting have a largely positive correlate with each other in three levels of small, medium, and large measurements ($P < 0.001$, $R = 0.86$-0.96). Therefore, the average value of K is considered as the indicator of delayed discounting in order to avoid the first type error. Kirby et al. (1999) reported Cronbach's alpha coefficient of this scale in the range of 0.83 to 0.95. The reliability and validity of this test are in progress in Iranian culture.

3. Sensation Seeking Scale (Form V): This scale has been developed by Zuckerman. Form V is a shortened form of the fourth version that was produced in 1978. Many studies have been conducted on this scale based on factor analysis where four sub-scales, namely "thrill and adventure seeking", "experience seeking", "disinhibition", and "boredom susceptibility" have been extracted. For each of the factors, ten items have been considered. There are a total number of 40 items in this scale. The items of this scale are two-part questions where the two parts of each item are separated from each other by two components, namely "A" and "B" so that the audience can respond to one component of each item. The raw score in each of the four factors is from zero to ten and the scoring is specified based on the key sheet. Then, the scores earn their true value score by

referring to the conversion table. Cronbach's alpha of the scale has been reported in the range of 0.83 to 0.86.

Results

The descriptive statistics of the demographic variables are presented in Table 1 for each group.

Table 1: Descriptive statistics of demographic variables for each group

Variable	Group	N.	Mean	SD
Age	Stimulant users	45	26.02	6.04
	Opiate users	45	27.96	7.62
Education	Stimulant users	45	13.01	2.78
	Opiate users	45	12.64	2.95

Independent t-test results showed that the two groups were matched in terms of age (P>0.05; t = 0.74) and education (P>0.05; t = 0. 53). The descriptive statistics of the research variables are presented in the following table for each group.

Table 2: Descriptive statistics of the research variables for each group

Variable	*Stimulant users*		*Opiate users*	
	Mean	*SD*	*Mean*	*SD*
Delayed reward discounting	40.27	2.54	38.74	2.78
Sensation seeking (experience seeking)	8.18	1.23	5.84	1.73
Sensation seeking (adventure)	7.22	1.92	5.69	2.03
Sensation seeking (boredom susceptibility)	2.49	1.75	4.18	1.61
Sensation seeking (disinhibition)	7.18	1.71	6.71	2.06

In the beginning, it should be noted that the analysis of the diagnostic function is considered as the multivariate analysis of variance analysis in various sources. For this purpose, the results of investigating the difference between the groups in the predictor variables using multivariate analysis of variance are considered as one of the main assumptions of diagnostic function analysis. One of the assumptions of MANOVA is the equality of covariance matrices. The results of the M box test showed that this assumption has been met (P>0.05, F = 1.86). The results of multivariate analysis of variance were indicative of the presence of a significant difference between the two groups (P< 0.001, F = 32.18, Wilks's lambda = 0.22). Univariate analysis of covariance was used to examine the patterns of difference as follows.

Table 3: Results of ANCOVA for examining the patterns of difference

Variable	*Df*	*F*	*Sig.*
Delayed reward discounting	88	7.43	0.001
Experience seeking	88	54.18	0.0005
Adventure	88	13.73	0.0005
Boredom susceptibility	88	22.57	0.0005
Disinhibition	88	1.82	0.102

As it has been shown in Table 3, there is a significant difference between the two groups in all variables other than disinhibition. To determine the diagnostic role of predictive variables in the group membership of the research participants, stepwise diagnostic function analysis was used, and the pertaining results are presented in the following table.

Table 4: Results of the stepwise diagnostic function analysis

Steps	*Entered variables*	*Wilks's lambda*	*F*	*Sig.*
1	Experience seeking	0.221	54.16	0.0005
2	Boredom susceptibility	0.196	44.27	0.0005
3	Adventure	0.173	35.62	0.0005
4	Delayed reward discounting	0.158	28.44	0.0005

Table 4 shows the variables that have a significant contribution to the diagnostic function through the stepwise method in the order of importance. The results of the analysis of diagnostic function and the significance test are presented in the following table.

Table 5: Results of the diagnostic function analysis

Diagnostic function	*Function's Eigen value*	*Percentage of variance*	*Canonical correlation*	*Wilks's lambda*	*Chi square*	*Df*	*Sig.*
1	1.263	100	0.792	0.217	73.484	4	0.0004

Since there are two comparison groups, a diagnostic function has been obtained. According to the results of Table 5, the Eigenvalue of the function that makes a differentiation between opioid and stimulant user groups is equal to 1.263, which explains 100% of the variance. The canonical correlation of this function equals 0.79, and the chi-square value is equal to 73.4484, which indicates the significance of the created distinction in the groups has emanated from this function. Table 6 shows the correlation coefficients of the predictive variables entered into the model and the diagnostic function.

Table 6: Correlation coefficients of predictive variables and diagnostic function

Predictive variables	*Diagnostic function*
Experience seeking	0.57
Boredom susceptibility	0.45
Adventure	0.37
Delayed reward discounting	0.28

Experience seeking has made the highest contribution to the created function and the other variables have been listed in the order of importance. The final results and summary of the diagnostic function analysis are presented in Table 7 for each group.

Table 7: Final results of diagnostic analysis for each group

	Group	*Stimulants*	*Opiates*	*Total*
Frequency	Stimulants	39	6	45
	Opiates	7	38	45
Percentage	Stimulants	86.66	13.34	100
	Opiates	15.56	84.44	100

As it has been shown in Table 7, the diagnostic function could correctly group 86.66% of stimulant users and 84.44% of opiate users. In other words, 60/85% of the total participants have been classified correctly.

Discussion and Conclusion

The present study aimed to analyze the diagnostic role of delayed reward discounting and sensation seeking in stimulant and opioid users. The results indicated that delayed reward discounting and sensation seeking were more effective in stimulant users than in opioid users. The results of studies done by Robles et al. (2012), Johnson et al. (2007), Kirby et al. (1999), Baker et al. (2007), and Bickel et al (1999) showed the significant effect of delayed reward discounting in drug users was significantly higher than that in non-drug users. However, no study thus far has compared stimulant users and opioid users in this regard.

To explain these findings, one can mention the preference for instant rewards, more pleasure, and craving for drug use in substance users. Addicts have the power to control and have the ability to delay rewards and pleasures to a lesser extent, which causes the persistence, relapse, and craving for drug use (MacKillop et al., 2011). One can also mention the phenomenon of tolerance among substance users. Substance users turn to the use of higher amounts of substances for the acquisition of initial immediate pleasure and fun. In addition, since the use of stimulants is associated with instant rewards and pleasures (Semple, Zians, Grant, & Patterson, 2005); therefore, the degree of delayed reward discounting in stimulants consumers is more than that in opioid users. On the other hand, researchers have reported a close relationship between impulsiveness and delayed reward discounting and have labeled delayed reward discounting as impulsiveness (Ensil, 1975; Logue, Rodriguez, Pena-Correal, & Mauro, 1984), and a significant correlation between these two components and addiction (Baldacchino, Balfour, Passetti, Humphris, & Matthews, 2012). Stimulants have a more powerful effect on impulsiveness, and the rate of relapse is directly related to impulsiveness; in addition, impulsiveness in stimulant users is higher than that in opioid users (Miller et al., 2001). Therefore, it can be claimed that delayed reward discounting is higher in stimulant users than that in opioid users.

Researchers have defined delayed reward discounting as a behavioral economic indicator for impulsive decision-making (Madden & Bickell, 2009). In fact, addicts are defective in ignoring and neglecting immediate rewards and

sacrifice the larger and better rewards that are to receive in the future for the sake of smaller and instant rewards. In this regard, international research findings in this area indicate that delayed reward discounting is one of the variables that is highly found in addicts (MacKillop et al., 2011). Therefore, according to previous findings and studies, delayed reward discounting is more likely to occur in stimulant users than opioid users, and it is necessary that prevention and necessary therapies be conducted by modifying this variable in such individuals. This signifies the importance and the need for the assignment of special attention to this variable, which can create a variety of psychiatric and psychological disorders in individuals, and can also provide the grounds for positive outcomes throughout life from educational performance to addiction treatment (Hirsh, Morisano, & Peterson, 2008).

In addition, the results of data analysis showed that sensation seeking is higher in the group of stimulant users than that in the opioid users. This finding is consistent with the research findings reported by Ravson, & Washton (2002); Siqueira, Bodian, & Rolnitzky (2000); and Alipour, Sa'eedpour & Hassani (2015). To interpret this finding, one can refer to the malfunctioning of in the dopaminergic system that is associated with the search for new and high-risk behaviors (Lesch et al., 1996), and it is also possible to mention factors such as the existence of a more active behavioral activation system, which is related to sensation seeking. This system is known as the one that explains the identified substance use disorders (Fowles, 1994). Since one of the most important personality traits in people's vulnerability to risky experiences, such as tendency to substance abuse is sensation seeking and may open the door to new experiences, it can disinhibit the high-risk behaviors and provide a means to escape from monotony and boredom (New Comb, & Mc Gee, 1991). In addition, considering that stimulants create risky behaviors and lead to the avoidance of monotony and boredom to a greater extent than opiates do, stimulant users are likely to have the highest inclination to making new and risky experiences. In this way, they can reach the level of arousal and predict the fewer risks of the addictive and stimulant substances. Hence, there is a higher level of sensation seeking in stimulant users than that in opiate users (Leeman, Hoff, Krishnan-Sarin, Patock-Peckham, & Potenza, 2014). Accordingly, it can be said that the inappropriate level of sensation seeking predicts the individual's tendency toward different types of drugs. Moreover, the more the level of sensation seeking in individuals is adjusted through positive methods, the lower their tendency towards drug use (Hansen, & Breivik, 2001).

One of the limitations of the present research was that it was not possible to do research on women for various reasons and, thereby, the current research was done only on the affected men. It is suggested that the role of gender be examined in future research. In therapeutic and diagnostic interventions, the role of delayed reward discounting and sensation seeking should be assigned special attention in terms of etiology, continuity, and therapeutic treatment.

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