On the Role of Brain-Behavioral Systems (BAS/BIS), Novelty seeking, Reward Dependency, and Pathological Worry in Predicting Addiction Potential

Abstract

Objective: The purpose of this study was to investigate the role of brain-behavioral systems, personality traits (novelty-seeking, reward dependency) and pathological worry in addiction potential among university students. **Method:** The method used in this study was descriptive and of correlation type. All the students of Shahid Madani University of Azarbayjan in the academic year 2014-2015 constituted the statistical population of this study. From this population, the number of 150 students was selected as the participants by multistage random sampling method. For data collection purposes, Carver and White's BIS/BAS Questionnaire, Pennsylvania State Worry Questionnaire, Cloninger's Temperament and Character Inventory of Personality, and Addiction Potential Scale were used. **Results:** The results showed that pathological worry and behavioral inhibition system were negatively correlated with addiction potential whereas behavioral activating system and novelty-seeking dimensions of personality traits were positively correlated with addiction potential. **Conclusion:** According to the obtained results, one can devise some proper solutions to prevent tendency to addiction by detecting the people with high behavioral activating system (BAS) and high novelty-seeking characteristics. **Keywords:** pathological worry, novelty-seeking, reward dependency, brain-behavioral systems, addiction potential

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Introduction

Substance abuse is among the major health problems and issues while Iran is among the countries that needs to do more efforts to curb this issue compared with the average global statistics. The high prevalence of drug abuse with more than 1.8 million people in the country highlights the need for attention to this problem. In addition, the topic of addiction, as a preventable and curable disease, lies on top priorities of research (Ekhtiari, 1999). Substance abuse in young adults is related to genetic factors (Schuchit, Smith & Kalmijn, 2004) determinants of social factors (Hussong, 2003), and various individual differences (Colder & O'connor, 2002). Most of the addicts have been suffering from psychological, personality, and life disorders before addiction and these disorders become intensified and appear in destructive manifestations after addiction. Therefore, the issue of addiction is not only the matter of narcotic drugs, but it is also a two-way relationship between drugs and consumers' personality (Oraki & Hosseinnasab, 2012). In the field of personality psychology, theorists have tried to explain the role of different parts of the human nervous system in behavioral tendency of personality by describing its activities and functioning. In this way, they explore the role of all these sub-systems to in psychopathology.

Taking a look at the extensive research in this area shows that personality psychologists in recent decades have tried to explain personality differences from the perspective of biology (Babapour Khairuddin, Dadashzadeh & Toosi, 2011) where Gray's theory has received the highest attention. Gary introduced the three following emotional systems that explain variability in personality: behavioral inhibition system, behavioral activation system, and fight-flight system. Behavioral activation and inhibition systems constitute some part of neurobiology of behavior and emotion that provide the motivational basis for individual differences in behavior, mood, and affect (Smits & Boeck, 2006; Chang, Zumberg & Sanna, 2007). The attributes that reflect behavioral activation system are impulsive and those that reflect behavioral inhibition system are anxiety traits (Carver & White, 1994). The activation system is sensitive to nonpunishment and reward and is associated with positive affects and emotions (hope, elationu, and happiness) (Heponiemi, Keltikangas-Jarvinen, Puttonen & Ravaja, 2003; Harmon-Jones, 2003). In contrast, the inhibition system leads to behavioral inhibition and increased levels of stimulation and attention; and is sensitive to such cues as nonreward, punishment, and novel experience and is associated with negative affects and emotions, such as fear, anxiety, frustration, and sadness (Heponiemi, Keltikangas-Jarvinen, Puttonen & Ravaja, 2003). Given that the activity of the activation system pushes people to do things with the probability of being rewarded (regardless of the probability of negative consequences), its sensitivity of this system is considered as a factor motivating the spread of drug abuse and

addiction potential (Abdollahzadeh Jedi, Hashemi Nosrat Abad, Moradi & Farzad, 2010). Franken & Muris (2006) reported that high levels of activation system provided mental pathological conditions that are specified through pathological involvement in appetitive behaviors, such as alcohol and drug abuse. Research findings showed that drug users had obtained higher activation system scores than the control group. Knyazev, Slobodskaya, Kharchenko & Wilson (2004) reported that activation system is the best personality predictor of substance abuse. Similarly, Park, Park, Lee, Jung, Lee & Choi (2013) reported brain-behavioral systems as a good predictor of addiction. In addition, Franken & Muris (2006) showed that the subscale of fun seeking is more strongly correlated with substance abuse than the subscale of drive. Azadfallah (2000) showed that the higher sensitivity and activity of the behavioral activation system and the weakness of behavioral inhibition system in people with drug dependency represent signs of punishment and difficulty in harmonization with social punitive frameworks.

However, research on personality traits, especially its relationship with addiction potential is important for several reasons. First, such research is, indeed, the evaluation of the nature of inherited traits that may mediate the relationship between genotype and drug use behaviors. For example, Elovainio, Kivimäki, Viikari, Ekelund & Keltikangas-Järvinen (2005) concluded that novelty seeking indirectly affects drug users' behavior by dopamine receptor D4. Second, the systems involved in the process and response to passion, aversion, and new stimuli are associated with mood and may cause substance use (Chaudhri, Caggiula, Donny, Palmatier, Liu & Sved, 2006). Finally, there are also contradictory results obtained from different studies. In this regard, Etter et al. (2003) reported the existence of a negative correlation between drug dependence and reward dependence, whereas Leventhal et al. (2007) did not find any significant relationship between reward dependence and drug use. Leventhal et al. (2007) showed that people with high levels of novelty seeking would experience higher craving for cigarette smoking when they are in the cessation and abstention period of cigarette smoking. In addition, novelty seeking is a feature that refers to sensation seeking desires, opposition to monotony, quick decision-making, and interest in risk; and it can predict addiction potential (Oraki & Hosseinnasab, 2012).

As it was mentioned above, the excessive activity of the inhibition system leads to personality traits of anxiety, high sensitivity to threatening stimuli, and anxiety-related behaviors, such as worry and rumination. In this domain, research findings suggest that the behavioral inhibition system is interrelated with pathological and non-pathological worries (Mansoori & Bakhshipoor Roodsari, 2010).

Worry is also a cognitive process that refers to the persistent and repetitive thoughts about personal concerns and difficulty ending this chain of thoughts (Jong-Meyer, Beck & Riede, 2009). Worry is divided into two categories:

normal and pathological (Berkovec, Raey & Stoeber, 1998; cited in Covin, Ouimet, Seeds & Dozois, 2008). Worry takes the pathological feature when it is chronic, excessive, and uncontrollable and lead to the loss of enjoyment of life (Covin et al., 2008). Barlow (2002) believes that the primary function of worry is to get ready to cope with future threats in such a way that people with anxiety disorders, particularly general anxiety disorder are highly inclined to underestimate the disadvantages of worry. It is believed that worry brings constructive purposes, such as the prevention of bad accidents and events. Anxious people accept that negative events occur in the future; therefore, they make use of worry as a method to solve the problems in the situations where future affairs are unclear and vague. As it was mentioned above, the inhibition system has a positive effect on the creation of pathological worry; and this system also prevents the tendency to addiction. However, this system originates from addiction motivators, stress, anxiety, and depression that worry is one of the main components. Accordingly, it has been attempted to examine this contradiction in this study.

Method

Population, sample, and sampling method

The method used in this study was descriptive and of correlation type. All the students of Shahid Madani University of Azarbayjan in the academic year 2014-2015 constituted the statistical population of this study. From among this population, the number of 150 students was selected as the participants by multistage random sampling method out of the Faculties of Psychology and Educational Sciences, Science, Theology, and Technology In fat, three faculties were selected from Shahid Madani University of Azarbayjan and three classes (a total of 9 classes) were randomly selected from each faculty. In terms of marital status, 72 participants were single and and 78 ones were married. They ranged between 19 and 30 years of age.

Instruments

Addiction Potential Scale: This scale was sued to measure addiction potential. It has been designed by Weed et al (1992) and has been composed of three subscales, namely Addiction Potential Scale, MacAndrew Alcoholism Scale, and Addiction Acknowledgement Scale. The Addiction Potential Scale has been validated in Iran. The original version of this scale contains 39 questions. The responses provided to each of the items includes two options "yes" and "no" where responses yes and no are given 1 and 0 score, respectively. The standardized version of Addiction Potential Scale for Iranian high school students consists of 36 items (Minooei & Salehi, 2003). According to Minooei & Salehi (2003), the scores ranging from 1 to 18 indicate very low addiction potential, scores ranging from 19 to 20 represent low addiction potential, scores

ranging from 21 to 21 suggest moderate addiction potential, scores ranging from 23 to 24 represent high addiction potential, and the score 25 or higher indicates a high potential for addiction. In the present study, Cronbach's Alpha coefficient for Addiction Potential Scale was obtained equal to .91.

Brain-Behavioral Systems (Behavioral Activation and Inhibition): This scale was developed by Carver and White in 1994. It consists of 24 questions that are scored based on a 5-point Likert scale from 1 to 5. The items are categorized into four subscales. The subscale of behavioral inhibition system consists of 7 questions that measure the sensitivity of behavioral inhibition system or response to threats and feelings of anxiety in the face of threatening cues. Behavioral Activation System Scale contains 13 items in three scales, namely Reward Responsiveness scale (5 items), the Drive scale (4 items), and the Fun Seeking scale (4 items). The reliability coefficient of .78 has been reported for the inhibition system; and coefficients of .82, .75, and .86 have been reported for the subscales of the activation system, respectively. The concurrent validity of the scale has been obtained in correlation with

Beck's Inventory (r=.38), Eysenck's Scale (r=.27), and Negative Affect Schedule (r=.40), which are all significant (Saboori Moghaddam, 2010).

Pennsylvania State Worry Questionnaire: This is a 16-item questionnaire that assesses the generality, excessiveness, and uncontrollability of worry. This questionnaire is used as an instrument to screen generalized anxiety disorder (Davey & Wells, 2006). The items are scored based on a 5-point Likert scale and each item is given one score (not at all typical of me) to 5 scores (very typical of me). The number of 11 questions of the questionnaire is scored positively while the number of 5 items (items numbered 1, 3, 8, 10, and 11) is scored negatively. The score of the whole scale ranges from 16 to 80 where higher scores represent a higher degree of worry. Dehshiri et al. (2009) have assessed the convergent validity of the scale by correlating its scores with Spielberg Anxiety Questionnaire and the Beck Depression Inventory scores on a 56-participant sample and the results indicated a significant positive correlation. In the present study, Cronbach's alpha coefficient of .88 was obtained for the total scale.

Temperament and Character Inventory of Personality: This questionnaire was developed by Cloninger, Przybeck, Svrakic & Wetzel in 1994 to assess the personality traits and characteristics that are available in people either through genetics (temperament) or the environment (character). This questionnaire contains seven subscales, including novelty seeking (NS), harm avoidance (HA), reward dependence (RD), persistence (PS), self-directedness (SD), cooperativeness (CO), and self-transcendence (ST). The first four subscales measure temperament and the other three sub-scales measure character (Kaviani, 2005). The items are scored through true/false options. The internal consistency of the subscales was obtained on a 1212-participant sample through Cronbach's alpha coefficient as follows: .72 for NS, .80 for HA, .73 for RD, .55 for PS, .77 for CO, .84 for SD, and .72 for ST.

Results

Descriptive statistics of the variables are presented in the table below.

Table 1: Descriptive statistics of the variables under study

| Variable	Mean	SD
Addiction Potential	53.69	5.64
Pathological Worry	45.36	11.37
NS	29.22	2.82
RD	20.58	2.10
BIS	18.39	4.41
Reward Responsiveness	10.79	5.34
Drive	10.51	3.04
Fun Seeking	10.87	3.73

The correlation matrix of the variables under study is presented in the table 2.

Table 2: Correlation matrix of the variables

Variable	1	2	3	4	5	6	7
1. Addiction Potential	1	-	-	-	-	-	-
2. Pathological Worry	**.37	1	-	-	-	-	-
3. NS	*.16	.09	1	-	-	-	-
4. RD	-.10	.11	*.20	1	-	-	-
5. BIS	*-.17	*-.21	.11	.04	1	-	-
6. Reward Responsiveness	**.36	**.47	*.16	.11	**.22	1	-
7. Drive	**.23	*.21	***.69	.13	**-.28	**.67	1
8. Fun Seeking	**.38	**-.24	**.22	.10	*-.19	.04	.12

$* P<.05; ** P<.01; *** P<.001$

Regression test was used to predict addiction potential by the following variables, including pathological worry, novelty seeking, reward dependence, and brain-behavioral systems. Before the conduct of regression test, the required assumptions were assessed and the results showed that all of them had been met: a) the normal distribution of errors was observed via histogram. b) Durbin-Watson test was used to assess the independence of errors whose value equaled 2.05. Since it is smaller than 2.50, this assumption was also met. c) The collinearity between predictor variables was also met as the results are reported in Table 3.

Histogram
Dependent Variable: aps
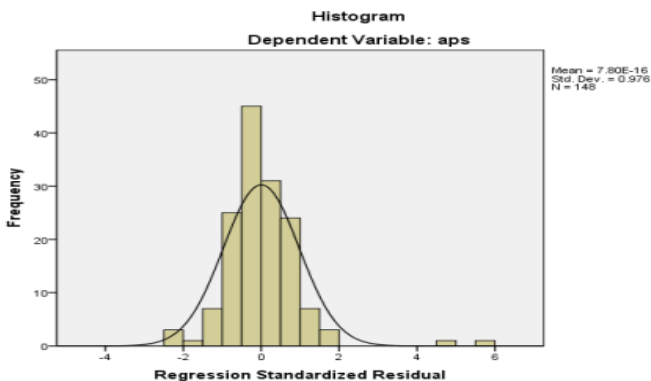
Regression was performed (Enter) and the variables could explain 32.5% of the variance of addiction potential. The regression coefficients are presented in the table below.

Table 3: Table of regression coefficients of addiction potential based on the predictor variables

Predictor variable	B	SD	β	t ratio	Sig.	Tolerance Index	VIF
Pathological Worry	-.088	.044	-.178	-1.995	.048	.608	1.64
NS	.276	.150	.138	2.204	.023	.859	1.16
RD	.284	.194	-.106	-1.461	.146	.924	1.08
BIS	.217	.099	-.170	-2.190	.030	.800	1.25
Reward Responsiveness	.206	.118	.195	1.741	.084	.456	2.00
Drive	.098	.182	.058	.537	.592	.496	1.85
Fun Seeking	5.12	.114	.339	4.499	.0005	.850	1.17

As it is observed in the above table, pathological worry, novelty seeking, and behavioral inhibition system have significantly predicted addiction potential at the significance level of .05 and fun seeking has also significantly predicted addiction potential at the significance level of .001.

Discussion and Conclusion

The results of this study showed that there is a significant negative correlation between addiction potential and pathological worry. Given that behavioral inhibition system has a significant positive impact on pathological worry (Breniner, Beauchaine & Sylvers, 2005; Johnson, Turner & Iwata, 2002), the high activity of this system leads to such personality traits as anxiety and high sensitivity to threatening stimuli and anxiety-related behaviors, such as anxiety and rumination (Van der Linden, Taris, Beckers & Kindt, 2007; Breniner et al., 2005; Johnson et al., 2002). As various studies have pointed out, behavioral inhibition system has a significant negative correlation with tendency to addiction (Babapour Khairuddin, Dadashzadeh & Toosi, 1390; Azadfallah, 2000; Knyazev et al., 2004). Hence, it can be argued that pathological worry can affect addiction tendency. Research findings indicate that the high activity of the inhibition system is one of the factors effective in the production of pathological worry and leads to high sensitivity to threatening stimuli and, thereby, anxiety is produced. Then, the produced anxiety causes a cautious attitude and tendency that inhibits dominant behaviors and increases the threatened assessment, anticipation, and recall as a result of the worry. In other words, the person makes use of worry as a cognitive avoidance strategy in order to inhibit disturbing and frightening images of experiencing anxiety and other negative emotions (Booth & Hasking, 2009).

Behavioral activation system is a call for the conduct of behaviors in response to new phenomena and rewarding cues or escape from punishment. Therefore, individuals in such behavioral activities (novelty seeking) are different from each other; and, considering this novelty seeking characteristic, the current

research hypothesis stating that novelty seekers have a higher addiction tendency was confirmed. Elovainio et al. (2005) concluded that novelty seeking indirectly influences drug users' behavior by dopamine receptor D4. Leventhal et al. (2007) showed that people with high levels of novelty seeking would experience higher negative effects and craving for cigarette smoking when they are in the cessation and abstention period of cigarette smoking. In the same way, Evren, Evren, Yancar & Erkiran (2007) showed that drug dependent people obtained higher scores in novelty seeking (dimension of temperament) than alcohol-dependent patients. Thus, it can be argued that the individuals with a higher level of novelty seeking experience anxiety and anger and regulate social and emotional problems with immature methods. Such people try to have new experiences, are unable to control their situation, and act impulsively and irrationally in decision-making; therefore, they turn to high-risk behaviors, especially drug use. Moreover, it can be said that novelty seekers are usually willing to do exploratory activities, are thrill seeker and emotional, oppose to monotony, tend to experience new things, and make hasty decisions with little information. These characteristics expose such individuals to risks and lead them to take refuge in drugs. In confirmation of these points, Abolghasemi, Kiamarsi & Momeni (2013) reported higher scores of novelty seeking for addicted people.

The results of this study showed that there is no significant relationship between addiction potential and reward dependence. This finding was not consistent with those of the studies conducted by Leventhal et al. (2007), and Etter et al. (2003), and Elovainio, et al. (2005). The results also showed that there was a significant negative correlation between behavioral inhibition system and addiction potential, which is consistent with the findings reported by Fahimi et al. (2011), Franken & Muris (2006). This finding can be accounted for by the claim that the activity of this system reinstates the emotional state of anxiety and behavioral inhibition, passive avoidance, extinction, increased attention, and arousal. In a research conducted by Azadfallah (2000), it was concluded that the weakness of the behavioral inhibition system in people with drug dependency indicates their lower sensitivity to signs of punishment and difficulty in harmonization with social punitive frameworks. The dominance of behavioral activation system over behavioral inhibition system and the weakness of behavioral inhibition system have also been reported in studies on other antisocial groups. Passive avoidance (punishment avoidance through inactivity or surrender) and extinction (stopping non-rewarding behaviors) are two components of the behavioral inhibition system (Wilson, Gary & Barrett, 1990). It seems that when people with a more active behavioral inhibition system are exposed to a risky situation (supply of cigarette or drugs), the feeling of fear and anxiety in these individuals leads them to withdraw from and avoid the risk situation and this brings them a solace.

Johnson, Turner & Iwata's extensive research (2002) showed that high scores in behavioral activation system are a predictor of substance abuse and

dependence. Similarly, the current research suggests that tendency to substance abuse is correlated with high scores in the behavioral activation system and the subscales of fun seeking, reward responsiveness, and drive. Franken et al. (2006); and Fahimi et al. (2011) showed that this system is highly active among addicts. To explain this finding, one may argue that the activity and increased sensitivity of this system leads to the activation of emotions and avoidance (Gray & McNaughton, 2000) and the sensitivity of behavioral activation system represents one's impulsivity (Gray, 1994). Thus, the increased activity of behavioral activation system and high sensitivity to signs of rewards are reinforced via drug use and experience of the behaviors that lead to reward and reinforcement. This reflects the presence of underlying biological factors in individuals with addiction potential and can result in people's tendency to drug use. Finally, the results of the present study showed that pathological worry, novelty seeking, and behavioral inhibition and behavioral activation systems are good predictors of addiction potential where novelty seeking and fun seeking of behavioral activation system made the highest contribution. The excessive activity of behavioral activation system leads to impulsive behavior. The person do some affairs that probably lead to reward without paying much attention to the negative consequences. In fact, some scientific evidence suggests that that extraverts are more inclined to positive outcomes than negative consequences and strongly yearn for stimulation. Behavioral activation system is activated by pleasant stimuli associated with reward or nonpunishment and includes approach motivation, active search for rewards, active avoidance, and punishment avoidance. This system is the fundamental reason for impulsivity and is associated with extraversion and thrill seeking. Behavioral activation system, as a motivating incentive system, triggers behaviors in response to rewarding stimuli. The high level of activity and sensitivity of behavioral activation system is because of the high activity of neural circuits of mesolimbic dopamine.

Cloninger states that novelty seeking represents the individual differences of the behavioral activation system in the brain. A person who gains a high score in novelty seeking will be usually willing to do exploratory activities, enjoy thrill seeking, and get excited and emotional. On the other hand, such a person displays emotions in the face of novel ideas, does not like monotony, gets bored with it, is able to make fast decisions with little information, insists on bringing changes, , is prone to distraction, is prodigal and active, is interested in risk-taking, and does not like a disciplined trend. Dopaminergic bonds that are linked from ventral tegmental in the brain stem to the striatum and other areas and cerebral cortex play a decisive role in regulating the behavioral activation when giving response to emergent stimuli and reward cues or nonpunishment.

Novelty seeking is predicted by the behavioral activation system and this is consistent with the definition of novelty seeking (behavioral activation in response to new stimuli and reward cues and nonpunishment). The high activity of behavioral activation system is positively related to substance dependence and

abuse (Loxton et al., 2001). Johnson et al. (2003) also showed that high scores in behavioral activation system are a predictor of substance abuse and dependence. They emphasized that the high activity of behavioral activation system may be an effective factor in the higher sensitivity of individuals to reward cues and also in the individuals' tendency to drug use dependence. This finding is in parallel with the findings of the current research regarding the prediction of addiction based on behavioral activation system and novelty seeking. The findings of the present study are consistent with those of the research undertaken by Franken & Muris (2007). They observed that the subscales of fun seeking and reward responsiveness have a positive relationship between with addiction and substance dependence.

To explain the above findings, one may claim that people behave towards the phenomenon of drug use differently depending on their personality traits; and these are personality traits that make people more vulnerable to developing mental disorders. Some psychologists believe that personality is based on the function of the nervous system; therefore, the behavioral activation system has an effect on drug addiction. This effect is due to the simultaneity of its pleasurable nature and the delay of its negative effects, both of which are pleasant for people with a high degree of behavioral activation system. The dominance of behavioral activation system over behavioral inhibition system causes the production of impulsive mood and tendency to bringing positive reinforcing changes pertaining to drug use dependence. It is anticipated that the individuals with the lower activity of the behavioral inhibition system than normal people are at the highest risk of drug use dependence. The results of the above-mentioned studies are consistent with this finding.

This was a correlational study; thus, it is not possible to infer any causal relationship between the variables. This study was conducted only on students of Shahid Madani University of Azarbayjan; therefore, the results cannot easily be generalized to students of other universities. From the results of this study, it is possible to identify the individuals with a high degree of addiction potential and plan the required program towards addiction prevention by identifying personality traits and brain-behavioral systems.

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