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Former Heroin Addicts with or without a History of Cocaine Dependence are more Impulsive than Controls

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Abstract

Background—Personality traits such as impulsivity and sensation seeking may contribute to the initiation and maintenance of illicit drug use. Since studies have reported higher impulsivity and sensation seeking traits in cocaine dependent subjects, we were interested in determining whether former heroin addicts in methadone pharmacotherapy with comorbid cocaine addiction have greater impulsivity than those without.

Methods—Instruments to assess impulsivity (Barratt Impulsiveness Scale version 11) and sensation seeking (Sensation Seeking Scale version V) were administered to former severe heroin addicts meeting Federal criteria for methadone maintenance pharmacotherapy with ($n = 71$) or without cocaine dependence ($n = 31$) and to 145 normal healthy (non-methadone-maintained) volunteers.

Results—The methadone-maintained without cocaine dependence and the methadone-maintained with cocaine dependence groups, both scored higher than did the normal volunteer group on the Barratt Impulsiveness Scale total score ($p < 0.001$). On the Barratt Impulsiveness Scale Attentional, Nonplanning, and Motor subscales, the methadone-maintained and methadone-maintained with cocaine dependence groups scored higher than did normal volunteers with no history of drug abuse or dependence ($p < 0.001$). There was no difference among groups on total score or any subscale of the Sensation Seeking Scale. However, males in all groups overall scored higher than did females on Disinhibition and Thrill and Adventure seeking subscales of the Sensation Seeking Scale version V ($p < 0.001$).

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Contributors

Authors D.A.N., A.H., S.K., and M.J.K. designed the study. Authors D.A.N. and P.V. managed the literature searches and summaries of previous related work. Authors P.V. and A.B. assisted in data organization. Authors S.K. and L.B. oversaw the clinical data collection. Author A.H. performed the statistical analyses. Authors D.A.N. and P.V. wrote the first draft of the paper and all authors contributed to the final version. All authors contributed to and have approved the final version.

Conflict of Interest

No conflict declared.

Conclusions—This study demonstrates higher impulsivity in former severe heroin addicts meeting criteria for or currently in stable methadone maintenance pharmacotherapy, irrespective of a positive or negative history of cocaine dependence.

Keywords

impulsiveness; sensation seeking; methadone maintenance; heroin addiction; cocaine dependence; gender differences

1. Introduction

Behavioral traits are considered to be fairly stable although some have been shown to change with factors such as age (Kosten et al., 1994; Zuckerman et al., 1978). In this study, we were interested in whether impulsiveness and sensation seeking traits were greater in former heroin addicts with comorbid cocaine addiction than those without. Specific personality traits may contribute to the initiation and maintenance of illicit drug use (Kreek et al., 2005; Perry and Carroll, 2008). Two traits that may be central to the development and treatment of drug addiction are impulsivity and sensation seeking. Impulsivity is a personality trait characterized by behavioral disinhibition and as “acting suddenly in an unplanned manner to satisfy a desire” (Kreek et al., 2005). It has been characterized as “an inability to evaluate a stimulus fully before responding to it (rapid-response impulsivity), and as an inability to delay responding despite a larger reward (reward-delay impulsivity)” (Swann et al., 2009). Impulsive behavior involves a disinhibition of cognitive control that suppresses reward-driven or automatic responses (Aron, 2007) and occurs without conscious deliberation.

The initiation of illicit drug use in some cases may be due to impaired impulse control, which may lead to drug addiction with repeated episodes of drug use (Kreek et al., 2005; Perry and Carroll, 2008). Impulsiveness is common in drug dependent individuals (Reynolds, 2006). High impulsivity has been found to be associated with cocaine (Bornoalova et al., 2005a; Bornoalova et al., 2005b; Fillmore and Rush, 2002; Li et al., 2006; Moeller et al., 2002; Moeller et al., 2001; Patkar et al., 2003; Verdejo-García et al., 2007; Verdejo-Garcia et al., 2007) abuse or dependence. Drug addiction may facilitate impulsive acts by interfering with normal inhibitory controls (Verdejo-Garcia et al., 2008). An association has been reported between impulsivity and subjective euphoria following acute cocaine administration in male intravenous cocaine users (Cascella et al., 1994), average daily cocaine use, and cocaine withdrawal symptoms (Moeller et al., 2001).

Previous studies have shown that current heroin addicts have higher levels of impulsivity than non-addicts do. Higher levels of discount delayed rewards were found in heroin addicts compared to non-addicts (Bornoalova et al., 2005a; Kirby et al., 1999; Madden et al., 1997) as well with other measures of impulsivity (Clark et al., 2006; Lejuez et al., 2005; Verdejo-Garcia et al., 2007). Similar findings have been reported in rodents with opioids. Acute morphine administration increased specific measures of impulsivity in rats (Kieres et al., 2004; Pattij et al., 2009). Furthermore, in these rodent studies, naltrexone blocked this morphine enhancement of impulsive behavior, with no effect on basal impulsivity.

Sensation seeking on the other hand is “the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience” (Zuckerman, 1979). A scale was developed to assess differences in a subject’s optimal levels of arousal or stimulation. It was proposed that the need for intensity, change, and variety of stimulation would be reflected in the types of social, sensory, or thrill-seeking behavior in which one engages (Zuckerman, 1971). Sensation seeking has been found to

predispose an individual to drug use (Teichman et al., 1989). Increased sensation seeking has been found in opiate (Andrucci et al., 1989a) and cocaine (Ersche et al., 2010; Patkar et al., 2002; Patkar et al., 2003), use or dependence.

In this study, we were interested in determining if comorbid cocaine addiction is associated with greater impulsivity and sensation seeking traits in former heroin addicts who are or previously were in methadone maintenance treatment. Since previous studies reported higher impulsivity and sensation seeking traits in cocaine dependent subjects we wanted to know if these traits remain stable during successful pharmacotherapy or abstinence, or are similar to levels found in normal healthy volunteers. Since differential results by gender have been reported, we included gender in our analyses (Allen et al., 1998, Andrucci et al., 1989b, Kosten et al., 1994, Lejuez et al., 2007, Satinder and Black, 1984, Sutker et al., 1978, Zuckerman, 1972).

The present study investigated the relationship between impulsiveness and sensation seeking traits in former heroin addicts, most of whom were in methadone maintenance treatment versus normal volunteers, and a subset of these with or without a past history of cocaine dependence using the Barratt Impulsiveness Scale version 11 for impulsivity and the Sensation Seeking Scale version V for sensation seeking. We hypothesized that subjects with a history of long-term severe heroin addiction would be more impulsive and sensation seeking than control subjects with no history of drug abuse or dependence, and that those subjects with a history of heroin and cocaine dependence comorbidity would be more impulsive and more sensation seeking than those subjects with past heroin addiction alone. In addition, we hypothesized that males overall would be more impulsive and more sensation seeking than the females.

2. Methods

2.1. Participants

Subjects for this study were consecutive volunteers ascertained for ongoing genetic studies (October 2003–August 2008) in the Laboratory of the Biology of Addictive Diseases at The Rockefeller University who met the inclusion criteria below ($n = 247$; Table 1). Participants in these studies were recruited through advertisements in local newspapers or through methadone maintenance treatment programs for patients with severe heroin addiction. The study was approved by The Rockefeller University Institutional Review Board. Written informed consent was obtained from all subjects prior to participation.

The Structured Clinical Interview for DSM-IV (SCID) was administered by a licensed clinical practitioner to all subjects (DSM-IV; American Psychiatric Association, 1994). The SCID was used to determine the psychiatric diagnoses including opioid and cocaine abuse and dependence.

In the case of the opioid dependent subjects, we went beyond the DSM-IV diagnosis and classified subjects as to whether they met Federal guidelines for entrance into methadone maintenance treatment program (one year or more of daily multiple self-administrations of heroin or other opiates, $n = 102$; Rettig and Yarmolinsky, 1995). Of these subjects, 80 were currently in methadone maintenance treatment and 22 had previously been in methadone maintenance treatment. There were 31 subjects in the methadone-maintained without cocaine dependence group and 71 subjects in the methadone-maintained with cocaine dependence group. The Medical Status and the Drug and Alcohol Use sections of the clinician-administered Addiction Severity Index (ASI; McLellan et al., 1980) were completed for each subject and urine toxicology for multiple drugs of abuse were performed on all subjects. Subjects in the normal healthy (non-methadone-maintained) volunteer group

($n = 145$), meeting the same criteria we have used in previous genetic studies (Bond et al., 1998; Levran et al., 2008), had 1) no alcohol intoxication or illicit drug use (except possibly cannabis) in the last 30 days, 2) no previous history of alcohol drinking to intoxication 3 or more times per week for 6 months or more, 3) no illicit drug use for more than 6 months (except possibly cannabis), and 4) no excessive use of cannabis (3 or more times per week for more than 4 years).

2.2. Measures

All subjects were given the self-administered Barratt Impulsiveness Scale version 11 and the Sensation Seeking Scale version V, two commonly used instruments to measure impulsivity and sensation seeking: the Barratt Impulsiveness Scale (Patton et al., 1995; Stanford et al., 2009) and the Sensation Seeking Scale (Zuckerman, 1969; Zuckerman et al., 1978). These questionnaires were administered at the end of a battery of assessments, primarily for human genetics research. The response rates for the Barratt Impulsiveness Scale ranged from 74 to 85% for the total score and from 84 to 94% for the subscales (Table 2). The response rates for the Sensation Seeking Scale ranged from 65 to 79% for the total score and from 82 to 97% for the subscales (Table 3).

2.2.1. Barratt Impulsiveness Scale version 11—The Barratt Impulsiveness Scale version 11 is a 30-item self-report questionnaire that measures impulsivity using three subscales including Attentional, Nonplanning, and Motor, as well as providing a total score (Patton et al., 1995). This scale quantifies personality factors relating to impulsivity using three subscales to measure impulsivity: “Attentional” (cognitive instability and inattention), “Nonplanning” (intolerance of cognitive complexity and lack of self-control), and “Motor” (lack of perseverance and motor impulsiveness; Patton et al., 1995). These subscales can be combined to form a total score. Each subject was asked to answer questions that measure some of the ways in which he or she acts or thinks. Sample questions from the Barratt Impulsiveness Scale version 11 include “I say things without thinking,” “I have outside thoughts when thinking,” and “I act on impulse.” Individuals are asked to rate the degree to which these statements are true as: “Almost Always,” “Occasionally,” “Often,” and “Rarely/Never.” These responses are scored 1 through 4 with 4 reflecting the most “impulsive” response. Total scores can range from 30 to 120.

2.2.2. Sensation Seeking Scale version V—Sensation seeking traits are assessed using version V of the Sensation Seeking Scale (Zuckerman, 1969; Zuckerman et al., 1978). The Sensation Seeking Scale was created to measure a subject’s level of arousal or stimulation. The Sensation Seeking Scale version V is a 40-item self-report questionnaire designed to measure individual differences in “optimal levels of stimulation and arousal.” Four subscales were developed through factor analyses: Thrill and Adventure Seeking, Disinhibition, Experience Seeking, and Boredom Susceptibility. Individuals can obtain scores ranging from 0–10 on each subscale so that the total score varies between 0–40. Sample questions from the Sensation Seeking Scale version V include “I like to dive off the high board” (Thrill and Adventure Seeking), “I like wild uninhibited parties” (Disinhibition), “I would like to take off on a trip with no preplanned or definite routes, or time tables” (Experience Seeking), and “I have no patience with dull or boring persons” (Boredom Susceptibility). The higher the score, the higher the “optimal level of stimulation and arousal” for an individual.

2.3. Data analysis

All participants were asked to complete each scale. However, since not every participant completed each subscale, two approaches were used for data analysis of the BIS-11 and the Sensation Seeking Scale version V. First, each subscale was analyzed separately by two-way

analysis of variance (ANOVA), Addiction History (methadone-maintained without cocaine dependence, methadone with cocaine dependence, non-methadone-maintained volunteer) X Gender. The factor of Gender was included since prior reports have found males to be more impulsive and sensation seeking. Then, for all participants who had completed all subscales of an instrument, a two-way ANOVA was used to examine total scores. ANOVAs were followed by Newman-Keuls *post hoc* tests. The primary independent variables were group and gender, with age examined in some analyses. The dependent variables were the total and subscale scores of the Barratt Impulsiveness Scale version 11 and the Sensation Seeking Scale version V.

3. Results

3.1. Preliminary analysis of former severe heroin addicts

Subjects who met Federal criteria for entrance into methadone maintenance pharmacotherapy were of two types, those currently in pharmacotherapy ($n = 80$) and those who had been in methadone maintenance in the past ($n = 22$). Preliminary analyses were carried out to see if there were significant differences between these groups. Two-way ANOVAs, Pharmacotherapy Status X Gender, of total score of the Barratt Impulsiveness Scale and of the Sensation Seeking Scale showed no significant main effect of Pharmacotherapy Status, nor was there a significant Pharmacotherapy Status X Gender interaction. On the Motor subscale of the Barratt Impulsiveness Scale, and on the Boredom Susceptibility subscale of the Sensation Seeking Scale, past methadone-maintained individuals scored higher than current methadone-maintained persons: $F(1,84) = 4.63, p < 0.05$, and $F(1,90) = 4.80, p < 0.05$. No other differences were found. For subsequent analyses, all subjects who were currently or previously in methadone maintenance pharmacotherapy were considered as one group, stratified into those with cocaine dependence (methadone maintained with cocaine dependence, $n = 71$) or without (methadone-maintained without cocaine dependence, $n = 31$).

3.2. Barratt Impulsiveness Scale

The relation of impulsivity as measured by the Barratt Impulsiveness Scale version 11 was assessed in the three groups. The mean ($\pm$ s.e.m.) total and subscale scores for the Barratt Impulsiveness Scale version 11 by each Addiction History group and gender with the number of subjects completing the total subscale indicated for each group are shown in Figure 1. Only significant findings are shown.

Total Score—There was a significant main effect of Addiction History, $F(2,194) = 19.22, p < 0.001$, no significant effect of Gender, $F(1,194) = 2.88$, and a significant Addiction History X Gender interaction, $F(2,194) = 7.30, p < 0.001$ (Figure 1A). Newman-Keuls *post hoc* tests showed that methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence groups each were significantly higher than the normal healthy (non-methadone-maintained) volunteer group ($p < 0.001$).

Attentional Subscale—There was a significant main effect of Addiction History, $F(2,221) = 21.19, p < 0.001$, no effect of gender, $F(1,221) = 2.26$, and a significant Addiction History X Gender interaction, $F(2,221) = 5.13, p < 0.01$ (Figure 1B). Newman-Keuls *post hoc* tests showed that methadone-maintained without cocaine dependence and methadone with cocaine dependence groups each had higher scores than the normal healthy (non-methadone-maintained) volunteer group ($p < 0.001$). Examination of the Group X Gender interaction by Newman-Keuls *post hoc* tests revealed that females in the methadone-maintained without cocaine dependence group and females in the methadone-maintained with cocaine dependence group had higher scores than did normal healthy (non-methadone-

maintained) volunteer females ($p < 0.001$), and that methadone-maintained with cocaine dependence males scored higher than normal healthy (non-methadone-maintained) volunteer males, $p < 0.002$.

Non-Planning Subscale—There was a significant main effect of Addiction History, $F(2,223) = 14.15$, $p < 0.001$, with no effect of Gender, $F(1,223) < 1.0$, and no significant Addiction History X Gender interaction, $F(2,223) = 1.45$ (Figure 1C). Methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence groups each had higher scores than did the normal healthy (non-methadone-maintained) volunteer group ($p < 0.001$).

Motor Subscale—There was a significant main effect of Addiction History, $F(2,217) = 11.42$, $p < 0.001$, females scored significantly higher than males, $F(1,217) = 6.90$, $p < 0.01$, and there was a significant Addiction History X Gender interaction, $F(2,217) = 4.20$, $p < 0.02$ (Figure 2C). Methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence groups each scored significantly higher than the normal healthy (non-methadone-maintained) volunteer group ($p < 0.005$). That the females scored significantly higher than did the males overall is due to the higher female scores in the methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence groups as can be seen in Figure 1D, and both methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence females scored higher than did the normal healthy (non-methadone-maintained) volunteer females ($p < 0.0005$ and $p < 0.001$).

3.3. Sensation Seeking Scale

The relation of sensation seeking as measured by the Sensation Seeking Scale version V was assessed in the three groups. The total score of the Sensation Seeking Scale did not show a significant main effect of Addiction History, $F(1,177) < 1.0$, nor was there a significant effect of Gender, $F(1,177) = 2.67$, and there was no Addiction History X Gender interaction, $F < 1.0$ (Figure 3). Separate ANOVAs of the four subscales of the Sensation Seeking Scale did not show sensation seeking scores to be significantly different among groups with different addiction histories. The response rate for the total Sensation Seeking score was relatively low (65%) for methadone-maintained without cocaine dependent group, which calls into question the generalizability of comparisons of this group on this score. However, the response rates for the Sensation Seeking subscales in this group ranged from 82% to 90% (Table 3).

On the Thrill and Adventure Seeking (TAS) subscale (Figure 2A), males scored higher than females, $F(1,215) = 4.26$, $p < 0.05$. On the Disinhibition (DIS) subscale (B), males scored significantly higher than females, $F(1,211) = 14.60$, $p < 0.002$, with no significant Addiction History X Gender interaction, $F < 1.0$.

3.4. Relationship of Sensation Seeking to Age

Since there were differences in age between the three addiction history groups studied (Table 1), the relationship of the total score and of each subscale to age was examined in male and in female normal volunteers by regression analysis. Only in the Disinhibition subscale and in the total Sensation Seeking Scale version V score of females were there significant correlations: Total and Disinhibition subscale scores were inversely correlated with age in females (Figure 3). Age accounted for only 7% of the variation in the Sensation Seeking Scale version V total score (Figure 3A) and 11% of the variation in the Disinhibition subscale in the female normal healthy (non-methadone-maintained) volunteer group (Figure 3B). Since there were no significant relationships found in any Barratt

Impulsiveness Scale subscale or total score with age, it is unlikely that the higher scores on the Barratt Impulsiveness Scale version 11 in the methadone-maintained without cocaine dependence and the methadone-maintained with cocaine dependence groups are related to age differences.

4. Discussion

We had hypothesized that the methadone-maintained without cocaine dependence group would be more impulsive and sensation seeking than the normal healthy (non-methadone-maintained) volunteer group, but less than the methadone-maintained with cocaine dependence group. In this study, the methadone-maintained without cocaine dependence and methadone-maintained with cocaine dependence subjects were similar to each other, with both being more impulsive than the normal healthy (non-methadone-maintained) volunteer group. To our surprise, we did not see any difference among these groups on the sensation seeking scales or any of the subscales. In addition, we hypothesized that males would be more impulsive and sensation seeking than females. However, the only difference we found between the genders was in two of the Sensation seeking subscales, Thrill and Adventure Seeking and Disinhibition, where males scored higher than females.

Former heroin addicts with or without a history of cocaine dependence had significantly higher impulsivity scores than normal volunteers in the total score and each of the three subscales of the Barratt Impulsiveness Scale version 11. These results demonstrate that individuals with a history of severe heroin addiction scored higher than normal volunteers in impulsivity as measured by the Barratt Impulsiveness Scale version 11, and greater impulsivity occurred independent of history of cocaine dependence. There was no difference related to drug addiction in sensation seeking. Males across groups scored higher than females in the Thrill and Adventure Seeking, and Disinhibition subscales of the Sensation Seeking Scale version V. Administration of naltrexone, a μ -opioid antagonist, has been reported by one investigator to reduce impulsivity as reflected by delay discounting in both healthy controls and alcoholics, suggesting that stimulation of the opioid system may increase impulsivity under both stimulated and basal conditions in humans (Mitchell et al., 2007). A recent study that used rats separated into high and low impulsive groups found that "trait-like impulsivity" did not predict escalation of heroin self-administration across 18 days of six hour sessions (McNamara et al., 2010). However, in a similar study found that rats with high "impulsivity" showed greater escalation of intravenous cocaine self-administration (Dalley et al., 2007).

To our knowledge, this is the first study that has examined both impulsivity and sensation seeking traits in subjects with a history of severe heroin addiction, who have been or are in stable methadone treatment. Our results are similar to other reports on impulsivity in cocaine dependent subjects, who had higher scores on the Barratt Impulsiveness Scale when compared to controls (Ersche et al., 2010; Kjome et al., 2010; Moeller et al., 2002; Patkar et al., 2002; Patkar et al., 2004). Opiate dependent subjects have been reported to have lower Barratt Impulsiveness Scale Attentional scores than ex-users of cocaine or opiates, and were found to have higher Barratt Impulsiveness Scale Nonplanning scores than controls subjects (Clark et al., 2006).

In our study, we found no difference between the addiction history groups on the Sensation Seeking Scale version V total score or on any of the subscales. Our findings contrast with other studies on opiate use that reported higher sensation seeking on the Disinhibition and Thrill and Adventure Seeking subscales in opiate dependent subjects entering treatment (Franques et al., 2003), higher sensation seeking in families with probands seeking treatment (Kosten et al., 1994; Luthar et al., 1992), and higher scores on the Sensation Seeking Scale

version V total and the Experience Seeking and Disinhibition subscales in narcotic users than in nonusers in a study of high school students (Andrucci et al., 1989b). Higher sensation seeking was reported in cocaine dependent subjects (Patkar et al., 2002; Patkar et al., 2004), cocaine using university students (Jaffe and Archer, 1987), and was associated with more severe symptoms of substance abuse in cocaine abusers (Ball et al., 1994).

Since the majority of subjects in our addiction cohort were in long-term methadone maintenance pharmacotherapy, the treatment regimen may have selected those with lower impulsivity and sensation seeking. Others have reported an inverse correlation between days in treatment for cocaine dependence with Sensation Seeking Scale version V scores and an association with BIS-11 scores (Patkar et al., 2004). Subjects with lower impulsiveness on the Barratt Impulsiveness Scale version 11 remained in treatment longer than those with high impulsivity (Moeller et al., 2001). A nine month stay in a therapeutic community reduced Barratt Impulsiveness Scale version 11 scores of substance abusers (Bankston et al., 2009). However, we are not aware of any study that has used these instruments to examine whether there are changes in impulsivity from entry to stabilized methadone treatment.

Unique behavioral traits have been found to be associated with subjects who are dependent on various classes of drugs. Drug users, in general, tend to have higher sensation seeking scores than controls subjects (Zuckerman, 1986). Cocaine users have been reported to be more impulsive than heroin users (Bornoalova et al., 2005a), although in our study the former heroin addicts with cocaine dependence were similar to those without cocaine codependence. These differences may be attributed to factors that differ between studies, resulting in different patterns of impulsive behavior observed in these groups.

Early studies hypothesized that subjects preferring sedating or depressant drugs, such as heroin, might be low in sensation seeking (Kaestner et al., 1977; Kohn et al., 1979). Patients in methadone treatment scored higher on a novelty seeking scale, marginally higher on external sensation seeking, and appeared “more bored and desirous of change in their lives” than were controls (Kohn et al., 1979). These differences diminished with length of history of opioid dependence, but not with time in methadone maintenance pharmacotherapy, suggesting that these traits may diminish over time or be attenuated by pharmacotherapy.

Sensation seeking behavior may be predictive of drug abuse vulnerability, particularly in adolescence (Martin et al., 2004). High sensation seeking predicted an earlier age of onset for substance use and abuse (Ball et al., 1994; Sutker et al., 1978), and adolescent drug use in a longitudinal study (Teichman et al., 1989). Siblings of opioid addicted subjects were more likely to use drugs if they had tried drugs as teenagers, had used drugs with peers, and/or had scored higher on sensation seeking as measured by the Sensation Seeking Scale (Kosten et al., 1994; Luthar et al., 1992).

Significant differences between males and females in impulsivity scores were found in our study in an Addiction History X Gender interaction in the Motor subscale of the Barratt Impulsiveness Scale. Female former heroin addicts scored higher than did male former heroin addicts and higher than female controls. Similarly, in a study of crack/cocaine users, female users were found to score higher on the Barratt Impulsiveness Scale version 11 Attention, Motor and total scales than did males users (Lejuez et al., 2007). In contrast, no gender differences were found in a study of impulsivity using the Barratt Impulsiveness Scale version 11 in subjects with cocaine dependence and controls (Allen et al., 1998).

We found no relationship between sensation seeking and a history of severe heroin addiction in subjects in methadone maintenance pharmacotherapy with or without cocaine dependence. Gender differences were found in both the Thrill and Adventure Seeking and the Disinhibition subscales of the Sensation Seeking Scale where males across groups

scored higher than females did. In the Thrill and Adventure Seeking scale, we found that males scored higher than females. These findings are similar to those of Zuckerman who found that males scored higher than females in the Thrill and Adventure Seeking and Disinhibition subscales for both those in a “drug users” group and a normative university student group (Zuckerman, 1972). Males with a severe history of heroin addiction, as well as normal volunteers, were more “disinhibited” than females with a similar history of addiction. Our findings are congruent with other studies, which reported that males had higher sensation seeking scores than females on the Disinhibition and Thrill and Adventure Seeking scores (Kosten et al., 1994; Satinder and Black, 1984), and that male high school students had higher Sensation Seeking Scale version V total score and Thrill and Adventure Seeking and Boredom Susceptibility subscales than did female students (Andrucci et al., 1989b). In a study on subjects in a residential treatment program it was found that men scored higher on Thrill and Adventure Seeking than did women (Sutker et al., 1978).

An inverse relationship was found with the total Sensation Seeking Scale version V and with the Disinhibition subscale scores with age in the female normal volunteer group. Other studies have shown that age is inversely related to sensation seeking (Kosten et al., 1994; Zuckerman et al., 1978). On the other hand, a study by Allen et al. found that age had no impact on impulsivity (Allen et al., 1998). Age may play a contributing role in drug addiction as experimentation and onset of drug addiction generally occurs in adolescence (Kreek et al., 2005). Neurodevelopmental processes and reproductive hormone changes during adolescence and early adulthood may alter impulse control, eventually leading to addiction.

This study demonstrates that impulsivity is higher in former heroin addicts currently or previously in methadone maintenance pharmacotherapy irrespective of their history of cocaine dependence than in non-drug using controls. Sensation seeking, however, showed only a difference between genders, with males scoring higher on several subscales. An understanding of the factors influencing these traits may aid in the prevention of drug abuse and in the treatment of drug addiction. Weight should be given to impulsivity and sensation in the counseling and treatment of heroin and cocaine addict, with a realization that these traits differ between genders. Since some of these traits were higher in males than females, the tailoring of therapies based on gender, impulsivity, and sensation seeking should be incorporated into counseling protocols.

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Barratt Impulsiveness Scale

Figure 1.

Barratt Impulsiveness scores (mean + s.e.m.) are shown in A: Total score, B: Attentional subscale, C: Nonplanning subscale, and D: Motor subscale for the normal healthy (non-methadone-maintained) volunteers (NV), methadone-maintained without cocaine dependence (former severe heroin addicts meeting eligibility requirements for methadone maintenance, MM), and methadone-maintained with cocaine dependence (former severe heroin addicts in methadone maintenance with comorbid cocaine dependence, MMCD) groups stratified by gender. Letter a indicates MM females greater than MM males for Total score ($p < 0.001$), Attentional subscale ($p < 0.01$), and Motor subscale ($p < 0.005$). Letter b indicates MM females greater than female NV in Total score and Attentional and Motor subscale ($p < 0.001$).

Subscales of Sensation Seeking Scale

Figure. 2.

Disinhibition (A) and Thrill and Adventure Seeking (B) subscale scores of the Sensation Seeking Scale. Scores (mean + s.e.m.) are shown for the normal healthy (non-methadone-maintained) volunteers (NV), methadone-maintained without cocaine dependence (MM), and methadone-maintained with cocaine dependence (MMCD) stratified by gender.

Female Normal Volunteers

Figure. 3.
Correlation of Total Sensation Seeking scores and Disinhibition subscale scores with age in female normal healthy (non-methadone-maintained) volunteers.

Table 1

Subject Categorization

	Methadone-maintained		Non-methadone-maintained
	Without cocaine dependence	With cocaine dependence	
Groups			
Normal healthy volunteer	0	0	145
Currently in methadone pharmacotherapy	26	54	0
Past history of MMTP *	5	17	0
Gender			
Male	18	39	71
Female	13	32	74
Mean age ($\pm$ s.d.)	43 $\pm$ 10	43 $\pm$ 8	34 $\pm$ 13
Ethnicity			
Caucasian	8	16	37
African American	8	30	69
Hispanic	15	21	22
Other	0	4	17
Total	31	71	145

* MMTP: Methadone maintenance treatment program

Table 2Barratt Impulsiveness Scale (Mean $\pm$ s.e.m.)

Group	Total Score (N, response rate)	Attentional (N, response rate)	Nonplanning (N, response rate)	Motor (N, response rate)
Methadone maintained without cocaine dependence	64.9 $\pm$ 2.6 (23, 74%)	16.1 $\pm$ 0.7 (26, 84%)	26.1 $\pm$ 0.9 (28, 90%)	23.4 $\pm$ 1.2 (28, 90%)
Methadone-maintained with cocaine dependence	65.2 $\pm$ 1.6 (54, 76%)	17.0 $\pm$ 0.6 (64, 90%)	25.7 $\pm$ 0.7 (65, 92%)	23.2 $\pm$ 0.7 (60, 85%)
Normal healthy (non-methadone-maintained) volunteers	55.8 $\pm$ 0.2(123, 85%)	13.3 $\pm$ 0.1 (137, 94%)	22.2 $\pm$ 0.1 (136, 94%)	20.4 $\pm$ 0.1 (135, 93%)

Table 3

Sensation Seeking Scale (Mean $\pm$ s.e.m.)

Group	Total Score (N, response rate)	Thrill and Adventure Seeking (N, response rate)	Disinhibition (N, response rate)	Experience Seeking (N, response rate)	Boredom Susceptibility (N, response rate)
Methadone-maintained without cocaine dependence	14.2 $\pm$ 1.4 (23, 74%)	5.0 $\pm$ 0.5 (30, 97%)	2.6 $\pm$ 0.4 (27, 87%)	4.5 $\pm$ 0.4 (27, 87%)	1.6 $\pm$ 0.3 (30, 97%)
Methadone-maintained with cocaine dependence	16.3 $\pm$ 1.0 (46, 65%)	4.7 $\pm$ 0.4 (58, 82%)	3.7 $\pm$ 0.3 (59, 83%)	5.2 $\pm$ 0.2 (58, 82%)	2.4 $\pm$ 0.2 (64, 90%)
Normal healthy (non-methadone-maintained) volunteers	15.4 $\pm$ 0.1 (114, 79%)	5.2 $\pm$ 0.0 (133, 92%)	3.3 $\pm$ 0.0 (131, 90%)	4.8 $\pm$ 0.0 (128, 88%)	2.2 $\pm$ 0.0 (137, 94%)