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INDIVIDUAL DIFFERENCES AMONG COCAINE USERS

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Abstract — The present study examined whether individual differences in personality could differentiate two types of cocaine users. We hypothesized that self-medicators (SM) use cocaine as a way to alleviate their dysphoric moods, whereas sensation seekers (SS), in contrast, use cocaine primarily to engender positive mood states. Eighteen male cocaine users were classified based on two dimensions of the Tridimensional Personality Questionnaire. SM were defined by having high harm avoidance (>17) and low novelty-seeking scores (<18), and SS by high novelty-seeking (>18) and low harm-avoidance scores (<17). It was predicted that SM would report higher depression and anxiety than would SS, and would also exhibit a brain activity pattern similar to that found in clinical depression. The results showed that SM reported higher anxiety than SS, $F(1, 8) = 27.5$, $p < .001$, but did not differ in depression. SM exhibited decreased blood flow within the left frontal lobes, $F(1, 10) = 6.78$, $p < .05$, similar to what has been observed in major depressive disorder. These findings suggest the importance of attending to individual differences in the motivation for cocaine use so that treatment can be targeted more effectively. © 2000 Elsevier Science Ltd.

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The self-medication hypothesis postulates that drug abusers seek to self-administer substances that correct or compensate for discomfiting features of their biology and usual emotional state. Khantzian (1985), for example, theorized that most substance users choose drugs to medicate withdrawal or other negative moods. Other investigators propose that vulnerability to depression or dysthymia constitutes the primary motivation for drug use (Gawin & Kleber, 1986; Weiss, Griffin, & Mirin, 1992). That suggestion is consistent with evidence showing that individuals with mood disorders have a high prevalence of drug abuse (Rounsaville et al., 1991). It is plausible that the direct dopaminergic effects on the brain of stimulant drugs like cocaine could yield an antidepressant action that would make self-administration especially reinforcing to individuals who are vulnerable to depression. More difficult to explain from that perspective is why depression-prone substance abusers would self-administer a variety of drugs with different pharmacological properties, including sedative effects. Also difficult to explain from a self-medication perspective is the observation that nondepressed individuals, as well as depressed ones, adopt cocaine as their drug of choice (Weiss et al., 1992). Cocaine's strong dependence-producing potential is well recognized and attributed to its immediate and powerful euphoric effect. Nevertheless, some have still construed chronic cocaine abuse as a form of self-medication to treat depression because mood deteriorates after the initial "high," and is followed by increasing dysphoria over time (Weiss et al., 1992).

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Although it is possible that most cocaine abusers share an underlying vulnerability to dysphoric moods, it is also possible that individuals differ in their motivations for drug abuse. For example, Baker, Morse, and Sherman (1986) propose a two-affect model of drug abuse whereby some abuse drugs as a way of dispelling negative affect or withdrawal symptoms. In contrast, others abuse drugs because of positive affective urges and the desire to get high. The dual-affect motivational model is supported by research findings across a variety of addictive drugs. Brandon, Tiffany, and Baker (1986) found evidence that some smokers use nicotine to medicate negative emotions, whereas others use nicotine to enhance positive affect. Shiffman (1982) reported that either positive or negative situations stimulate relapse to smoking. Both Marlatt and Gordon (1980) and Pomerleau, Fertig, Baker, and Cooney (1983) observed the same kind of positive and negative triggers among alcoholics who relapse to drinking.

Just as dysphoria-prone individuals should be most prone to self-administer drugs to dispel negative mood, a different kind of person should be most prone to self-administer drugs to induce a positive affective state. One suggestion is that the latter subgroup of users are sensation seekers who exhibit psychopathic personality traits as well as enhanced appetitive motivation (Arnett, Smith, & Newman, 1997). They use drugs to enhance their positive feelings and overall excitement level (Cloninger, 1987; Nixon & Parsons, 1990; Smith & Newman, 1990). Sensation seekers are motivated to get high and heighten a positive mental state at least partly because they find it difficult to enjoy most activities without being high. Cocaine's ability to increase arousal levels may be appealing to thrill seekers because of their tendency to be underaroused (Chesno & Kilman, 1975; Kuhar, Ritz, & Boja, 1991; Patrick, 1994; Raine, 1989; Schmauk, 1970).

The purpose of this study was to determine whether cocaine abusers could be meaningfully categorized using the two-affect model of drug abuse. We predicted that cocaine users could be divided into two distinct subgroups. One group of harm-avoidant individuals would be motivated to use cocaine to dispel negative affect, whereas the other group of sociopathic users would be motivated to use cocaine to seek positive affect. Initial observations of these patients were previously reported (Konopka et al., 1995).

CLASSIFYING PERSONALITY TYPES

The two personality types were operationalized using Cloninger's Tridimensional Personality Questionnaire (TPQ); Cloninger, Przybeck, & Svrakic, 1991). According to Cloninger, individuals who score high on harm avoidance have a propensity to be worried, brooding, fatigued, and easily upset (Cloninger, Svrakic, & Przybeck, 1993), which he attributes to low serotonergic tone (Cloninger, 1987). The description of individuals who score high on the harm-avoidance subscale corresponds to the clinical presentation of individuals with depressive symptoms. In fact, several research studies have documented a strong, positive association between Cloninger's harm avoidance subscale and level of depression as measured by the Minnesota Multiphasic Personality Inventory (MMPI; Wetzel et al., 1992), and Multidimensional Personality Questionnaire (Waller, Lilienfeld, Tellegen, & Lykken, 1991), as well as by severity of clinical depression (Strakowski, Faedda, Tohen, Goodwin, & Stoll, 1992). We predicted that cocaine users with high harm-avoidance scores would be depression-prone self-medicators who use cocaine to rid themselves of negative moods. Support for that hypothesis would be given by finding that self-medicators exceeded sensation seekers in behavioral and brain indicators of negative emotions.

Sociopathy and sensation seeking are reflected in Cloninger's subscale: novelty seeking, which is theorized to reflect dopaminergic deficiency. Individuals who score high on novelty-seeking are characterized by impulsive behavior, quick temper, excessive effort toward reinforcement seeking, and a general irresponsibility. A number of different studies have shown that individuals with high sensation-seeking tendencies exhibit many of the same behaviors as psychopaths (McCourt, Gurrera, Henry, & Cutter, 1993; Nagoshi, Walter, Muntaner, & Haertzen, 1992). Because sensation-seeking individuals tend to be under aroused (Patrick, 1994), we postulate that their drug use is motivated by cocaine's ability to increase arousal.

The first hypothesis was that self-medicators would exhibit strong negative mood, as evidenced by self-reports of feeling sad, "down," or anxious on the Beck Depression Inventory and the State-Trait Anxiety Inventory. The second hypothesis was that self-medicators would have a brain image profile that resembles the pattern observed in clinically depressed individuals. Studies using single photon emission computed tomography (SPECT) and positron emission tomography (PET) methods to quantify brain activity in depressed people have documented a distinctive brain pattern (Baxter et al., 1989; Bench et al., 1992; George, Ketter, & Post, 1993; Ketter et al., 1994; Mayberg, Lewis, Regenold, & Wagner, 1994). These studies show that increasing levels of depression are associated with less activity in the cortex, specifically in the left frontal areas, and paralymbic regions. SPECT studies show a generalized hypoperfusion throughout the cerebral cortex in depressed individuals, in addition to pronounced hypoperfusion in the left frontal lobe (George et al., 1993). Similar findings have also been reported in a study examining global and regional brain blood flow in chronic substance abusers with comorbid affective disorders (Semple et al., 1996). If self-medicators are using cocaine to manage their depression, then they should score high on tests of dysphoria and have a SPECT image consistent with the pattern of hypoperfusion shown by depressed individuals.

In contrast, sensation seekers were expected to score significantly lower on tests that assess dysphoria or anxiety. Although chronic cocaine abuse can independently lead to hypoperfusion in frontal and parietal-temporal regions (Cadet & Bolla, 1996; Strickland et al., 1993), the few studies examining brain image characteristics in sensation seekers show no evidence of the left frontal hypoperfusion (Hart, Forth, & Hare, 1990) that we expected to characterize the self-medicators. Therefore, although we expected that as a result of chronic cocaine abuse all subjects would show some degree of hypoperfusion in the frontal regions, we expected that sensation seekers would show markedly less hypoperfusion in these regions than self-medicators.

METHOD

Subjects

Subjects were 18 male veterans receiving inpatient services for their substance abuse from the Hines Veterans Administration (VA) Medical Center. All subjects were cocaine abusers as diagnosed by a structured clinical interview conducted by the attending psychiatrist. Subjects were precluded from the study if they were medically unstable, if they had a diagnosis of schizophrenia or dementia, or if they had experienced a significant head injury that prevented them from comprehending the focus of the research. Subjects ranged in age from 24 to 67 ($M = 41.68$; $SD = 8.68$). Eleven were African American and seven were Caucasian. All gave written consent to participate in the research study.

Measures

Personality styles. Cloninger's Tridimensional Personality Questionnaire (TPQ) (Cloninger et al., 1991) was used to classify self-medicators and sensation seekers. The TPQ consists of 100 items that subjects endorse as either true or false descriptions of themselves. Scores are calculated for each of three primary scales: novelty seeking, harm avoidance, and reward dependence. Only the harm-avoidance and novelty-seeking subscales were used in this study.

Mood. Two self-report measures of negative affectivity were obtained from each subject. The Beck Depression Inventory (BDI) is a psychometrically sound self-report measure of depression that consists of 21 statements describing specific symptoms of depression (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Subjects are asked to rate the degree to which each item describes their current state. Total scores range from 0 to 63.

The State-Trait Anxiety Inventory-Trait Scale (STAI-T) is a 20-item questionnaire that measures usual anxiety level (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Subjects are asked to read each item and to rate it on a 1- to 4-point scale to indicate whether it is typical and characteristic of the individual (1 = almost never; 2 = sometimes; 3 = often; 4 = almost always descriptive of them). Scores range from 20 to 80 with higher scores indicating a greater level of trait anxiety.

Brain activity. Single Photon Emission Computed Tomography (SPECT) utilizing 99mTc-HMPAO was used to determine whether differences in personality styles corresponded to detectable differences in brain activity. SPECT is a measure of cerebral blood flow (CBF) that has been utilized extensively (Hart et al., 1990; Ketter et al., 1994; Konopka et al., 1995). Using a rotating gamma camera system equipped with three ultra high resolution fan beam collimators (Trionix system), approximately 60 transverse images of the brain were taken for each individual. Following reconstruction with a Hanning filter, tomographic slices were scaled for intensity so that every study contained the same number of counts in the brain. Voxel-by-voxel comparison between individual subject and a composite normal reference study (Barber, 1992) was performed by subtracting the two studies, generating a difference image. From the difference image, *t*-value image was generated by dividing the difference count value by a pooled value of the standard deviation for the counts at the voxel. Voxels indicating hyperperfusion and hypoperfusion were identified. The spatial resolution of the camera is 200 voxels; thus only voxels greater than 200 were used for comparison. Applying a standardized template superimposed on the brain we identified specific brain regions. The image in total, as well as specific regions, were considered significant if there was either an increase or decrease in perfusion activity that was two or more standard deviations from that of the normal reference image. These deviations were reflected in the number of voxels seen in any area of the brain. The greater the number of voxels in any region, the greater the effect.

To quantify differences between self-medicators and sensation seekers in either the total cerebral cortex or in the frontal lobes, the voxel data were analyzed by summing together the blood flow volume observed within the areas that showed decreased perfusion. Self-medicators were expected to show reduced perfusion as compared to sensation seekers in the total cortex, and specifically, in the left frontal lobes.

Classification

Self-medicators and sensation seekers were classified using a more stringent and a less stringent classification procedure. The stringent method of classification involved

using both the harm-avoidance and novelty-seeking subscale scores to classify both groups, and requiring that subjects score *high* on one scale as well as *low* on the other scale. As such, self-medicators were individuals who scored above the median on the harm-avoidance scale ($Mdn = 17$), and below the median on the novelty-seeking scale ($Mdn = 18$). In contrast, sensation seekers were individuals who scored below the median on the harm-avoidance scale ($Mdn = 17$) and above the median on the novelty-seeking scale ($Mdn = 18$). This classification method resulted in six self-medicators and five sensation seekers.

In an attempt to increase the sample size, as well as test whether harm avoidance on the one hand and novelty seeking on the other, were independently responsible for mood effects on brain perfusion, a less stringent method of classification was also used. This involved using only one subscale of the TPQ to define each group. Using this method, self-medicators were individuals who scored above the median on harm avoidance, regardless of their novelty-seeking scores. Subjects who scored below the median on harm avoidance were characterized as nonself-medicators. Similarly, sensation seekers were individuals who scored above the median on the novelty-seeking subscale, regardless of their harm-avoidance scores. This second method potentially affords additional power by increasing the sample size, but at the expense of also increasing heterogeneity in each group. In addition, it allows for the appraisal of each subscale separately, and thereby provides a more in-depth evaluation of the relationship between the TPQ, mood, and rCBF. The less stringent grouping criterion resulted in 8 subjects classified as sensation seekers and 10 as nonsensation seekers. No differences were found in age, education, ethnicity, or health status between any of these groups. The groups were also similar in their severity of cocaine abuse in that they did not differ in the number of years they abused cocaine ($t = .85, p = ns$) or in their average weekly use prior to treatment ($t = .22$). Although the groups differed in age at onset of cocaine use ($t = 7.32, p < .05$), this difference was expected and is in accordance with Cloninger's (1987) theory on substance abuse, which states that more sociopathic individuals generally start abusing drugs earlier in their lives. Table 1 shows comparisons between the two groups as defined by the less stringent grouping criteria. The results were equivalent for the more stringent criteria.

Procedure

Prior to completing a 21-day inpatient substance abuse treatment program, a research technician met individually with each subject to determine his interest in partic-

Table 1. Demographic and abuse characteristics of cocaine abusing subgroups

	Self-medicators	Sensation seekers
Characteristics	*M* (*SD*)	*M* (*SD*)
Age (years)	46.2 (9.37)	40.6 (6.73)
Education (years)	11.2 (1.94)	12.1 (1.72)
Ethnicity		
African American	6	5
Caucasian	4	3
Age at onset of cocaine use*	32 (2.6)	22 (3.2)
Years of cocaine use	9.5 (6.3)	12.4 (8.1)
Days used in 1 week	3.1 (2.7)	2.8 (2.9)
Total	10	8

*$t = 7.325; p < .05$.

ipating in a neuroimaging study investigating brain activity differences between substance abusers and normal controls. All measures and procedures involved in the study were clearly described. After subjects gave informed consent to participate, they completed the TPQ and a brief medical history and were scheduled for testing. Testing occurred between 14 and 20 days after admission to the program. Urine analyses verified that subjects had been clear of any nonprescription drug use from the time of admission.

On the test day, subjects arrived at the Neurophysiology Laboratory at Hines VA Medical Center and completed the BDI and STAI-T. A trained technician then inserted an IV into the subject's right arm. Subjects were then seated in a reclining position in an isolation booth, where they acclimated for 1 hour. Following the acclimation period, subjects' eyes were covered and a radiopharmaceutical ligand, 25 mCi of 99mTc-HMPAO, was injected through the IV. Between 5 and 10 minutes after injection no further redistribution of the ligand takes place. Subjects' brains were imaged 1 to 1.5 hours following the 99mTc-HMPAO administration. After completing the scan, subjects returned to the laboratory where they were debriefed and scheduled for a follow-up appointment at which the results of the scan were discussed.

RESULTS

Mood

The first study hypothesis was that self-medicators use cocaine to dispel unwanted negative mood. Support for that hypothesis would be given by findings indicating that self-medicating cocaine users report greater feelings of depression and anxiety than do sensation-seeking cocaine users.

Using the more stringent method of classification, results from a one-way analysis of variance (ANOVA) examining BDI depression scores showed no significant differences between the groups, $F(1, 9) = .079$, $p = ns$. In fact, depression scores for self-medicators ($M = 17.5$, $SD = 6.32$) were nearly identical to those reported by sensation seekers ($M = 16.0$, $SD = 11.14$). Interestingly, however, the scores of both groups are suggestive of current depression, indicating that the two groups were experiencing moderate mood disturbance at the time of the assessment.

Anxiety scores were examined using the same ANOVA model. This analysis showed that self-medicators differed significantly from sensation seekers in their self-reported level of anxiety, $F(1, 8) = 27.50$, $p < .001$. As Figure 1 shows, self-medicators were nearly twice as anxious as sensation seekers.

The finding that self-medicators reported more anxiety than sensation seekers lends partial support to the hypothesis that a subgroup of cocaine abusers self-administer the drug in an effort to treat underlying mood disturbance. However, the finding that the two groups reported equal depressive symptomatology is contrary to the self-medication hypothesis. The findings might indicate that harm-avoidant cocaine users use the drug to dispel anxiety more than depression. Alternatively, any differential propensity toward depression that characterized the harm-avoidant users may be camouflaged by withdrawal symptoms, including dysphoric mood, that discontinuing drug use triggers in both groups.

Brain image

The second study hypothesis predicted that self-medicators, as compared to sensation seekers, would show a pattern of decreased blood perfusion in the cerebral cor-

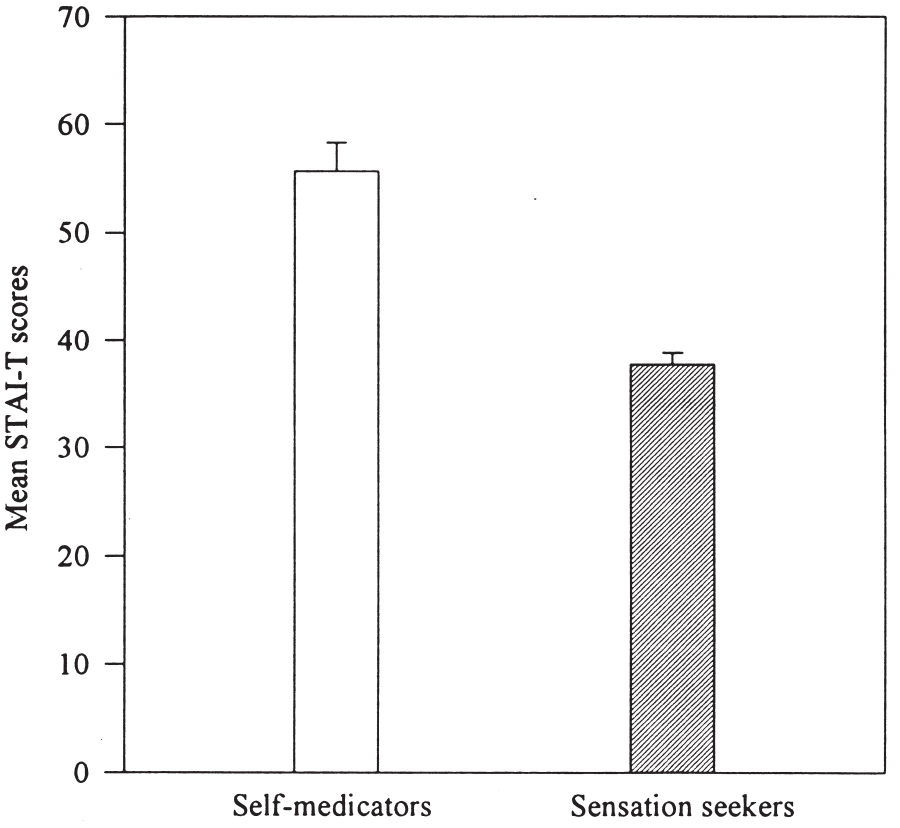

Fig. 1. Mean (and standard deviation) State-Trait Anxiety Inventory-Trait Scale (STAI-T) scores for self-medicators and sensation seekers.

tex, and specifically in the left frontal lobe. To test this prediction, group comparisons were made first for the total cortex and then for just the frontal regions. The ANOVA comparing the groups on perfusion within the total cortex failed to detect differences between them $F(1, 10) = .52, p = ns$.

Since mood is thought to be regulated extensively by the frontal regions, particularly the left frontal area, a one-way ANOVA was performed examining just that region. The results of this analysis showed that, although the magnitude of deficits seemed to be greater in self-medicators ($M = 2{,}597$, $SD = 1{,}728.54$) than sensation seekers ($M = 1{,}905$, $SD = 3{,}645.74$), the difference was not statistically significant. Since the pattern of deficits was in a direction consistent with the hypothesis, however, group comparisons were performed with each hemisphere separately. Examination of the right frontal lobe again revealed no significant difference between the self-medicators and the sensation seekers, $F(1, 10) = .5, p = ns$. Comparison with the left frontal lobe, however, revealed a significant difference between groups, $F(1, 10) = 6.78, p < .05$. As shown in Figure 2, self-medicators exhibited significantly less blood flow in the left frontal lobe than did sensation seekers.

The brain-imaging data suggest that self-medicators exhibit differences in neuroimaging pattern when compared to sensation seekers. These differences are regionally specific, and they mirror the findings from the self-report measures. Self-medicators

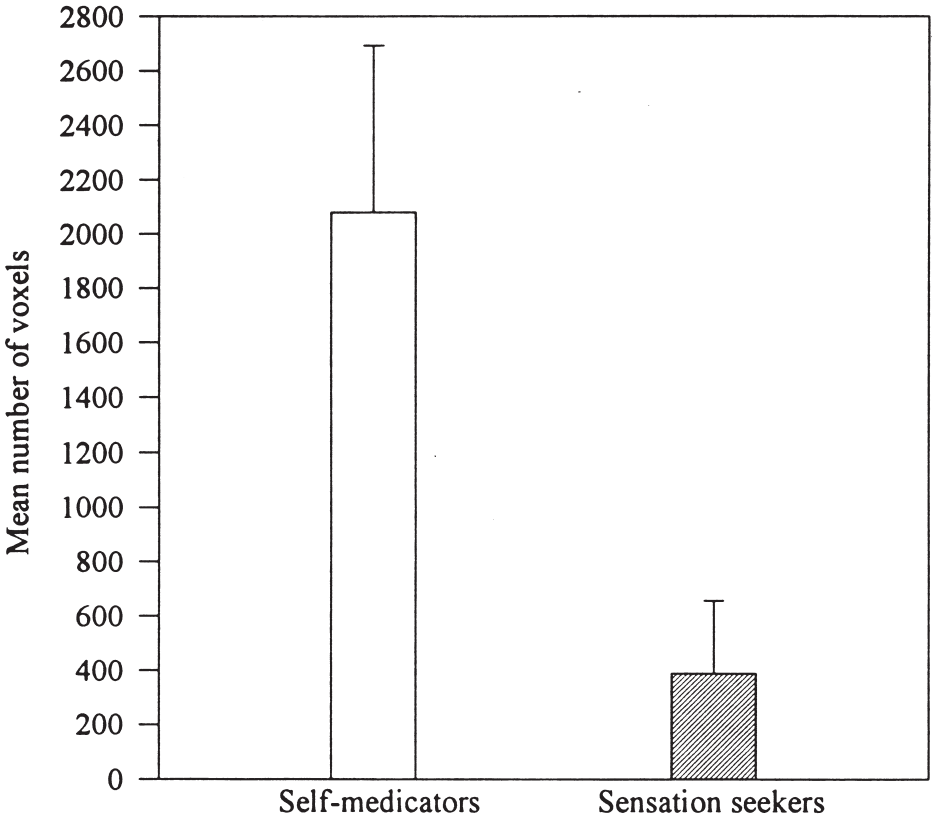

Fig. 2. Mean (and standard deviation) left frontal hypoperfusion level in self-medicators and sensation seekers. Greater number of voxels indicate greater hypoperfusion.

show a proportionally greater decrease in blood flow in the left frontal region than sensation seekers. To the extent that affect is regulated extensively by the left frontal regions (Baxter et al., 1989; Bench et al., 1992; George, Ketter, & Post, 1993; Ketter et al., 1994), it would be expected that patients who present with left frontal hypoperfusion would also self-report negative mood. Taken together, these findings provide support for the hypothesis that two subtypes of cocaine users—self-medicators and sensation seekers—can be differentiated on the basis of personality style. However, in an effort to further explore the relationship between the TPQ and the outcome measures, comparisons were also made using the less stringent classification method described earlier.

Self-medicators. Via the less stringent classification method, high scorers on the harm-avoidance subscale were considered self-medicators, and low scorers were considered nonself-medicators. Using this classification, we again tested the prediction that self-medicators would show greater negative mood than would nonself-medicators. The results paralleled those reported previously for the more stringent grouping criteria. Both self-medicators ($M = 20$, $SD = 6.61$) and nonself-medicators ($M = 15.4$, $SD = 12.28$) had BDI scores indicative of current depression and were not significantly different from each other, $F(1, 16) = .96$, $p = ns$. STAI-T scores, however,

showed the self-medicators ($M = 59.11$, $SD = 7.79$) to be significantly more anxious than the nonself-medicators ($M = 41.63$, $SD = 11.93$), $F(1, 15) = 13.12$, $p < .01$. Cortical blood flow patterns in the two groups were also the same as previously observed. There was no difference between the groups in blood flow to the total cortex, $F(1, 17) = .72$, $p = ns$. However, self-medicators showed less blood flow in the left frontal lobe than nonself-medicators, $F(1, 17) = 5.93$, $p < .05$, and no differences were observed in the right frontal lobe, $F(1, 17) = .47$, $p = ns$.

Sensation seekers. High scores on the novelty-seeking subscale classified subjects as sensation seekers. Low scorers were considered nonsensation seekers in this analysis. Using this approach, high sensation seekers were expected to report less feelings of depression and anxiety than would nonsensation seekers. They were also expected to present less evidence of brain deficits involving decreased blood perfusion activity. Using this grouping criterion, none of the comparisons proved to be significant. Both sensation seekers ($M = 19.38$, $SD = 9.9$) and non-sensation seekers ($M = 15.4$, $SD = 10.13$) showed elevated BDI scores, but there was no difference between them, $F(1, 16) = .39$, $p = ns$. Nor did sensation seekers ($M = 49.86$, $SD = 15.52$) and nonsensation seekers ($M = 51.6$, $SD = 12.10$) differ, $F(1, 17) = .07$, $p = ns$ on STAI-T scores. The brain image data showed no differences between the two groups on either total cortex, $F(1, 17) = .21$, $p = ns$ or frontal lobe activity, $F(1, 17) = .073$, $p = ns$.

DISCUSSION

Commonalities in the use of drugs like cocaine may obscure different underlying motives for drug usage (Cloninger, 1987). This study examined the proposition that two broad subtypes of cocaine users can be differentiated on the basis of personality characteristics. Using data previously obtained from a sample of male veterans receiving inpatient treatment for drug abuse, this study tested the hypothesis that some individuals use cocaine as a way to dispel unwanted negative moods, whereas others use it to increase their excitement level. Cocaine users were divided into two groups on the basis of their scores on the harm-avoidance and novelty-seeking scales of the Tridimensional Personality Questionnaire. Mood and brain activity patterns were measured with the expectation that self-medicators would self-report greater negative affectivity than would sensation seekers and that their neuroimaging pattern would resemble those of depressed individuals.

The results of this study lend some support to the primary hypotheses. Self-medicators, defined as those who scored high on harm avoidance and low on novelty seeking, reported markedly higher levels of trait anxiety than did sensation seekers, who scored high on novelty seeking and low on harm avoidance. These differences were also mirrored by SPECT imaging data showing that self-medicators had decreased blood perfusion, specifically in the left frontal lobes. Left frontal hypoperfusion has previously been observed in individuals diagnosed with major depression (Drevets et al., 1997; Ketter et al., 1994). This difference is observed in spite of some general frontal hypoperfusion observed in all subjects, which is likely due to the known effects of cocaine on rCBF (Cadet & Bolla, 1996; Strickland et al., 1993).

Although self-medicators were also expected to have higher BDI scores than sensation seekers, no difference was observed. Both groups showed moderate and similar levels of current depression. It may be that the similar depressive symptoms seen in both groups of cocaine abusers reflect personality changes associated with chronic co-

caine use or cocaine withdrawal symptoms, since subjects were tested between 2 and 4 weeks after their last cocaine use. Castaneda (1994) has documented that the withdrawal effects of cocaine include depression and prolonged anhedonia after drug use is discontinued. Since the BDI measures current depressive state as opposed to depressive traits, it is impossible to infer what levels of depression might have been like prior to withdrawal. In contrast, the STAI-T assesses typical, generalized, or trait levels of anxiety from which prewithdrawal anxiety level may be inferred.

It is noteworthy that using both the novelty-seeking and the harm-avoidance subscales to classify each group improved categorization validity over using each scale singly. Attempting to distinguish the groups with only one subscale increased within-group heterogeneity, and created comparison groups that were not readily definable. For example, low novelty seekers were necessarily defined by what they were not (i.e., sensation seekers), but it could not be assumed that they were harm-avoidant self-medicators. To afford greater diagnostic sensitivity, further research should include the use of structured clinical interviews to classify subject groups.

The clinical significance of the study is that it provides preliminary evidence of the existence of two distinct personality styles that are compatible with cocaine abuse. Treatment efficacy might be improved by matching the different types of cocaine abusers to different treatment strategies. For example, using anti-depressant pharmacotherapy together with cognitive-behavioral or interpersonal therapies that address their depressogenic behavioral style, might optimally treat self-medicating individuals who are vulnerable to depression. Serotonergic medications could be especially valuable in ameliorating the biological condition to which Cloninger (1987) attributes this personality style. In contrast, using a program of behavioral techniques aimed at enhancing frustration tolerance and identifying effective alternative rewards might treat sensation-seeking abusers more effectively. Sensation seekers might also benefit from pharmacotherapy that facilitates dopaminergic transmission, reducing the need to self-administer cocaine to compensate for their dopaminergic deficits (Cloninger, 1987). Dopaminergic agents have proved helpful in treating the poor frustration tolerance and inability to delay gratification that characterize sociopathic cocaine abusers (Leal, Ziedonis, & Kosten, 1994). Before recommending the initiation of new treatment strategies, further clinical testing is warranted to validate the existence of these two subtypes. Diagnosis based on the Structured Clinical Interview for DSM-IV or another semi-structured interview would be more informative about symptom course and comorbidity in this patient population, and would allow for categorization based on a broader range of information. Despite its limitations, use of the TPQ can be justified as a tool for preliminary investigation of individual differences among cocaine abusers.

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