

PERSONALITY PROFILE AND NEUROPSYCHOLOGICAL TEST PERFORMANCE IN CHRONIC COCAINE-ABUSERS*

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Little is known about the association between personality disorders and neuropsychological test performance in chronic cocaine users. The aims of the present study were to (1) pinpoint the specific neuropsychological characteristics of chronic cocaine abusers, (2) analyze their personality profile, and (3) explore the association between personality traits and neuropsychological test performance. A sample of 42 drug-abusers (mean age = 34.15; $SD = 6.73$; mean educational level = 11.44; $SD = 2.01$) was selected from a state rehabilitation facility and was compared to a control group (mean age = 34.53; $SD = 9.01$; mean educational level = 12.29; $SD = 1.31$). The following information was collected for each subject: (1) A clinical history adapted from Horton (1996). (2) The Personality Assessment Inventory (PAI) (Morey, 1991). (3) A neuropsychological test battery including: Arithmetic and Digits subtests from the WAIS-R, California Verbal Learning Test, Trial Making Test, Verbal Fluency tests, Rey-Osterrieth Complex Figure, Wisconsin Card Sorting Test, Benton Visual Retention Test, Stroop Neurological Screening Test and Hooper Visual Organization. Thirty-seven of the drug-dependent subjects obtained an abnormal score in at least one PAI scale. The personality profile of the drug-dependent subjects found *via* the PAI pointed to a Borderline/Antisocial personality, frequently associated with mania features. In six of the drug-abusers, a normal personality profile was observed. Neuropsychological test performance scores were within the low average or borderline range. The most abnormal scores were observed in attention, memory, and executive functioning tests. The results did not show any robust association between personality profile and neuropsychological test performance.

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INTRODUCTION

Psychoactive substance use has been associated with conduct and personality disorders. In antisocial personality disorders, there is a predisposition for the development of psychoactive substance use (American Psychiatric Association, 1994). This association between antisocial personality and drug-abuse has been frequently corroborated. In a sample of 249 cocaine-dependent men, McMahon and Richards (1996) found elevations on the Antisocial, Aggressive/Sadistic, Narcissistic, Passive-Aggressive, and Borderline scales of the Millon Multiaxial Inventory-II. Similarly, Marlowe *et al.* (1998) and Calsyn *et al.* (1996) found elevations on the Antisocial, Narcissistic and Aggressive scales. Sex differences were also documented: Women were more likely to be assigned to histrionic and dependent personality disorder subtypes. Kranzler, Satel and Apter (1994) observed that 70% of 50 patients meeting the criteria for cocaine dependence also met criteria for at least one Axis II diagnosis. Ninety percent of the most common diagnoses were borderline (34% of all subjects), antisocial (28%), and narcissistic (28%) personality disorders. In a sample of 289 cocaine dependent subjects Barber *et al.* (1996) found that 48% of the subjects had at least one personality disorder and 18% had two or more. Of those with personality disorders, 65% had a cluster of antisocial and borderline personality. Rosse, Miller and Deutch (1993) documented that cocaine abusers with violent behavior performed significantly better on the Wisconsin Card Sorting Test than low violence antisocial participants.

Some researchers have proposed that substance abusers can be reliably divided into subtypes based on different characteristics, such as premorbid risk factors and personality disorders (*e.g.*, Babor *et al.*, 1992; Ball, Carroll, Babor and Rounsaville, 1995; Feingold, Ball, Kranzler and Rounsaville, 1996). The first subtype (Type A or 1) has a later onset, fewer early risk factors, and is less frequently associated with psychopathology. The second subtype (Type B or 2) is associated with childhood behavioral problems, is usually more severe than the

first subtype, and frequently is associated with personality disorders, particularly antisocial personality. For example, Ball, Kranzler, Tennen, Poling and Rounsaville (1998) distinguished two types of personalities, Type A and Type B, in a sample of 370 alcohol, cocaine, and opiate abusers. Type A substance abusers were diagnosed with personality disorders in 47% of the cases. Type A abusers scored higher on agreeableness, consciousness, cooperativeness, and self-directedness. Type B substance abusers were diagnosed with personality disorders in 70% of the cases. Type B was associated with antisocial, borderline, paranoid and avoidant personality disorders.

Depression has been frequently mentioned as a predisposing factor for drug-abuse (*e.g.*, Bobo, McIlvain and Leed-Kelly, 1998; Brown *et al.*, 1998; Carpenter and Hittner, 1997; Kush and Sower, 1997; Rosselli and Ardila, 1996). Ardila and Bateman (1995) developed a questionnaire designed to assess the prevalence of psychoactive substance use and its relation with (a) central nervous system risk factors, (b) associated disorders (allergies, migraine-type headaches, developmental dyslexia history, smoking, suicide attempt, and sleep disorders), and (c) cognitive-type symptoms. A sample of 1,879 university students was taken. 3.4% of the sample self-reported use of a psychoactive substance. Results indicated that the incidence of risk factors such as minor brain injury or dysfunction, smoking, suicide attempt, and headache was higher among self-reported psychoactive substance users. Cognitive-type symptoms, except suicide ideation, did not differ between drug-users and nonusers. These results suggested a significant association between psychoactive substance use and depressive symptoms.

The psychopathological effects of cocaine are relatively well known (Gawin and Ellinwood, 1988; Gawin and Kleber, 1986; Hartman, 1988; Manschreck *et al.*, 1988; Miller, Gold and Milman, 1989; Washton and Gold, 1984; Washton and Tatarsky, 1984). However, the cognitive consequences of chronic cocaine abuse are less clearly defined. Washton and Gold (1984) reported that 57% of the cocaine abusers experienced chronic memory problems. Research by Manschreck *et al.* (1990) documented persistent short-term disturbances in cocaine abusers. Press (1983) found a non significant difference in performance scores of a normal sample compared to cocaine abusers on the Luria-Nebraska Neuropsychological Battery; verbal memory subtests were the most

decreased. Mittenberg and Motta (1993) documented memory and learning difficulties in cocaine abusers. Low scores in the range of impairment on the Trial Making Test, Parts A and B have been reported in freebase cocaine users (Adamse, 1987). Similar findings have been reported by other investigators (*e.g.*, Beatty, Katzung, Moreland and Nixon, 1995; Berry, 1993; O'Malley, Adamse, Heaton and Gawin, 1992; Rodriguez, 1993; Strickland, Mena, Villanueva-Meyer, Cummings, Mehringer, Satz and Myers, 1993).

Ardila, Rosselli and Strumwasser (1991) administered a neuropsychological assessment test battery to 37 chronic freebase cocaine ("crack") abusers. In general, performance in cocaine-abusers was lower than expected based on their age and educational level. Significant impairment in short-term memory and attention was observed. Neuropsychological test scores were correlated with lifetime cocaine use, supporting an association between cocaine abuse and cognitive impairment.

In a more recent study, Rosselli and Ardila (1996) selected 183 participants and categorized them as: (1) cocaine-dependent; (2) polydrug-dependent; or (3) normal. All subjects were evaluated using a basic neuropsychological assessment battery. The substance dependent groups exhibited significantly lower scores on short-term memory, attention, and concept formation tests. Performance on some subtests correlated negatively with the length of dependency and frequency of substance use. Compared to the control group, the drug-dependent groups exhibited significant differences in the following personal and family areas: (a) depression and anxiety traits; (b) self-aggression and lack of fear in childhood; (c) family history of substance dependency; and (d) difficulties with interpersonal relationships.

Bernal, Ardila and Bateman (1994) administered a basic neuropsychological test battery to 64 adolescents who were divided into two groups: drug abusers and non-drug abusers. The abused psychoactive substances included marijuana, "basuco", inhalants (solvent inhalation and gasoline sniffing), and alcohol. In general, performance was mildly, but nonsignificantly, lower in the drug abuser than in the nonabuser group. Only some neuropsychological test scores correlated with the length of use and the amount of psychoactive drug use.

In summary, chronic cocaine users demonstrate deficits in tests of memory, attention, and concept formation. Additionally, there is

evidence of an association between antisocial personality disorder and substance abuse. Several studies have shown that depression is the most common dual diagnosis of chronic cocaine users. Few studies, however, have explored the association between personality traits and neuropsychological test performance among chronic cocaine users.

The aims of the present study were to (1) pinpoint the specific neuropsychological characteristics of chronic cocaine abusers, (2) analyze their personality profiles, and (3) explore the association between personality traits and neuropsychological test performance. Antisocial personality traits were expected in most cocaine participants. We hypothesized that cocaine users, with severe antisocial traits would perform worse on neuropsychological tests.

METHOD

Participants

A sample of 42 crack and/or cocaine dependent subjects was selected from the patients at a state rehabilitation facility. Participants were native English speakers, of whom 28 were men and 14 were women. The sample included 21 Anglo–Americans, 12 African–Americans, and 9 Hispanic–Americans. The following inclusion criteria were used: (1) fulfillment of DSM-IV (1994) criteria for cocaine substance dependence; (2) absence of significant neurological or psychiatric antecedents such as brain injury, cerebrovascular disease, epilepsy, and psychiatric hospitalizations (different from substance dependence); (3) cocaine dependence criteria for more than two years; and (4) abstinence for at least two months. The primary addiction of all subjects was to crack or cocaine.

Participants reporting a concurrent alcohol dependence were excluded from the sample. However, use of marijuana and alcohol was reported in most subjects' past addiction history. (2) Subjects with a history of nondrug related arrests were also removed from the analyzed sample. (3) Subjects were also removed from the study if they presented elevated scores in the validity scales of the Personality Assessment Inventory (PAI). Scores higher than 64T in the Inconsistency scale (ICN), above 68T in the Infrequency (INF) scale, higher

than 73T in the Negative Impression (NIM) scale and above 68T in the Positive Impression (PIM) where considered elevated scores. To assess handedness, an adaptation of the Waterloo Handedness Questionnaire (Bryden, 1977) was used. The participants were asked to answer which hand they used for: (1) writing (2) throwing a ball (3) holding a toothbrush (4) striking a match (5) twisting off the lid of a jar and (6) hammering a nail. Thirty-four of the subjects were right-handed and 8 were left-handed or ambidextrous. Table I presents the sample characteristics.

Subjects lived under permanent supervision in the rehabilitation facility at the time of the evaluation. Although toxicology tests were not performed, illegal substances were not available to them.

A control group was also recruited through student advertisement. Inclusion required potential subjects to have no history of alcohol or drug abuse and never to have been diagnosed with any psychiatric or neurological disorder. Eleven females and six males met the inclusion criteria and agreed to participate in the study. There was one

TABLE I Sample characteristics

<i>Variable</i>	<i>Cocaine</i> (<i>N</i> = 42)	<i>Control</i> (<i>N</i> = 17)	<i>Statistic*</i>	<i>p</i>
Age	34.15 ± 6.73	34.53 ± 9.01	0.03	.854
Years of education	11.44 ± 2.01	12.29 ± 1.31	2.55	.115
Marital status				
Single	42%	35%		
Divorced/Separated married	35%	35%	3.33	.641
Married	23.0%	30%		
No jobs last year	23%	20%	2.92	.230
Ever been a cigarette smoker	90%	47.1%	7.74	.005
Age began smoking	14.76 ± 3.80	15.70 ± 3.92	.119	.683
Age first tried alcohol	15.30 ± 3.23	14.30 ± 3.34	.923	.342
Age began using crack	23.56 ± 8.08	NA		
Age began using cocaine	18.09 ± 8.37	NA		
Legal history				
How many times during your life have you been arrested?	8.344 ± 8.95	0.23 ± 0.56	13.75	.001
How many of these arrests were about drugs?	8.344 ± 8.95	0.0	16.66	.001
How many times arrested before age 18?	1.40 ± 2.26	0.02 ± 0.24	3.83	.056

*F test or Chi-square.

left-handed individual in the control sample. There were 10 Anglo–Americans (58%), four African–Americans (24%), and three Hispanics (18%). The substance abuse and control groups did not differ significantly in age or education. There were proportionally more females in the control group.

None of the participants were paid for their participation. All participants were south Florida urban residents.

Instruments

The following information was collected for each subject:

1. Clinical Intake adapted from Horton (1996). The following sections were included: (a) sociodemographic background, (b) family background, (c) criminal history, and (d) drug history.
2. Personality Assessment Inventory (PAI) (Morey, 1991). The following clinical scales were analyzed: Somatic complaints (SOM), Anxiety (ANX), Anxiety-Related Disorder (ARD), Depression (DEP), Mania (MAN), Paranoia (PAR), Schizophrenia (SCZ), Borderline Features (BOR) Antisocial Features (ANT), and Drug Problems (DRG). The inventory also included the following treatment consideration scales: Aggression (AGG), Suicidal Ideation (SUI), and Stress (STR).
3. Neuropsychological test battery. The following tests were included:
 - (a) The Arithmetic and Digits subtests from the Wechsler Adult Intelligence Scale Revised (WAIS-R) (Wechsler, 1981).
 - (b) California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan and Ober, 1987).
 - (c) Trail Making Test (TMT) (Forms A and B) (Reitan and Wolfson, 1985). Time was scored in seconds.
 - (d) Verbal Fluency: Semantic (animals) and phonologic (F, A, and S): Subjects provided as many words as possible using categories of animals and words beginning with the letter F (or A or S) in 1 minute. The average number of elements for the semantic and the phonologic conditions was scored (Spreen and Strauss, 1998).
 - (e) Rey-Osterrieth Complex Figure (ROCF) (Osterrieth, 1944) (copy and delayed recall). Maximum score was 36.

- (f) Wisconsin Card Sorting Test (WCST) (Heaton, 1981). Correct responses, errors, perseverative responses, and number of categories were independently scored.
- (g) Benton Visual Retention Test (BVRT) (Sivan, 1992).
- (h) Stroop Neurological Screening Test (SNST) (Trenerry, Crosson, DeBoe and Leber, 1989). The score was the number of correct responses minus any incorrect responses.
- (i) Hooper Visual Organization Test (HVOT) (Hooper, 1958).

Procedure

All cocaine-dependent participants initially were interviewed to determine eligibility. Drug use histories were gathered independently from each participant for this study, and not simply taken from the medical records of the rehabilitation facility. Clinical records were reviewed to confirm inclusion criteria. After obtaining a signed informed consent, the directed interview and testing were presented by a trained psychology research assistant. A professor supervised research assistants during the interview. Testing was carried out over two sessions of approximately 90 minutes each. Participants with invalid PAI scores were excluded from further analysis.

Statistical Analyses

The following statistical procedures were used: (1) Percentages of responses to the different items in the Intake Form were compared using chi-squares. (2) MANOVA was used to compare the cocaine and control groups' performances in the different neuropsychological tests and in the different scales of the PAI. After the overall MANOVA was calculated, univariate MANOVAs were obtained for each test. (3) Multiple regression analyses were carried using BOR, ANT, STR and DRG scales from the PAI as independent variables, and the neuropsychological test scores as the dependent variables.

RESULTS

Family characteristics are presented in Table II. It is observed that in about 50% of the cases, parents were divorced or separated. Parental

TABLE II Family history

<i>Variable</i>	<i>Cocaine</i> (<i>n</i> = 42)	<i>Control</i> (<i>n</i> = 17)	<i>Chi square</i>	<i>p</i>
Family background				
Parents divorced/separated	51%	41%	0.48	0.485
Father				
Worked regularly on a job	90%	94%	0.45	0.334
Supported your family with money	81%	94%	4.18	0.381
Spent enough time with you	24%	23%	0.03	0.963
Really loved you	64%	76%	3.49	0.479
Hit you too hard	27%	6%	4.72	0.099
Was a very good parent	37%	53%	4.79	0.309
Drunk alcohol	36%	35%	1.75	0.416
Used other drugs	20%	6%	2.93	0.568
Warned you about drugs or alcohol problems	33%	41%	4.49	0.344
Did things against the law	24%	0%	5.09	0.278
Spent time in jail	6%	0%	5.75	0.569
Mother				
Worked regularly on a job	65%	47%	2.95	0.565
Supported your family with money	73%	53%	10.14	0.038
Spent enough time with you	80%	71%	5.65	0.226
Really loved you	91%	82%	6.82	0.146
Hit you too hard	11%	6%	3.15	0.533
Was a very good parent	87%	82%	3.69	0.448
Drunk alcohol	16%	17%	0.92	0.922
Used other drugs	9%	0%	4.17	0.383
Warned you about drugs or alcohol problems	56%	47%	0.79	0.940
Did things against the law	7%	0%	2.13	0.344
Spent time in jail	0%	0%	-	-

Note: Percentages refer to participants answering "almost always" to the corresponding question in clinical intake adapted from Horton (1996). Chi squares compared the response frequencies of the two groups on each question on a scale from "never," "rarely," "sometimes," "often," and "almost always."

addictions, especially to alcohol, were frequently mentioned, particularly on the fathers' side. However, there were not significant differences in terms of the parents' characteristics between the cocaine and the control group. In the cocaine group the mothers provided more economical support than the mothers of the control group. In addition, a significant percentage of the cocaine users had legal antecedents related to the drug use.

Table III presents the analyses of the scores in the neuropsychological testing using MANOVA. The overall multivariate test-Hotelling's T was found statistically significant ($F = 2.13$; $p < .020$).

TABLE III Mean scores and *F*-values (MANOVAs) in neuropsychological tests

	<i>Cocaine group</i>		<i>Control group</i>		<i>F</i>	<i>p</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
WAIS-R: Arithmetic	7.43	2.58	10.31	2.06	16.92	0.001
Digits	8.47	2.35	11.38	3.34	13.52	0.001
CVLT: List A trial 1	5.92	1.91	7.06	2.17	3.73	0.058
List A trial 5	11.15	2.83	12.87	2.30	4.85	0.032
Long delay free recall	9.37	3.29	11.25	3.47	11.36	0.001
TMT: Form A: Time	34.22	13.76	29.38	8.04	1.73	0.193
Form B: Time	92.35	42.73	59.88	15.58	10.28	0.002
Verbal Fluency: Semantic (animals)	17.58	4.28	17.38	5.16	0.002	0.882
Phonologic (F, A, S)	34.68	10.86	38.50	11.26	1.38	0.244
ROCF: Copy	31.52	5.22	34.75	1.80	5.75	0.020
Delayed recall	14.88	6.35	17.06	6.99	1.26	0.266
WCST: Errors (T-score)	42.20	12.83	52.37	10.76	7.82	0.007
Perseverative responses (T-score)	47.00	17.92	53.81	12.28	1.93	0.170
Number of categories	4.22	1.82	5.38	1.36	5.20	0.026
BVRT: Correct score	4.72	1.47	6.50	1.55	16.49	0.001
SNST: Color-word score	94.65	19.23	105.31	13.43	4.09	0.048
HVOT: T-scores	54.15	7.32	51.06	8.50	1.85	0.179

On most cognitive tests, control subjects outperformed experimental subjects. Statistically significant differences were observed in the following tests: WAIS-R Arithmetic and Digit subtests; CVLT-Ls A Trial A and Long delay free recall; TMT Form B: Time; ROCF Copy; WCST Errors and Number of categories; and BVRT Total Correct Score and SNST Color word score.

Table IV presents the mean T scores and differences in the PAI profiles in both groups. The overall multivariate test-Hotelling's T was found statistically significant ($F=8.910$; $p < .0001$). Statistically significant differences between groups are noted in all but the SUI scale. The greatest discrepancy between the experimental group and normal subjects were found in the DRG, ANT BOR and STR scales.

Each personality profile was individually analyzed. Eighty eight percent (37) of the drug-dependent subjects obtained an abnormal score (70T or above) in at least one PAI scale. Fifty seven percent (24 subjects) scored in the abnormal range of the ANT scale and 23% (10 participants) on the DEP scale. The most frequent abnormal scales are on DRG (95%), ANT (57%), BOR (50%), STR (45%), and MAN (45%). The least frequent one is the SUI (7%). Seventy two percent presented an abnormal score on the BOR and/or ANT scales.

TABLE IV Mean scores and *F*-values (MANOVA) in the PAI profiles

	<i>Cocaine group</i>		<i>Control group</i>		<i>F</i>	<i>p</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>		
Somatic complaints (SOM)	58.00	12.34	46.65	4.49	13.52	0.001
Anxiety (ANX)	62.20	10.81	49.47	7.25	19.56	0.001
Anxiety-related Disorder (ARD)	66.95	15.01	49.71	8.53	19.67	0.001
Depression (DEP)	61.29	10.30	47.00	8.07	26.01	0.001
Mania (MAN)	66.41	12.40	51.24	11.22	19.00	0.001
Paranoia (PAR)	64.10	9.22	49.41	7.43	33.88	0.001
Schizophrenia (SCZ)	63.83	13.56	46.65	9.31	22.74	0.001
Borderline Features (BOR)	70.83	11.05	51.65	12.21	34.06	0.001
Antisocial Features (ANT)	71.76	12.33	53.71	13.60	24.25	0.001
Drug Problems (DRG)	89.22	12.25	53.82	13.91	92.69	0.001
Aggression (AGG)	62.61	14.35	51.29	12.60	6.64	0.013
Suicidal Ideation (SUI)	54.78	12.82	50.00	8.90	1.96	0.167
Stress (STR)	68.93	10.57	51.00	7.11	40.97	0.001

Consequently, the personality profile of the drug-dependent subjects found *via* the PAI points to a Borderline/Antisocial personality, frequently associated with Mania features. Nonetheless, in some 10% of the drug-abusers, a normal personality profile was observed.

Multiple regression analyses were conducted, with all participants, using neuropsychological test scores as dependent variables and the PAI scores as independent variables (Tab. V). Only abnormally high scales (BOR, ANT, STR and DRG) were included in this analysis. Few correlations were statistically significant. For most of the neuropsychological tests, PAI scores did not predict neuropsychological performance. In some cases only one PAI scale entered into the regression model. The DRG scale predicted the score on the WAIS-R Arithmetic subtest, CVLT Trial 1, SNST Color-Word task, and BVRT Total correct score. The ANT scale also predicted the SNST Color-Word task score. BOR, and STR scales did not predict any neuropsychological test scores.

TABLE V Multiple regression analyses

	<i>R</i>	<i>R-square variables</i>	<i>Included</i>	<i>Beta</i>	<i>t</i>	<i>p</i>
WAIS-R: Arithmetic	0.413	0.170	DRG	0.557	2.50	0.015
CVLT: Trial 1	0.449	0.201	DRG	0.617	2.82	0.007
SNST: Color-word task	0.443	0.205	DRG	0.660	3.03	0.004
			ANT	0.470	2.21	0.031
BVRT: Correct score	0.448	0.200	DRG	0.510	2.47	0.017

Note: Independent variables were BOR, ANT, STR and DRG scales from the PAI.

DISCUSSION

The present study supports an association between antisocial/borderline personality and cocaine-abuse (*e.g.*, Babor *et al.*, 1992; Ball, Carroll, Babor and Rounsaville, 1995; Barber *et al.*, 1996; Feingold, Ball, Kranzler and Rounsaville, 1996). We also confirmed that in a significant percentage of cocaine-abusers, no evident psychopathological personality profile is found. We failed, however, to confirm an association between depression and cocaine-abuse, even though self-reported depression was found in one fifth of cocaine-abusers. Nonetheless, the opposite affective disorder (mania) was significantly higher in about 50% of the cocaine-dependent population.

The most abnormal personality scales in the cocaine group were DRG, BOR, ANT, and STR. Scores that are markedly elevated are typically associated with drug abuse and drug dependence (Morey, 1991). All cocaine subjects in our sample met the criteria for cocaine dependence; therefore the elevation on this scale was expected. High scores on the BOR scale, on the other hand, are found in people who are likely to be impulsive and emotionally labile, feel misunderstood by others, and find difficulty in maintaining close relationships. These people tend to be angry and suspicious while at the same time being anxious and needy, making them quite ambivalent about interactions with others. Individuals with over two standard deviations on the ANT scale are likely to be impulsive and hostile, and there may be a history of antisocial acts. Others may see such individuals as exploitative in their relationships and as not having long-lasting friendships. The STR scores provide an assessment of life stressors that the respondent is currently experiencing or has recently experienced.

In interpreting current results, several factors should be taken into consideration: (1) rehabilitation facilities in which cocaine-dependent research samples are selected may vary in the type of population they treat. The socioeconomic status and the educational level, for instance, can be different among drug-treatment facilities. Therefore, confounding variables may exist in sample selection. Certain differences in the frequency of some psychopathological disorders, for example, are expected. Consequently, the personality profile is not expected to be totally consistent across different studies using different populations.

(2) Cultural differences may exist in the perception of drug-use behavior. In the United States, for example, drug use is perceived as delinquent behavior. In other countries, such as Holland, the social perception of drug-use is different, and cocaine-use may attract a different type of population. In Colombia, for instance, a very strong association between drug-abuse and depression has been reported, but a significant association with conduct problems and antisocial personality traits has not been noted (Rosselli and Ardila, 1996). Noteworthy, Colombians believe that depressed people tend to use alcohol and other drugs. Therefore, it is not coincidental that depressed people are over-represented in Colombian drug-abuser populations. The perception and acceptance of drug-use may also vary in different subcultural environments. For instance, middle-class Midwesterners do not necessarily perceive and interpret drug-use in the very same way as dwellers of a poor New York neighborhood. In brief, cultural and subcultural differences may exist with regard how drug-use is perceived, and hence, what particular type of population find drug use attractive. (3) Mania was abnormally increased in over 50% of our participants. Mania may be associated with a history of depression. Covert depression might represent a contributing factor to drug-abuse. And (4) an evident psychopathological disorder is not always observed in cocaine-abusers. Certain personality traits may predispose subjects to the use of drugs, but some additional factors, such as environmental conditions, have to be taken into consideration. For some drug abusers, family conditions may be the most significant.

The results from this research support the presence of mild cognitive deficits associated with chronic cocaine abuse. Decreased scores were observed in virtually all neuropsychological tests, although usually only between the mean expected score and the two standard deviation range. Abnormal scores were observed in the WAIS-R Arithmetic and Digits subtests, CVLT, ROCF-copy condition, WCST-Errors, and the BVRT. In several tests, scores were in the "low average" and "borderline" range. In general, the pattern we found is consistent with the neuropsychological profile usually found in chronic psychoactive substance users (Adams *et al.*, 1975; Carlin, 1986; Carlin and Trupin, 1977; Carlin *et al.*, 1978; Hartman, 1988; Mittenberg and Motta, 1993; Rosselli and Ardila, 1996; Strickland *et al.*, 1993; Washton and Gold, 1984). Although the possibility exists that cocaine abuse might stem

from pre-existing cognitive deficits, evidence that the amount and duration of cocaine use correlates negatively with test scores supports the contribution of this substance to cognitive deficits (Rosselli and Ardila, 1996).

Persisting neuropsychological deficits in nonverbal abstraction, motor-perceptual integration, and memory have been described in substance-dependent patients even after several drug-free months (Grant and Judd, 1976; Grant, Adams, Carlin and Rennik, 1977; Grant, Mohns, Miller and Reitan, 1976; Mittenberg and Motta, 1993; Murray, Greene and Adams, 1971). The persistence and severity of these cognitive impairment abnormalities have been correlated with the amount of drug used (Cummings and Benson, 1992). It has been further proposed that chronic polydrug abuse can produce a chronic dementia that may not reverse with abstinence (Grant and Judd, 1976). In our sample, most scores were less than two standard deviations below the expected means. Our subjects, however, were relatively young in age. It can be conjectured that neuropsychological deficits could progress with aging if drug abuse is continued, eventually resulting in major cognitive defects. Age seems to be an important variable when the effects of psychoactive substances in the brain are considered (Bernal, Ardila and Bateman, 1994). Dementia, for example is more common among elderly alcoholics than it is among younger individuals who have been drinking for a similar period of time (Cummings and Benson, 1992).

Neuropsychological impairments may result from changes in normal cerebral blood flow. Vasculitis, cerebral hemorrhages, and ischemic strokes have been reported to be associated with cocaine use (Engstrand, Daras and Tuchman, 1989; Kaku and Lowenstein, 1989; Kaye and Fainstat, 1987; Mathew and Wilson, 1991; Moore and Paterson, 1989; Strickland *et al.*, 1998). Strickland *et al.* (1993) demonstrated significant cerebral hypoperfusion in the frontal, periventricular, and/or temporal-parietal areas in long-term cocaine abusers. Deficits usually observed in memory (verbal and non verbal) and abstraction may eventually result from frontal and temporal lobe dysfunction associated with chronic abuse. It has been further pointed out that cocaine may cause damage to cell membranes, even in the absence of evident tissue infarction (MacKay, Meyerhoff, Dillon, Weiner and Fein, 1993).

Few attempts have been made to correlate personality traits with neuropsychological test performance (e.g., Reitan and Wolfson, 1997). No significant association between personality profile and neuropsychological test performance has been observed to date. We failed to demonstrate any robust relationship between personality profile and neuropsychological test performance. Neuropsychological test scores in participants with mostly abnormal personality profiles were similar to the scores observed in participants with a normal personality profile. Our results suggest that neuropsychological test performance is independent from personality traits.

Important limitations of our study are the small sample size and the possibility that cognitive differences between the cocaine and the control group may be related to premorbid differences in cognitive ability rather than cocaine use. Without question, more research in larger samples with a better matched control group is required to understand the variables predisposing people to drug abuse as well as the effects of different drugs on cognitive test performance.

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