Revista Brasileira de Psiquiatria. 2014;36:24–31
© 2014 Associação Brasileira de Psiquiatria
doi:10.1590/1516-4446-2013-1206

ORIGINAL ARTICLE

Role of personality traits in cocaine craving throughout an outpatient psychosocial treatment program

Flávia Ismael,[1] Danilo A. Baltieri[2]

[1]*Department of Psychiatry, Universidade de São Paulo (USP), São Paulo, SP, Brazil.* [2]*Department of Psychiatry, Faculdade de Medicina do ABC, Santo André, SP, Brazil.*

Objective: Cocaine dependence is a major international public health concern. Its chronically relapsing nature is possibly related to craving intensity, which can be influenced by diverse biological and psychological aspects. This study aimed to evaluate the role of different personality traits in craving measured throughout a psychosocial treatment program.
Method: The sample comprised 66 cocaine-dependent outpatients who were enrolled in an individual and manualized cognitive-behavioral therapy program. The influence of personality traits on craving intensity, frequency, and duration was analyzed using a generalized estimating equations model with an autoregressive correlation structure.
Results: Craving varied during treatment. The personality traits of novelty seeking, reward dependence, and harm avoidance interacted with craving intensity, and the personality trait of persistence interacted with craving duration throughout the treatment period. Furthermore, there were significant interactions between drug use and craving intensity, and between different routes of administration and craving intensity. Participants who used cocaine/crack while in treatment and concurrent users of crack (i.e., freebase) cocaine and powder cocaine also had a higher craving intensity.
Conclusion: The extent of craving variation can depend on certain personality styles. This study shows that craving is influenced by personality traits, and this may presumably change clinical expression involved in disease.

Keywords: Cocaine dependence syndrome; craving; personality dimensions; route of administration

Introduction

There are approximately 0.9 million current users of cocaine in Brazil, and the Southern Cone countries together account for over two-thirds of all cocaine users in South America. In North America, there are about 1.9 million current cocaine users, with the U.S. having the highest prevalence rate (2.4% of the population between 15 and 64 years of age).[1] Although cocaine use disorders are a major international public health concern, to date, there is no effective pharmacotherapy for cocaine dependence, and standard psychosocial treatments seem to be ineffective for many cocaine-dependent patients.

Although cocaine-dependent individuals list several reasons for using this drug, the feeling states of euphoria and craving seem to be the main reinforcers of addiction. The chronically relapsing nature of cocaine dependence is possibly related to different dimensions of craving, whose measurement during treatment can be helpful in monitoring patients' clinical status and, presumably, assessing their risk for relapse. In fact, craving reduction has been a target outcome in the testing of certain medications and in the evaluation of psychotherapies such as cue exposure therapy.[2]

Cocaine craving can be stimulated by several internal cues, such as dysphoria and boredom, and by external triggers, such as white powder, cash, liquor, needles, and other environmental cues that bring to mind previous cocaine use experiences.[3]

Several factors can also influence measures of craving, such as recent history of drug use and the treatment setting. In addition, craving is related to multiple dimensions, including biological and psychosocial aspects. In the psychological field, certain personality traits have been posited to impact the craving experiences of cocaine-dependent individuals.[4] High impulsiveness and novelty seeking (NS) seem to be associated with craving in individuals with alcoholism,[5] and alcohol misuse is a highly prevalent problem among cocaine/crack users.[6] In addition, NS seems to be linked to the use of illicit substances in non-clinical samples.[7] Furthermore, neuroticism and impulsiveness have been correlated with craving among nicotine- and opiate- dependent subjects,[8,9] and harm avoidance (HA) has been associated with positive reinforcement smoking.[10]

Studies have revealed that around 50% of subjects with general substance use disorders have personality

Correspondence: Danilo Antonio Baltieri, Av. Angélica, 2100, conjunto 13, CEP 01228-200, São Paulo, SP, Brazil.
E-mail: dbaltieri@uol.com.br
Submitted Jul 08 2013, accepted Jul 25 2013.

disorders,[11] and that almost 25% of crack cocaine users have antisocial personality disorder.[12] In fact, several personality traits, including NS, anxiety, and impulsiveness, are associated with addiction, and this indicates the necessity of identifying personality dysfunctions and styles when treating dependent individuals.

Although personality traits may not be stable over the lifespan, their stability within relatively short periods seems to be high.[13] In contrast, craving is a fairly labile phenomenon and repeated measures must be carried out over the course of treatment. Unfortunately, many studies have evaluated craving only at baseline in longitudinal studies, or even from a cross-sectional perspective. This design is insufficient to evaluate the extent to which craving can be influenced by other variables, such as personality traits.

If certain personality traits influence craving during treatment, researchers should pay more attention to this possible interaction when developing new and presumably effective management strategies. Our study aimed to evaluate the role of different personality traits in craving as measured over the course of treatment. We hypothesized that the personality traits of NS, HA, and impulsiveness would be associated with cocaine craving.

Methods

Participants

The sample was drawn from a universe of 18-to-60-year old male patients with a diagnosis of cocaine dependence as per the ICD-10 who enrolled as outpatients in the Assistance Sector of the Interdisciplinary Group of Studies on Alcohol and Drugs at the Universidade de São Paulo (PROGREA). This service is dedicated exclusively to the treatment of men with drug abuse and dependence problems.

Participants met the following inclusion criteria: a) ICD-10 criteria for cocaine dependence; b) report of cocaine use at least four times in the month prior to admission; and c) duration of cocaine use for a period of at least 12 months preceding enrollment into the study. Exclusion criteria were as follows: a) $<$ 18 years or $\geqslant$ 60 years of age; b) serious clinical comorbidities (e.g., inadequately controlled diabetes, heart failure, alcoholic cirrhosis, seizure disorders); c) previous treatment with any psychotropic medications within 6 months of this study; d) concomitant psychiatric disorders evaluated by the Mini International Neuropsychiatric Interview (MINI version 5.0)[14]; e) current use of any psychotropic medications; f) inability to give full informed consent; and g) clinical history of mental retardation (which may reduce the accuracy of the information given).

Participants were informed about the objectives of the study and the nature of the treatment offered. All patients were assured of the confidentiality of the data and were informed that they were free to withdraw their consent and could discontinue their participation in the study at any time without any negative effect on their continued medical care. After signing consent for screening, participants underwent psychiatric and physical examination by our staff. This study was approved by the Ethics Committee of Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HC-FMUSP), Brazil.

All participants were also encouraged to participate in Narcotics Anonymous (NA) groups, but this was not an obligatory condition for participation in the study.

Measures

In the first interview, after a full history and clinical examination, patients who fulfilled entry criteria were evaluated. A standardized semi-structured interview to collect information on socio-demographic characteristics, lifetime drug history, family history of cocaine problems, daily consumption of cocaine, age at onset of cocaine use, years of cocaine use, and preferential route of administration was performed. This interview is commonly used in the therapeutic setting of PROGREA.

All participants were evaluated with the measure listed below.

The Timeline Follow-Back (TLFB)

This self-reported substance abuse method was used to obtain reports of alcohol and cocaine use at the screening visit (the previous 30 days), and in the weekly visits (daily use during treatment).[15] The primary outcome measures derived from TLFB data were the amount and frequency of cocaine use. The TLFB was administered by a trained researcher at screening and at each weekly visit throughout the trial.

Addiction Severity Index-6 (ASI-6)

The ASI is a structured interview to assess drug and alcohol use and areas of functioning usually affected by substance abuse, such as the medical, employment, family/social, psychiatric, and legal domains. In the 6th version, there is one set of summary scores available, the ASI-6 Summary Scores for Recent Functioning (SS-Rs). The SS-Rs refer to status/functioning in the past 30 days, and provide objective information derived from items based on a combination of rational and empirical methods. They are psychometrically derived using non-parametric item response theory and classical psychometric methods. There is one score in each problem area, except for family/social, in which there are three different scores: family/social problems, family/social support, and child problems. They represent standardized t scores with a mean equal to 50 and a standard deviation (SD) equal to 10; the scores theoretically range from 0 to 100. Higher scores indicate greater problem severity. The ASI-6 has been validated for the Brazilian context.[16]

Minnesota Cocaine Craving Scale (MCCS)

The MCCS is composed of five items that correspond to the intensity, frequency, duration of craving, changes in relation to previous weeks, and the craving response to medication. For this study, we evaluated intensity, frequency, and duration.[3,17] At baseline and at weeks 4,

8, and 12, participants answered the following questions: On average, how strong has your craving for cocaine been during the past 4 weeks? On average, how many times a day have you experienced craving for cocaine during the past 4 weeks? On average, how long (in minutes) has the craving for cocaine lasted during the last 4 weeks?

Temperament and Character Inventory (TCI)

The TCI is a self-administered psychometric instrument validated for use in the Brazilian context.[18] It measures seven personality dimensions in accord with a psychobiological and dimensional model that integrates the role of certain neurotransmitters (serotonin, dopamine, noradrenaline) in regulating behavior.

These dimensions are divided into four scales of temperament and three of character.

The temperament scales are:

1) NS: tendency towards exploratory activity in response to novelty, lack of inhibition, impulsiveness. This dimension is related to the level of control and excitability and corresponds to the sum of four subscales measuring more specific traits: exploratory excitability (11 items), impulsiveness (10 items), extravagance (9 items), and disorderliness (10 items).
2) HA: tendency to anxiety, shyness, worry, and avoidance of punishment. This dimension is assessed by means of four subscales: anticipatory worry (11 items), fear of uncertainty (7 items), shyness (8 items), and fatigability (9 items).
3) Reward dependence (RD): attachment and social attachment systems. It is associated with dependence on external approval. This dimension encompasses three subscales: sentimentality (10 items), attachment (8 items), and dependence (6 items).
4) Persistence: capacity to maintain behavior in adverse conditions. It is characterized by making demands on self, hard work, and striving for excellence. It has a single eight-item scale.

The character scales are:

1) Self-directedness: related to maturity, strength, and self-sufficiency. Capacity to manage behavior guided by goals chosen voluntarily and individually and not by circumstances, impulses or external stimulus. This dimension is assessed as the sum of five subscales measuring more specific related traits: responsibility (8 items), purposefulness (8 items), resourcefulness (5 items), self-acceptance (11 items), and congruent second nature (12 items).
2) Cooperativeness: reveals an inclination towards social tolerance, empathy, friendliness, altruism, and respect for others. This dimension includes: social acceptance (8 items), empathy (7 items), helpfulness (8 items), compassion (10 items), and pure-heartedness (9 items).
3) Self-transcendence (ST): reflects a tendency towards spirituality, idealism, religious or mystical feelings, and identification with the wider world, as well as the ability to accept ambiguity and uncertainty, and a sense of communion with others. This dimension encompasses three subscales: self-forgetfulness (11 items), transpersonal identification (9 items), and spiritual acceptance (13 items).

The Barratt Impulsiveness Scale (BIS-11)

The BIS-11 is a self-report scale composed of 30 items with Likert-type questions that provide a total score of impulsivity and three subscores: attention, lack of planning, and motor impulsivity. Scores vary from 30 to 120, there is no established cutoff point, and their validity was verified in Brazil.[19]

Procedures

Each participant was enrolled in an individual and manualized treatment program based on the Marlatt & Gordon[20] relapse prevention model. This treatment was cognitive-behavioral and psychoeducational in nature and was conducted by two physicians with intensive training in managing individuals suffering from addiction. Patients attended cognitive-behavioral therapy (CBT) once per week for 12 weeks. The period of 12 weeks was used because this is the standard length of CBT treatment. The overall goal of these interventions was to increase the person's ability to cope with high-risk situations that could precipitate relapses. During the sessions, the patients were recommended to monitor good and bad daily situations throughout their treatment. These situations were discussed with the patients' physicians and, when possible, related to the addictive behavior. The following topics were standardized and applied to each patient during their treatment: management of negative mood, assertiveness, drug refusal skills, enhancement of social support networks, and relapse prevention.

Statistical analysis

We used the generalized estimating equations (GEE)[21] approach, which accommodates repeated-measures data and accounts for within-subject correlations. Non-normally distributed variables were log-transformed. The influence of personality traits on craving intensity, frequency, and duration throughout the treatment was analyzed by using the GEE model with an autoregressive correlation structure. For all statistical tests performed, a significance threshold of 0.05 was adopted. Data were analyzed using SPSS version 20.

Results

Sixty-six patients completed the four assessments and were included in analysis. As shown in Table 1, the mean age of the patients was 30.68±7.17 years; 36% were married; 62% were white; and 33% had not reached a 12th-grade education level. The mean age of onset of cocaine use was 20.51±5.79 years, and the mean duration of cocaine use was 10.17±6.05 years. Forty-one (62.12%) patients were cigarette smokers and 57 (86.36%) were

Table 1 Baseline characteristics of overall sample

Variables	Participants (n=66)
Age, mean (SD)	30.68 (7.17)
Age of first cocaine use, mean (SD)	20.51 (5.79)
Marital status, n (%)	
Married	24 (36.36)
Single	36 (54.54)
Separated/widowed	6 (9.10)
Race, n (%)	
White	41 (62.12)
Non-white	25 (37.88)
Educational level, n (%)	
1st-8th grade	5 (7.58)
9th-11th grade	16 (24.24)
$\geqslant$ 12th grade	45 (68.18)
Previous treatment for cocaine use, n (%)	27 (40.91)
Family history of cocaine dependence, n (%)	
First-degree relatives	20 (30.30)
Second-degree relatives	21 (31.82)
None	25 (37.88)
Days of cocaine used per week in the last 30 days, mean (SD)	2.72 (1.17)
Grams of cocaine used in the last 30 days, mean (SD)	15.97 (22.75)
Craving intensity, mean (SD)*	5.82 (2.58)
Frequency of craving (times/day), mean (SD)*	6.58 (3.11)
Duration of craving (in minutes), mean (SD)*	34.85 (21.36)
Current alcohol users, n (%)	57 (86.36)
ASI scales, mean (SD)	
Drug	56.33 (12.22)
Family/child	69.80 (1.99)
Alcohol	47.53 (12.22)
Psychiatric	50.01 (8.82)
Medical	49.30 (7.50)
Legal	55.76 (8.12)
Employment	51.29 (6.78)
Family/social support	54.42 (21.64)
Family/social problem	64.17 (13.69)
TCI scales, mean (SD)	
Novelty seeking	21.71 (3.87)
Harm avoidance	16.27 (4.72)
Reward dependence	12.41 (3.43)
Persistence	4.42 (1.66)
Self-directedness	22.35 (7.24)
Cooperativeness	28.01 (6.43)
Self-transcendence	19.20 (6.06)
BIS-11, mean (SD)	70.24 (10.46)

ASI-6 = Addiction Severity Index-6; BIS-11 = Barratt Impulsiveness Scale; SD = standard deviation; TCI = Temperament and Character Inventory. * Measured by the Minnesota Cocaine Craving Scale.

currently alcohol users. Twenty-seven (40.91%) were powder cocaine users, 17 (25.76%) reported using cocaine by the smoking route (crack cocaine), and 22 (33.33%) were dual users. No subjects reported using cocaine by the intravenous route of administration.

Temperament and character effects on craving intensity

As shown in Table 2, GEE analysis indicated a significant effect of NS (chi-square [3] = 8.99, p = 0.03), RD (chi-square [3] = 18.32, $p < 0.01$), and HA (chi-square [3] = 14.74, $p < 0.01$) on craving intensity throughout the treatment. The slopes of the lines in the craving intensity-NS graph were 0, 0.13, -0.10, and 0.20 at baseline, week 4, week 8, and week 12 respectively. In the craving intensity-RD graph, the linear slopes were 0, 0.23, -0.91, and 0.36 at baseline, week 4, week 8, and week 12 respectively. Finally, the slopes of the lines in the craving intensity-HA graph were 0.06, 0.08, -0.10, and -0.21 at baseline, week 4, week 8, and week 12 respectively.

Table 2 Interaction effect of TCI scales on intensity, frequency, and duration of craving across the treatment period among cocaine-dependent outpatients

Variables	Wald's χ^2	df	p-value
Intensity			
Novelty seeking	8.99	3	0.03*
Harm avoidance	14.74	3	< 0.01†
Reward dependence	18.32	3	< 0.01†
Persistence	0.51	3	0.92
Self-directedness	4.49	3	0.21
Cooperativeness	5.96	3	0.11
Self-transcendence	2.90	3	0.41
BIS-11	1.90	3	0.59
Frequency			
Novelty seeking	6.36	3	0.09
Harm avoidance	3.34	3	0.34
Reward dependence	3.23	3	0.35
Persistence	5.28	3	0.15
Self-directedness	1.62	3	0.65
Cooperativeness	5.29	3	0.15
Self-transcendence	1.52	3	0.68
BIS-11	1.60	3	0.66
Duration			
Novelty seeking	3.75	3	0.29
Harm avoidance	3.70	3	0.30
Reward dependence	0.45	3	0.93
Persistence	14.96	3	< 0.01†
Self-directedness	0.54	3	0.91
Cooperativeness	1.28	3	0.73
Self-transcendence	0.77	3	0.86
BIS-11	7.36	3	0.06

BIS-11 = Barratt Impulsiveness Scale; df = degrees of freedom.
* $p < 0.05$; † $p < 0.01$.

There were no significant effects of other temperament and character traits and impulsiveness on craving intensity throughout the treatment.

As illustrated in Figure 1, cocaine use during treatment predicted craving intensity (chi-square [3] = 9.61, p = 0.01), with users having a mean intensity of 5.02±0.28 compared to 3.84±0.24 for nonusers. The interactions between NS and cocaine use (chi-square [1] = 0.50, p = 0.48), HA and cocaine use (chi-square [1] = 0.44, p = 0.51), and RD and cocaine use (chi-square [1] < 0.01, p = 0.97) were not significant.

As illustrated in Figure 2, route of administration had a significant effect on craving intensity throughout treatment (chi-square [6] = 16.83, p = 0.01). On average, dual users (concurrent powder cocaine and crack cocaine users) had a craving intensity of 4.81±0.28, compared to 4.07±0.32 for powder cocaine users and 3.48±0.38 for crack cocaine users. Pairwise comparisons revealed that dual users had significantly higher craving intensity than crack cocaine users (mean difference = 1.32 [standard error {SE} = 0.47], df = 1, p < 0.01). There were no significant differences between dual users and cocaine users (mean difference = 0.74 [SE = 0.43], df = 1, p = 0.09) or between powder and crack cocaine users (mean difference = 0.58 [SE = 0.50], df = 1, p = 0.24).

The interaction between route of administration and cocaine use was not significant (chi-square [2] = 1.99, p = 0.37). In addition, the interactions between NS and route of administration (chi-square [2] = 0.89, p = 0.64), HA and route of administration (chi-square [2] = 2.42, p = 0.30), and RD and route of administration (chi-square [2] = 0.12, p = 0.94) were not significant.

Temperament and character effects on the frequency of craving

As illustrated in Table 2, the effects of temperament and character traits and impulsiveness on the frequency of craving throughout the treatment were not significant. Similarly, cocaine use during treatment (chi-square [3] = 5.01, p = 0.17), and route of administration (chi-square [6] = 5.10, p = 0.53) did not predict the frequency of craving during the treatment.

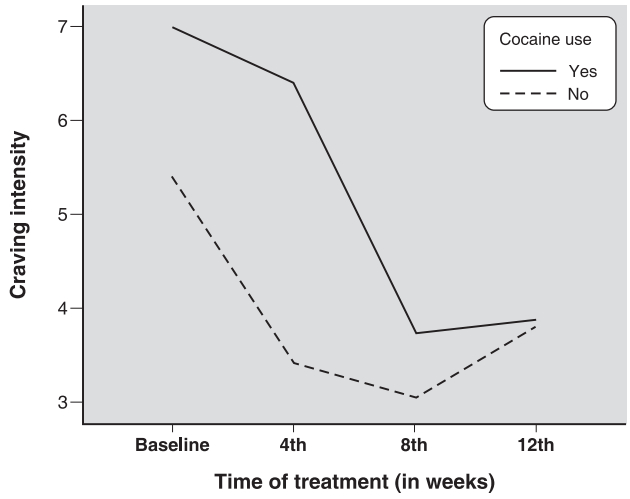


Figure 1 Craving intensity among cocaine-dependent outpatients by self-reported cocaine use

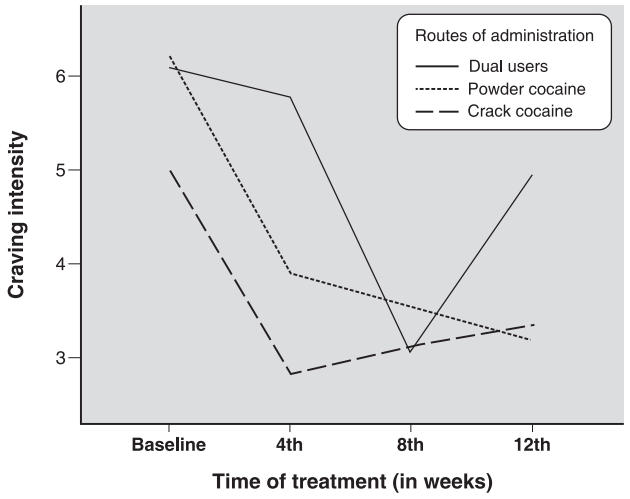


Figure 2 Craving intensity among cocaine-dependent outpatients by route of administration

Temperament and character effects on the duration of craving

As illustrated in Table 2, of the temperament and character traits, only persistence was significantly associated with the duration of craving throughout the treatment (chi-square [3] = 14.96, $p < 0.01$). The slopes of the lines in the craving duration-persistence graph were 0.02, -0.13, -0.08, 0.14 at baseline, week 4, week 8, and week 12 respectively.

Cocaine use during treatment did not predict the duration of craving (chi-square [3] = 2.91, p = 0.41). Route of administration did not show a significant effect on the duration of craving throughout treatment (chi-square [6] = 1.15, p = 0.98).

Discussion

The current study examined the associations between temperament and character dimensions – as assessed by Cloninger's TCI – and cocaine craving, measured over the course of an outpatient treatment. The findings indicated that the personality traits of NS, RD, and HA interacted with craving intensity, and that persistence interacted with craving duration. In line with our initial hypotheses, NS and HA were found to be aspects that require evaluation during craving assessment.

Dependent individuals appear to experience increases in craving following drug cessation (tonic craving) and in response to situational factors, such as exposure to environmental cues, negative affect, and stress (phasic craving). In addition, rather than remaining stable, the degree and pattern of tonic and phasic cravings vary meaningfully across individuals and over time. These variations appear to be related to the previous patterns of substance use, but also may be influenced by inherited personal characteristics. Moreover, evidence of neuroadaptive changes within the dopamine system and in other neurotransmitter systems has been used to explain craving fluctuations over time.[22]

The study of temperament underscores the notion that craving-related factors may be mediated by psychological traits that change neuroendocrine function and regulate clinical expression involved in disease. Neurobiological studies have indicated that the anticipation of reward, which is mediated by dopaminergic neurotransmission, can be reflected in the personality trait of NS. In fact, NS has been correlated with the extent of the cocaine-induced increase in extracellular dopamine in the ventral striatum. Exploratory behavior (one of the main aspects of NS) in novel environments has been associated with the propensity to self-administer cocaine in animal experiments. Cocaine may elicit a dopamine-mediated thirst for the drug; consequently, high novelty seekers would be particularly vulnerable to cocaine use. In addition, repeated cocaine use would aggravate this characteristic, altering the corticostriatal circuitry, increasing reward seeking, and producing decision-making deficits that, in turn, further increase the chance of self-administering cocaine.[23]

Similarly, the actual pleasant or hedonic experience of reward, which is mediated by opiate neurotransmitters, can be reflected in the personality trait of RD.[24] Indeed, μ-opiate receptor availability in the ventral striatum in abstinent alcoholic patients has been shown to be correlated with craving for alcohol and an important risk factor for relapse.[25]

Studies have also found an association between HA and craving among drug,[26] tobacco,[10] and alcohol-dependent individuals.[27,28] Among cigarette smokers, subjects with high HA experience greater abstinence-induced increases in irritability, anxiety, restlessness, and depression. These individuals are more likely to use drugs for negative reinforcement purposes.[10] HA has been associated with serotonin function, although the direction of this association is still uncertain.[29]

Although the personality dimension of persistence was not associated with craving intensity, it was related to the duration of craving throughout treatment. Persistence has been correlated with perfectionism, resilience, conscientiousness, and self-judgment.[30] This temperament trait could be related to self-vigilance of one's own thoughts, feelings, and symptoms. Persistence has been associated with dopamine receptor polymorphisms and reward systems.[31]

Different neurotransmitter systems seem to be associated with different facets of craving. Specifically, the dopamine system appears to be responsible for dissociable facets of motivation, including the incentive salience of the drug. The opioid system is related to the hedonic impact of the drug. The serotonin system is linked to the modulation of behavior.

Our study also showed a significant interaction between drug use and craving intensity during treatment. Drug users had a higher craving intensity than nonusers. Broadly speaking, craving is densely interwoven with drug use in the conceptualization of addiction. Increased drug craving in response to cocaine use has been well documented in several studies; similarly, high ratings of craving predict drug use and relapse in dependent individuals.[32,33]

Some studies have evaluated craving in response to different routes of administration of cocaine and have shown that the frequency of craving is higher in individuals dependent on crack cocaine than among those dependent on powder cocaine.[34,35] Although our study did not demonstrate a difference in craving intensity throughout treatment between crack and powder cocaine users or between powder cocaine and dual users, dual users had a higher craving intensity than crack cocaine dependents. The route of administration likely has a strong influence on the immediacy, intensity, and duration of the pharmacological effect of the drug, which supports the hypothesis that the route of administration affects the development and maintenance of drug use. Dual users can differ from mono users with regard to drug use severity.[36] In addition, dual users can have easier access to cocaine, given the different forms, prices, and availability of the same drug, and may be exposed to a wider range of environmental cues.

There are several and competing ways to measure craving.[37] We evaluated three dimensions of craving (namely, intensity, frequency, and duration) and found that personality traits interacted differently with each one. The inconsistent findings in the literature may be due to the myriad of ways available to measure craving. Nevertheless, studies that have examined the role of personality in craving have repeatedly shown that some personality aspects, mainly NS and HA, are associated with craving. However, it is important to note that craving significantly varies during treatment and that the extent and depth of this variation can depend on certain personality styles. In addition, our study was carried out in an outpatient setting; therefore, patients could have access to cocaine/crack and be exposed to diverse environmental cues during the study, which could have influenced craving measures. We have investigated the self-reported drug usage data and verified this information by contacting a family member of each patient for each appointment. No significant interaction was observed between drug use and these personality traits. Nevertheless, it was not possible to investigate the extent to which our subjects were exposed to environmental cues.

This study has several limitations that must be mentioned: a) our sample size was small. In truth, it is very difficult to obtain cocaine-dependent individuals who are adherent to an outpatient psychosocial treatment program, given the high dropout rates commonly observed in this population; b) inclusion criteria for sample collection were overly restrictive. We excluded participants with non-life-threatening clinical conditions and diverse psychiatric comorbidities. This may have harmed the representativeness of our sample because of selection bias; c) although the scale used to measure craving is easy to administer and score, is suitable for repeated measurements, and is sensitive to rapid changes in the psychological state being assessed, it can fail to reflect the presumably multidimensional nature of craving, e.g., its obsessive and compulsive aspects[38]; d) cocaine use assessment was based on self-report. This can lead to the perception (warranted or otherwise) that these outcome measures are less rigorous than biochemical ones. However, there seem to be discrepancies between self-reported cocaine use and urine assays at baseline, but not at follow-up assessments[39]; e) our results cannot be extrapolated to women, given that other studies have already shown a significant effect of gender on craving experiences[40]; f) only cocaine users who agreed to participate in this study were included. Hence, it is not clear whether these findings would apply to individuals who would refuse to participate in clinical studies or fail to meet the inclusion criteria; g) no other psychotherapeutic procedures or incentives were provided alongside CBT. Such incentives might have increased patient retention.

Studies about the effect of Cloninger's temperament dimensions on cocaine craving at baseline and throughout a treatment are scarce in the literature. Furthermore, studies on the influence of different personality dimensions in drug craving using any other instruments are virtually non-existent. This is surprising, given that craving can be related to external and internal cues, and that cue-elicited craving is an index of approach behavior towards alcohol and drugs of abuse. A less effective response inhibition or a higher NS trait could weaken the inhibition of approach behavior to such cues and contribute to relapse. Understanding and predicting crack/cocaine craving by means other than obvious characteristics such as quantity and time of last use is clinically relevant for treatment planning.

Acknowledgements

DAB has received research grants from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

Disclosure

The authors report no conflicts of interest.

References

1 United Nations Office on Drugs and Crime (UNODC). World drug report. Vienna: United Nations Publication; 2012.
2 Weiss RD, Griffin ML, Mazurick C, Berkman B, Gastfriend DR, Frank A, et al. The relationship between cocaine craving, psychosocial treatment, and subsequent cocaine use. Am J Psychiatry. 2003;160:1320-5.
3 Halikas JA, Kuhn KL, Crosby R, Carlson G, Crea F. The measurement of craving in cocaine patients using the Minnesota Cocaine Craving Scale. Compr Psychiatry. 1991;32:22-7.
4 Zilberman ML, Tavares H, el-Guebaly N. Relationship between craving and personality in treatment-seeking women with substance-related disorders. BMC Psychiatry. 2003;3:1.
5 Papachristou H, Nederkoorn C, Havermans R, van der Horst M, Jansen A. Can't stop the craving: the effect of impulsivity on cue-elicited craving for alcohol in heavy and light social drinkers. Psychopharmacology (Berl). 2012;219:511-8.
6 Duailibi LB, Ribeiro M, Laranjeira R. Profile of cocaine and crack users in Brazil. Cad Saude Publica. 2008;24:S545-57.
7 Chakroun N, Doron J, Swendsen J. [Substance use, affective problems and personality traits: test of two association models]. Encephale. 2004;30:564-9.
8 Reuter M, Netter P. The influence of personality on nicotine craving: a hierarchical multivariate statistical prediction model. Neuropsychobiology. 2001;44:47-53.
9 Powell J, Bradley B, Gray J. Classical conditioning and cognitive determinants of subjective craving for opiates: an investigation of their relative contributions. Br J Addict. 1992;87:1133-44.
10 Leventhal AM, Waters AJ, Boyd S, Moolchan ET, Heishman SJ, Lerman C, et al. Associations between Cloninger's temperament dimensions and acute tobacco withdrawal. Addict Behav. 2007;32:2976-89.
11 Grant BF, Stinson FS, Dawson DA, Chou SP, Ruan WJ, Pickering RP. Co-occurrence of 12-month alcohol and drug use disorders and personality disorders in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. Arch Gen Psychiatry. 2004;61:361-8.
12 Falck RS, Wang J, Siegal HA, Carlson RG. The prevalence of psychiatric disorder among a community sample of crack cocaine users: An exploratory study with practical implications. J Nerv Ment Dis. 2004;192:503-7.
13 Hampson SE, Goldberg LR. A first large cohort study of personality trait stability over the 40 years between elementary school and midlife. J Pers Soc Psychol. 2006;91:763-79.

14 Amorim P. Mini International Neuropsychiatric Interview (MINI): validação de entrevista breve para diagnóstico de transtornos mentais. Rev Bras Psiquiatr. 2000;22:106-15.
15 Sobell LC, Maisto SA, Sobell MB, Cooper AM. Reliability of alcohol abusers' self-reports of drinking behavior. Behav Res Ther. 1979;17:157-60.
16 Kessler F, Cacciola J, Alterman A, Faller S, Souza-Formigoni ML, Cruz MS, et al. Psychometric properties of the sixth version of the Addiction Severity Index (ASI-6) in Brazil. Rev Bras Psiquiatr. 2012;34:24-33.
17 Focchi GR, Leite MC, Andrade AG, Scivoletto S. Use of dopamine agonist pergolide in outpatient treatment of cocaine dependence. Subst Use Misuse. 2005;40:1169-77.
18 Fuentes D, Tavares H, Camargo CHP, Gorenstein C. Inventário de temperamento e de caráter de Cloninger - Validação da versão em português. In: Gorenstein C, Andrade LHSG, Zuardi AW, editors. Escalas de avaliação clínica em psiquiatria e psicofarmacologia. São Paulo: Lemos; 2000. p. 363-76.
19 Malloy-Diniz LF, Mattos P, Leite WB, Abreu N, Coutinho G, De Paula JJ, et al. Tradução e adaptação cultural da Barratt Impulsiveness Scale (BIS-11) para aplicação em adultos brasileiros. J Bras Psiquiatr. 2010;59:99-105.
20 Marlatt GA, Gordon SM. Prevenção de recaída. Estratégia de manutenção no tratamento de comportamentos adictivos. Porto Alegre: Artes Médicas; 1993.
21 Hedeker D, Gibbons RD. Application of random-effects pattern-mixture models for missing data in longitudinal studies. Psychol Methods. 1997;2:64-78.
22 Grace AA. The tonic/phasic model of dopamine system regulation and its implications for understanding alcohol and psychostimulant craving. Addiction. 2000;95:S119-28.
23 Leyton M, Boileau I, Benkelfat C, Diksic M, Baker G, Dagher A. Amphetamine-induced increases in extracellular dopamine, drug wanting, and novelty seeking: A PET/[11C]raclopride study in healthy men. Neuropsychopharmacology. 2002;27:1027-35.
24 Schreckenberger M, Klega A, Grunder G, Buchholz HG, Scheurich A, Schirrmacher R, et al. Opioid receptor PET reveals the psychobiologic correlates of reward processing. J Nucl Med. 2008;49:1257-61.
25 Heinz A, Reimold M, Wrase J, Hermann D, Croissant B, Mundle G, et al. Correlation of stable elevations in striatal mu-opioid receptor availability in detoxified alcoholic patients with alcohol craving: a positron emission tomography study using carbon 11-labeled carfentanil. Arch Gen Psychiatry. 2005;62:57-64.
26 De Los Cobos JP, Sinol N, Trujols J, Banuls E, Batlle F, Tejero A. Drug-dependent inpatients reporting continuous absence of spontaneous drug craving for the main substance throughout detoxification treatment. Drug Alcohol Rev. 2011;30:403-10.
27 Coton X, Pinto E, Reggers J, Hansenne M, Parent M, Ansseau M. [Impact of personality on the alcohol withdrawal syndrome intensity: a preliminary study with the Cloninger's model]. Encephale. 2007;33:264-9.
28 Tavares H, Zilberman ML, Hodgins DC, el-Guebaly N. Comparison of craving between pathological gamblers and alcoholics. Alcohol Clin Exp Res. 2005;29:1427-31.
29 Carver CS, Miller CJ. Relations of serotonin function to personality: current views and a key methodological issue. Psychiatry Res. 2006;144:1-15.
30 Cloninger CR, Zohar AH, Hirschmann S, Dahan D. The psychological costs and benefits of being highly persistent: personality profiles distinguish mood disorders from anxiety disorders. J Affect Disord. 2012;136:758-66.
31 Szekely A, Ronai Z, Nemoda Z, Kolmann G, Gervai J, Sasvari-Szekely M. Human personality dimensions of persistence and harm avoidance associated with DRD4 and 5-HTTLPR polymorphisms. Am J Med Genet B Neuropsychiatr Genet. 2004;126B: 106-10.
32 Fox HC, Talih M, Malison R, Anderson GM, Kreek MJ, Sinha R. Frequency of recent cocaine and alcohol use affects drug craving and associated responses to stress and drug-related cues. Psychoneuroendocrinology. 2005;30:880-91.
33 Sinha R, Talih M, Malison R, Cooney N, Anderson GM, Kreek MJ. Hypothalamic-pituitary-adrenal axis and sympatho-adreno-medullary responses during stress-induced and drug cue-induced cocaine craving states. Psychopharmacology (Berl). 2003;170:62-72.
34 Da Silveira DX, Doering-Silveira E, Niel M, Jorge MR. Predicting craving among cocaine users. Addict Behav. 2006;31:2292-7.
35 Ferri CP, Gossop M. Route of cocaine administration: patterns of use and problems among a Brazilian sample. Addict Behav. 1999;24:815-21.
36 Guindalini C, Vallada H, Breen G, Laranjeira R. Concurrent crack and powder cocaine users from Sao Paulo: Do they represent a different group? BMC Public Health. 2006;6:10.
37 Munoz MA, Martinez JA, Fernandez-Santaella MC, Vila J, Cepeda-Benito A. Two scales to evaluate cocaine craving. Subst Use Misuse. 2010;45:1303-18.
38 Rosenberg H. Clinical and laboratory assessment of the subjective experience of drug craving. Clin Psychol Rev. 2009;29:519-34.
39 Dillon FR, Turner CW, Robbins MS, Szapocznik J. Concordance among biological, interview, and self-report measures of drug use among African American and Hispanic adolescents referred for drug abuse treatment. Psychol Addict Behav. 2005;19:404-13.
40 McCaul ME, Svikis DS, Moore RD. Predictors of outpatient treatment retention: patient versus substance use characteristics. Drug Alcohol Depend. 2001;62:9-17.