ABSTRACT

Title of Thesis: **IMPULSIVITY PROCESSES UNDERLYING DRUG CHOICE AND RISKY SEXUAL BEHAVIOR**

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The current study included a sample of 86 inner-city treatment seeking drug users, comparing risky sexual behavior (RSB) across primary users of a) heroin and not crack/cocaine, b) crack/cocaine and not heroin, and c) both heroin and crack/cocaine. To explore potential mechanisms, additional analyses also examined impulsivity across several domains as mediators of RSB and drug choice. RSB was higher in primary crack/cocaine users than in primary heroin users, with those using both drugs evidencing equal or lesser levels of RSB than crack/cocaine users. A similar pattern was found for impulsivity for several measures. Little support for any dimension of impulsivity as a mediator in the relationship between drug group and RSB was found. The current results allow insight into contextual elements that contribute to RSB across drug groups, allowing one to determine if elevated impulsivity in crack/cocaine users is due to pharmacological effects of crack/cocaine.

IMPULSIVITY PROCESSES UNDERLYING DRUG CHOICE AND RISKY SEXUAL BEHAVIOR

By

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Chapter 1: Introduction

Background and Significance

Despite advances in prevention efforts that target specific behaviors which increase one's risk of contracting HIV, more than 850,000 Americans are currently living with AIDS and an estimated 40,000 more continue to contract HIV infection each year (Center for Disease Control and Prevention [CDC], 2003). Risky sexual behavior (RSB) is the most common means of acquiring HIV, accounting for approximately 80 percent of reported HIV cases in 2002 (CDC, 2003). A large body of literature indicates that the use of illegal drug paraphernalia, in addition to being a primary means of HIV transmission, is strongly related to engagement in risky sexual behavior (e.g., Hoffman, Klein, Eber, & Crosby, 2000). Although this relationship has been demonstrated in multiple populations, several studies have suggested individuals living in urban inner-city areas, with a special emphasis on ethnic/racial minorities, are particularly vulnerable to drug use and RSB as a result of to higher levels of poverty, violence, general risk practices, and availability of street drugs (e.g., Avants, Marcotte, Arnold, & Margolin, 2003; Ensminger, Anthony, & McCord, 1997; Miller & Neaigus, 2002; Dembo, et al., 1992). Mechanisms such as the exchange of sex for drugs or money, frequent sexual contact within a population at an elevated risk for seropositivity (i.e., IV drug users), and engagement in RSB as a result of drug use play a potent role in the spread of HIV/AIDS within this population (Avants et al, 2003; CDC, 1999; Calsyn, Saxon, Wells, & Greenberg, 1992; Chitwood et al., 2000; Substance Abuse and Mental Health Services Administration [SAMHSA], 2003; Holmberg, 1996; Joe & Simpson, 1995; Kral et al., 1998, Rhodes et al., 1990).

Risky Sexual Behavior as a Function of Drug Preference

Although drug use in general has been linked to RSB (CDC, 1999), the identification of a link between particular drug classes and RSB could assist in the development of theoretical models for better understanding RSB as well as the creation of practical strategies for preventing RSB. Heroin use is highly associated with HIV infection due to needle sharing for IV users, however, it has become evident that crack/cocaine use may be a greater risk factor than heroin use for HIV infection due to an association with elevated RSB (e.g, Booth, Kwiatkowski, & Chitwood, 2000; Bux, et al., 1995; Camacho, Bartholomew, Joe, Cloud, & Simpson, 1996; DeHovitz, Kelly, & Feldman, 1994; Falck, Wang, Carlson, & Siegal, 1997; Grella, Anglin, & Wugalter, 1995; Joe & Simpson, 1995; Sanchez, Comerford, Chitwood, & Fernandez, 2002).

Four of the most compelling studies targeting crack/cocaine as a correlate of RSB beyond heroin use were conducted by Joe and Simpson (1995), Bux et al. (1995), Grella et al (1995), and Camacho et al (1996). First, Joe and Simpson (1995) examined HIV risk including RSB as measured by the Texas Christian University/AIDS Risk Assessment (ARA) among heroin users that also evidenced (a) no use, (b) low use, and (c) high use of crack/cocaine. Second, Bux et al (1995) examined a sample of 274 inner-city drug users in a methadone maintenance program. Findings from both studies indicated that level of crack/cocaine use was positively related to RSB (i.e., infrequent condom use and exchange of sex for drugs/money) among opiate dependent individuals. Third, in a study of 409 inner-city heroin-dependent individuals, Grella et al (1995) found that individuals who used heroin and crack/cocaine compared to heroin alone were less likely to use condoms, more likely to trade sex for drugs/money, more likely to engage in a greater

variety of criminal activity, and more likely to be HIV-positive as reported on an interviewer-administered questionnaire. Finally, using the ARA, Camacho et al (1996) examined HIV-risk behavior in relation to cocaine use among a sample of 327 daily opiate users in methadone maintenance treatment. Findings indicated that cocaine users engaged in greater levels of RSB than cocaine non-users at baseline and to a lesser degree at 6-months post treatment.

Taken together, current research provides initial evidence of a unique relationship between crack/cocaine use and RSB, with heroin or other opiate use used as a comparison. However, several unanswered, yet fundamental, questions remain. First, studies examining RSB across drug classes often compare level of crack/cocaine use among heroin-dependent participants (e.g., Bux, et al., 1995; Joe & Simpson, 1995). Thus, it is unclear whether elevated RSB is a function of crack/cocaine use specifically, or the result of the additional use of another drug class (i.e., polysubstance use, severity of drug use). Indeed, a more stringent test of differences in RSB among crack/cocaine and heroin users requires separable groups of crack/cocaine and heroin users, controlling for use of drug classes other than crack/cocaine and heroin. As a second limitation of this line of research, few studies have provided a clearly developed theoretical framework to explain *why* increased levels of RSB are related to crack/cocaine use. To begin to address these issues, it is imperative for future research to examine RSB across primary heroin and primary crack/cocaine users, while considering potential mediators of this relationship. Although several potential mediators could be examined, individual difference variables such as impulsivity provide a theoretically and empirically relevant first step following previous research suggesting that disinhibition processes including

impulsivity may underlie the development of risk-taking behaviors including drug use and RSB (Krueger et al., 2002; Sher, Bartholow, & Wood, 2000). The study of mediators is critically important, as it may aid in the identification of possible mechanisms through which vulnerability processes operate. These mechanisms are theoretically the causal links between a risk factor (e.g., drug use) and an outcome (e.g., acquisition of HIV).

Before proceeding in the development of future research, it is first necessary to provide clear definitions of the three particular variables in question: drug groups (i.e., use, abuse, and dependence), RSB and finally, impulsivity. Thus, in the following sections, we present a comprehensive review of the measurement approaches and interrelationships between the constructs in question. Further, we outline the background and rationale for conducting this line of research, and conclude with a section on methodology to elucidate the role of the mechanisms underlying this relationship.

Drug Use and Dependence: Definitions and Measurement

Although drug use frequency and drug dependence are often seen as synonymous constructs, the extant literature clearly shows that the two are different, although somewhat overlapping. Indeed, the diagnostic criteria for substance dependence specifies a maladaptive pattern of substance use leading to clinically significant impairment or distress as manifested by three (or more) of problems (outlined below), occurring at any time in the same 12-month period. These problems include a) taking the substance in larger amounts or over longer period than intended; b) a persistent desire or unsuccessful efforts to cut down or control substance use; c) spending a great deal of time in activities necessary to obtain the substance (e.g., visiting multiple doctors or driving long distances), use the substance (e.g., chain smoking), or recover from its effects (e.g.,

recovering from a hangover). Further, d) often important social, occupational, or recreational activities given up or reduced because of substance abuse; e) the substance use is continued despite knowledge of having a persistent or recurrent psychological, or physical problem that is caused or exacerbated by use of the substance. Finally, two of the most "telling" symptoms of dependence are tolerance, defined as either a need for read amounts of the substance in order to achieve intoxication or desired effect; or markedly diminished effect with continued use of the same amount, as well as withdrawal (manifested by physical or psychological symptoms characteristic for a particular substance; APA, 1994). For instance, in the case of heroin, withdrawal symptoms may include flu-like symptoms, as well as nausea, stomach aches, and cramps. In contrast, withdrawal for crack/cocaine usually includes severe but transient dysphoria, nightmares or vivid and unpleasant dreams, and severe fatigue. Interestingly, clinical and research evidence suggests that when both crack/cocaine and heroin are used in combination for a period of time, the very severe withdrawal from heroin might "mask" the less severe crack/cocaine-related withdrawal, suggesting a need for careful screening and questioning in diagnostic interviews (CITE).

Although the diagnostic criteria do not explicitly state that the substance in question must be taken on a regular basis (in other words, often) in order to meet criteria for dependence, the screening instrument drawn from the DSM-IV (SCID-IV, First, Spitzer, Gibbon, & Williams, 1995) does state that in order for criteria to be met, the substance must be taken at least ten times in one month. In this way, frequency of substance use and substance dependence are clearly complimentary, but somewhat orthogonal constructs. Additional support is provided for the fact that the two constructs

may make different predictions in terms of RSB. For instance, there is reason to believe that whereas recreational use (i.e., frequency) may lead to some amount of risky sex, dependence may lead to more heavy sexual risk-taking, such as engaging in commercial sex in general (e.g., trading sex for drugs or money), and more risky forms of commercial sex (e.g., anal sex, "bareback" oral and penetrative sex, Gossop, Griffiths, Powis, & Strang, 1993; Morse et al, 1992). Taken together, it is clear that substance dependence, rather then simply frequency of use may be a more useful predictor of RSB.

Risky Sexual Behavior: Definitions and Measurement

Condom nonuse is the most commonly assessed indicator of RSB (e.g., Kalichman, 1999, Nemoto, Foster, & Brown, 1991), but it also is important to examine other variables such as (a) number of sexual partners, (b) unprotected anal, oral, or vaginal intercourse, both receptive and insertive, and (c) a combination of any two or more of these indices (Somlai, Kelly, McAuliffe, Ksobiech & Hackl, 2003; Joe & Simpson, 1995; Crepaz & Marks, 2001). Further, when considering the use of at-risk samples such as inner-city drug users, a researcher must consider high-rate behaviors in these samples, such as the exchange of sex for money/drugs (e.g., Chawarski et al, 1998). In following section, we provide a brief overview of methodological techniques and existing retrospective measures of RSB, as well as their utility in examining the relationship between RSB and drug choice.

Global Association Measures: When attempting to understand the role of RSB in drug users, a researcher has an option to utilize quasi-experimental/retrospective self-report or experimental paradigms. However, due to ethical and practical constraints, researchers examining the effects of drugs and alcohol on RSB generally do not utilize

experimental paradigms. Indeed, as Leigh and Stall (1993) point out, although one may muse about an experimental, controlled laboratory study on the association of engagement in sexual risk and drug use, where some persons can randomly be assigned to a 'soft drink' or 'drug' group and their sexual behavior be subsequently observed, such a study has, of course, not been conducted. In lieu of an experimental design, researchers generally measure RSB using retrospective measurement techniques such as measures of global association.

Global association measures of RSB focus on RSB and drug use through questions examining the general frequency of substance use, as well as the general frequency of RSB during the period of time in question; these two measures are then tested for associations and often interpreted with a causal model in mind (i.e., individuals who use substances more heavily are more likely to engage in RSB). For example, Somlai, Kelly, McAuliffe, Ksobiech & Hackl (2003) found that the use of crack/cocaine and methamphetamines predicted the type and frequency of RSB. Although the researchers are careful not to stress causality, the implications of the study might mistakenly be taken to suggest that the use of crack/cocaine and methamphetamine induce RSB. Further, Ross, Hwang, Bull, & Williams (2002) found that crack/cocaine preference and use is related to increased risk for sexually transmitted diseases. Finally, Sanchez et al (2002) found lifetime prevalence of sexually transmitted diseases (including HIV) to correlate highly with drug use. Further, increased drug use, especially of crack/cocaine, was positively related to an index of RSB; however, nowhere do the authors report RSB in the context of drug use. These and similar data have been interpreted in terms of a causal relationship; indeed, so prevalent is this interpretation,

that in many public education and prevention programs, substance use prior to engagement in sexual activity is addressed as an outcome variable (e.g., Carey et al., 1997a; National Institute of Drug Abuse, 1994; for further discussion on this topic, see Weinhardt & Carey, 2000).

Drawing conclusions about the relationship between general frequency of substance use and RSB is problematic for several reasons. First, in any cross-sectional correlational study, it is impossible to rule out the influence of a third variable. Second, the results could be explained by an alternative hypothesis, such that individual differences (e.g., personality variables) predispose an individual to engage in both RSB and drug use (e.g., Krueger et al., 2002; Moeller et al., 2001); In these studies, however, it is impossible to determine whether RSB occurred in the context of substance use at all (e.g., Sanchez et al., 2002), or whether drug-using individuals in these studies are more likely to engage in risky sex on non-using occasions (e.g., Leigh & Stall, 1993). This critique is especially relevant to research that attempts to elucidate the causal force of a third variable (i.e., individual differences variables); in order to determine if such a variable mediates the relationship between substances and RSB, one first needs to eliminate the possibility that the pharmacological properties of a specific drug have a causal influence on this relationship.

A measurement scale that reflects both the strengths and limitations of global measures outlined above is the HIV Risk Behavior Scale (HRBS; Darke et al., 1991). This 11-item scale is widely used as an index of engagement in HIV risk behaviors and includes an RSB composite (5 items; HRBS-RSB) and an IV drug use composite (6 items). For each item on the RSB composite, participants provide answers on a six-point

scale, with higher scores indicating higher risk. The scale has been shown to have good reliability and validity (Darke et al., 1991) and provides a *total* score that is useful for general impressions of RSB. The strength of this overall score also illuminates the weakness of the measure as the scale can downplay differences across types of partners (e.g., regular, commercial, and casual) if only the total score is used, and there is no attempt to examine the context (e.g., under the influence of drugs; Chawarski, Pakes, & Schottenfeld, 1998). It becomes apparent that global association measures are not sufficient, at least by themselves, for elucidating the influence of pharmacological effects of substances or the influence of a third variable (e.g., personality measures) on RSB. Indeed, it is well accepted by the research community that "health risk taking, whether it be sexual interaction, smoking, eating, sunbathing, or drug use, is a behavior or sequence of behaviors which occurs in a temporally and geographically (and often socially) bound environment" (Ross & Ferreira-Pinto, 2000, p. 60; for further examples, see Chawarski et al., 1998).

Event-Level Measures: Although context can vary from specific (e.g., affect) to global (e.g., geographical location), researchers have recommended to utilize *event-level* measures that focus on interpersonal domains when accessing for RSB. Specifically, Chawarski et al. (1998) recommends that individuals' engagement in risky sex vary across regular partners (i.e., spouse(s) or live-in sexual partners), commercial partners (i.e., individuals with whom sex was traded for drugs or money), and random or causal partners (i.e., non-commercial, non-live-in partners). Such differentiation between contexts for a single drug user will provide crucial information about whether crack/cocaine users are more likely to engage in risky sex across contexts or whether

elevated risky behavior in crack/cocaine users is context specific (e.g., when trading crack/cocaine for sex). In turn, this allows a researcher to determine how trait (or drug-induced) impulsivity interacts with various contexts. Although the HRBS does provide limited partner information (e.g., in the last 6 months, how often have you had unprotected sex with a commercial partner, answers may range from never to always), it does not provide actual number of instances of unsafe sex, or the number of partners across each context (with the latter variable considered a more reliable source then simply providing an answer on the "always" to "never" continuum). Thus, a measure of RSB should differentiate between different relationships and contexts in which behaviors occur, as well as providing more quantitative information within each context.

Situational Association Measures: To order to further enhance the researchers' ability to make causal inferences, researchers have attempted to utilize situational association measures, which examine the relationship between sexual behavior and substance use. Specifically, this type of measurement approach involves a comparison of any sexual behavior when intoxicated compared to total instances of RSB (intoxicated or not), with results typically indicating that the frequency of any sexual activity (risky or not risky) during periods of intoxication are related to overall level of RSB. Such an approach is not without limitations. First, because the approach typically assesses for any sexual behavior during intoxication and not necessarily RSB, it is impossible to determine whether RSB (as opposed to any sexual activity) occurred on the same occasions as substance use. Second, the documented relationship could simply be explained by the total amount of sexual activity for a given individual, and thus, a higher likelihood of engaging in risky sex (Leigh & Stall, 1993; Leigh, 1990b). Indeed, Leigh

(1990b) found that in sexual encounters, the best predictor of RSB was not substance use, but the reported overall frequency of sex. Other researchers have obtained similar results. Kelly, St. Lawrence, and Brasfield (1991), found that individuals who reported being under the influence of substances prior to sexual encounters were more likely to generally engage in high-risk sexual behavior than other participants. To correct for this problem, some researchers have began to utilize a more precise ratio system, whereas the index of risky behavior is created by a proportion of global amount of unsafe sexual activity to RSB under the influence of alcohol or drugs (e.g., Leigh, 1990b; Martin & Hasin, 1990), and this approach is indeed a promising one, as it controls for frequency of overall sexual activity. However, as with all retrospective self-report instruments, such research is limited by issues such as potential social desirability and retrospective bias and other memory issues. Indeed, researchers have documented state-dependent learning effects for various substances (e.g., Lowe, 1983). Thus, it is difficult to take the participants' answers as completely accurate, given that these individuals were under the influence of substances at the time of engagement in risky sex and may not be able to remember the details of the incident, or indeed, the incident altogether. Further, when asked about previous drug use and RSB, individuals are likely subject to attributional biases and may ascribe engagement in risky sex to the effects of drugs or alcohol (e.g., Buunk & Dijkstra, 2001). Together, it is clear that this type of assessment method by itself may produce misleading results.

Supplemental Indices of RSB: It is clear that self-report measures of RSB are riddled with limitations; subjects may under-report rates of RSB as the behavior in question may be socially sanctioned and/or highly illegal. Similarly, existing measures of

behaviors such as “In the past three months, how often have you had sex without a condom with IV drug users?” may be difficult for the participants to answer, as a given behavior may occur on an irregular basis or under the influence of drugs or alcohol (Chawarski et al., 1998). To address these limitations, researchers have begun to move toward more objective indices of RSB. For instance, several researchers (e.g., Chawarski et al, 1998) have recommended that the knowledge of an individual’s history of having contracted other sexually transmitted diseases may provide an indicator of an individual’s risk status in the absence of direct knowledge (or poor reporting) of one’s HIV risk behaviors (i.e., condom non-use). Several compelling studies have reported that a history of communicable diseases (especially STDs) may be an especially powerful predictor of both future RSB (Rodriguez et al, 1995; Jacobson, Harris, & Doyle, 1995) as well as actual HIV contraction (Jacobson et al, 1995**;** Lauver, Armstrong, Marks & Schwarz, 1995). Although one may argue that upon finding out the presence of such a disease, an individual may be motivated to change his or her risk practices, empirical evidence indicates that instead, the level of risk behavior remains the same (Kershaw et al, 2004; Timpson, Williams, Bowen, Keel, & Blair, 2003). It is clear that this method is especially relevant to the proposed study, as it is necessary to understand if and how differences in RSB across drug preference account for actual consequences.

Summary and Conclusions: In summary, the measurement of RSB has been criticized harshly in the literature (e.g., Catania, Gibson, Chitwood, & Coates, 1990; Leigh & Stall, 1993). The aforementioned critiques and limitations suggest that the examination of RSB and its association with drug use is not simple, and questionnaires traditionally used in gross association studies are simply not sufficient when attempting

to make causal inferences. When attempting to go beyond simply documenting a correlation, a measurement technique should address the following critiques and standards. First, the measure must provide a score beyond simple counts of discrete separate events of RSB and substance use. Specifically, the measure must provide rich data at the event level allowing for the differentiation of RSB across regular, non-regular, and commercial partners and at the situational level considering RSB in versus out of substance use contexts. Finally, to avoid the problems inherent in gross frequency and quantity counts, a measure should address a history of communicable diseases. To date, there are no well-validated measures assessing all the above recommendations simultaneously; thus, for the purpose of construct validity and in accordance with the recommendations of Campbell and Fiske (1959), a multi-method approach is both appropriate and necessary.

Impulsivity as a Potential Mechanism Underlying Drug Choice and RSB:

Few studies have directly examined the underlying mechanisms of drug choice and elevated RSB. This limitation is noteworthy and unfortunate, as understanding the mechanisms of risk processes (i.e., active ingredients to change) is likely to facilitate the development of innovative treatments that will yield larger effect sizes or similar effects to existing treatments at lower cost. Cross-sectional studies suggest that differences in RSB across drug classes may be accounted for at some level by pharmacological differences as well as contextual factors such as the strong association of crack/cocaine use and exchange of sex for money or drugs (Baseman, Ross, and Williams, 1999; Ross, Hwang, Zack, Bull, & Williams, 2002; Ross, Hwang, Leonard, Teng, & Duncan, 1999).

In addition to these factors, researchers also have begun to consider the role of dispositional/personality factors (Leigh & Stall, 1993).

One personality variable that has been linked independently to both drug use and RSB is trait-impulsivity. The focus on this personality variable is not surprising, given that multiple disorders in the DSM-IV include impulsivity within the diagnostic criteria (e.g., antisocial and borderline personality disorders), and often co-occurs with a substance abuse or dependence diagnosis (APA, 1994). Further, substance use itself has been conceptualized as impulsive behavior (e.g., Lane et al., 2003). However, beyond the general documentation of trait-impulsivity in drug users (i.e., greater levels of impulsivity are related to greater levels of drug use; Kirby, Petry, & Bickel, 1999; Krueger, Caspi, Moffitt, Silva, & McGee, 1996; Moeller et al., 2001, Moeller et al., 2002, Monterosso, Ehrman, Napier, O'Brien, & Childress, 2001), there is reason to believe that levels of impulsivity may be differentially associated with crack/cocaine use in particular. Although the literature on this topic is sparse, some researchers have suggested (though not testing this hypothesis explicitly) that cocaine's disinhibitory and euphoric effects increase impulsive responding, thus leading to a variety of high-risk behaviors, most notably unsafe sexual behavior (Avants et al., 2003; Kalichman, Belcher, Cherry, Williams, & Allers, 1998; Wilson, Minkoff, Dehovitz, Feldman, & Landesman, 1998). Indeed, the one available study provides mixed evidence suggesting that crack/cocaine users may be higher in impulsivity than heroin users (Donovan, Soldz, & Kelley, 1998).

Despite the lack of explicit research on this topic, indirect evidence may be taken to further support the hypothesis that levels of impulsivity may be positively associated with crack/cocaine use specifically. First, it is well accepted that traits such as impulsivity

and constraint have a biological basis (cf. Cloninger, 1987). Some researchers, however, have suggested that given the pharmacological effects of the drugs and individual differences in biological substrates that have emergent psychological properties (i.e., temperament, personality dispositions), certain drugs may have differential reward value for some individuals relative to others (Conway, Swendsen, Rounsaville, Merikangas, & Ries, 2002). For individuals with high levels of impulsivity, select substances (e.g., cocaine, amphetamines) may be especially rewarding. Other researchers have suggested that individuals high in impulsivity perceive incoming stimuli as muted or reduced (low-reactive) compared to individuals low in impulsivity (high-reactive); further, in the former individuals, reduced autonomic reactivity has been observed (cf. Zuckerman, 1984; Patrick, 1994). As such, impulsive individuals may then be more likely to prefer drugs such as crack/cocaine that tend to intensify or sharpen perception and experience. Conversely, low impulsive individuals may evidence drug preference for heroin or other substances that tend to attenuate or buffer sensory experiences (Compton, 2000). Taken together, it is reasonable to propose that levels of impulsivity present vulnerability not only for substance use in general, but certain drugs in particular.

In addition to a relationship between impulsivity and drug use, the literature also suggests a direct relationship between level of impulsivity and level of RSB (Horvath & Zuckerman, 1993; Donohew et al, 2000). To explain this finding, researchers have proposed that the tendency to engage in RSB reflects biologically based temperamental factors (i.e., impulsivity and sensation seeking; Zuckerman, 1991). Similarly, other researchers have proposed that RSB reflects an individual's general attraction to risk. For example, Farley (1991) has found that adolescents characterized as arousal seekers begin

engaging in sexual intercourse at an earlier age, report a greater number of partners, and engage in more varied sexual behaviors then adolescents who are arousal reducers. Thus, it is reasonable to conclude that biological dispositions (i.e., arousal seeking, impulsivity) increase vulnerability for engaging in RSB.

Given the paucity of literature, it is difficult to speculate on the causal direction of a relationship among impulsivity, drug choice, and RSB; however, several models are possible. First, given that impulsivity has been shown to have biological and genetic basis and can be conceptualized as a trait-like factor (e.g., Krueger et al, 2002), one can propose that this biological factor presents a vulnerability to both RSB and the use of drugs such as crack/cocaine. Another reasonable conclusion is trait-like impulsivity as a biological disposition leads to subsequent choice of crack/cocaine, which then impacts RSB (Miller & Neaigus, 2002). Conversely, there is reason to believe that impulsivity may result from acute effects (i.e., current pharmacological effects) and/or chronic effects (i.e., brain damage) of cocaine use. Studies in both animals and humans show that low serotonergic tone is associated with impulsivity (e.g., Brady, Myrick, & McElroy, 1998; Martin et al, 1994); further, repeated administration of cocaine is found to lower the brain serotonergic tone, promoting the loss of self-control and behavioral inhibition (Levy, Rittenhouse, & Li, 1992). Evidence again is indirect, yet it is plausible to propose that (a) crack/cocaine use results in both increased impulsivity and RSB or (b) crack/cocaine use results in impulsivity, which then impacts RSB. Although testing of these directional models ultimately is necessary, currently it is first necessary to establish the basic relationships between impulsivity, drug choice, and RSB, as would be provided with mediational analyses.

Multidimensional Nature of Impulsivity

One difficulty in examining impulsivity and its relationship with the other key variables is the multidimensional nature of the construct (Evenden, 1999; Monterosso, Ehrman, Napier, O'Brien, & Childress, 2001; Whiteside and Lynam, 2002). Definitions of the construct include, but are not limited to, the inability to delay gratification (Mischel, Shoda, & Rodriquez, 1989), the process of discounting a reward as a function of delay (Ainslie, 1975), and the inability to inhibit prepotent responding (Logan, 1994; Newman, Patterson, & Kosson, 1987); Several tasks and self-report instruments have been developed to measure each of these dimensions. Despite the recognized multidimensionality of impulsivity, most studies examining the construct examine one dimension of the construct in isolation without considering the implications (for an exception, see Lane, Cherek, Rhodes, Pietras, & Tcheremissine, 2003). Thus, it is difficult to speculate on the generalizability of the results across other dimensions of impulsivity, and more importantly, on how specific components of impulsivity are related to substance use.

To begin to study impulsivity as a multidimensional construct, it is first important to consider each dimension and the strategies for assessing these dimensions. At the most basic level, instruments measuring impulsivity may be subdivided into self-report and behavioral approaches. One distinction between these methods is that the self-report instruments are hypothesized to measure global personality dispositions, whereas behavioral measures of impulsivity evaluate performance under controlled conditions in the laboratory (Lane et al., 2003). The existing literature on the relationship within and between the two modalities is conflicting. Whereas self-report measures of impulsivity

often evidence some interrelationship (e.g., Lejuez et al., 2002), behavioral tasks often do not (Mitchell, 1999). Further, most studies find little relationship between self-report measures of impulsivity and their behavioral counterparts (Lane et al., 2003, Monterosso et al., 2001). In addition to a role of measurement error across tasks, these equivocal results suggest different dimensions of impulsivity. Thus, in the following section, several definitions/measurements of impulsivity are outlined, focusing on those that have been shown to be related to substance use.

Self-Report Measures: Patton et al. (1995) hypothesized three factors that reflect different components of impulsivity: attentional impulsiveness (i.e., the ability to focus on tasks at hand and cognitive instability), motor impulsiveness (i.e., acting on the spur of the moment/task persistence and perseverance), and non-planning impulsiveness (i.e., self-control and cognitive complexity). Using a scale that focuses on such factors (Barratt Impulsiveness Scale, BIS-11), studies of adolescents and young adults have demonstrated a relationship between impulsivity and overall drug use (Stanford, Greve, Boudreaux, & Mathias, 1996), level of cocaine use, withdrawal severity, and treatment dropout (Moeller et al, 2001), as well as severity of MDMA use (Moeller et al, 2002). Additionally, Tellegen et al. (1985) has proposed a personality system focused on three components: positive emotionality, negative emotionality, and constraint (i.e., control versus impulsiveness). In this system, constraint is hypothesized to tap into an individual's level of caution, restraint, propensity for risk-taking behavior, and acceptance of conventional society, and partially determines an individual's response to emotional stimuli. A relationship between Constraint scores on his Multidimensional Personality Questionnaire (MPQ; Tellegen et al., 1985) and subsequent substance use has been

demonstrated both cross-sectionally (Conway, Swendsen, Rounsaville, & Merikangas, 2002), as well as longitudinally (Swendsen, Conway, Rounsaville, & Merikangas, 2002). Beyond a total score, the non-planning subscale may be most relevant to RSB. For instance, a lack of planning may lead to a corresponding lack of protective paraphernalia in a moment of passion.

Less well known is the model of impulsivity operationalized by Whiteside and Lynam (2001, UPPS). Drawing on the five-factor model of personality (e.g., Costa & McCrae, 1992), the researchers have partitioned this construct into four personality traits representing distinct pathways to impulsive behavior: premeditation, urgency, sensation seeking and perseverance. Urgency or compromised ability to resist impulses that are driven by negative affect is hypothesized to be related to both borderline personality disorder and bulimia symptoms (disorders characterized by a high degree of impulsivity and negative affect). Individuals with such pathology are known to engage in impulsive behaviors that are intended to alleviate affective distress. Indeed, Fischer, Smith, and Anderson (2003) found that urgency but not lack of premeditation was associated with bulimic symptoms (e.g., binging, a behavior well-known to be used as a means of attenuating negative affect, Deaver, Miltenberger, Smyth, Meidinger, & Crosby, Ross, 2003). Regarding perseverance, Whiteside and Lynam (2001) suggest that the lack of ability to persist in a task despite boredom may play a role in the symptomatology of attention-deficit/ hyperactivity disorder (ADHD), a disorder in which high levels of impulsivity have been repeatedly documented. The third factor, or premeditation, is defined as the individual's ability to reflect on the consequences of a possible action, as well as the ability of the individual to choose between smaller, more immediate rewards

and larger but delayed rewards. Finally, sensation seeking, or the individual's need for stimulation is thought relate to engagement in risky activities such as drug use (e.g., Donohew et al., 1999, Lejuez et al, 2002).

Although the scale has been tested less extensively in clinical samples, the concept of different pathways to impulsive behavior is relevant to drug use (i.e., cocaine and heroin). Indeed, Whiteside and Lynam (2002) found that the UPPS differentiates pathways to alcohol abuse across subjects with and without antisocial personality disorder. One can then reasonably speculate that those subsets of drug using individuals that are documented to have high levels of negative affect (Gunnarsdottir et al., 2000) are likely to engage in impulsive responding (i.e., further drug use) to lessen such discomfort. Other subtypes have been shown to have a high degree of boredom susceptibility (Hutchison, Wood, & Swift, 1999), and may use substances to alleviate this aversive state. Further, it is hypothesized that yet another subtype of drug users are likely to engage in sensation seeking, possibly due to their hypothesized underarousal, another aversive state (e.g., Patrick, 1994). Because the proposed study aims to explore the meaning of the differences regarding impulsivity across drug groups, the concept of pathways to drug use may assist in differentiating the motivation across drug preference, with the most relevant subscales being urgency and sensation seeking (premeditation and perseverance provide somewhat redundant sets of information compared to the more commonly used BIS).

Finally, a somewhat overlooked variable that may be very relevant to risk behavior in general and substance use specifically is that of impulsive (unplanned) aggression. Indeed, more then half of domestic violence perpetrators present with

substance-related disorders (Maffli & Zumbrunn, 2003; Murphy, O'Farrell, Fals-Stewart, & Feehan, 2001; Stuart, Moore, Ramsey, & Kahler, 2003). Men entering treatment for alcoholism are four to six times more likely than nonalcoholic men to have engaged in partner violence (O'Farrell & Murphy, 1995), and substance use is reported in approximately 40% of domestic assaults (Leonard, 1993) and 70% of domestic homicides (Slade, Daniel, & Heisler, 1991). Beyond aggression directed toward others, impulsive aggression is often turned against the substance user himself. Indeed, substance abusers are up to 7.5 times more likely than non-substance abusers to attempt suicides (Anderson et al, 1995; Harris & Barraclough, 1997; Moscicki, 1997; Shaffer, Gould, Fisher et al., 1996). Finally, impulsive aggression is related to other types of risky and problematic behavior, namely RSB. Indeed, a large body of literature (albeit focused on adolescents) has demonstrated that aggression predicts engagement in RSB both cross-sectionally (Donenberg et al, 2001) and longitudinally (Prinstein & La Greca, 2004). Although impulsive aggression has been investigated via multiple measures and even measurement modalities, one specific instrument that has received recent attention is the Inventory of Interpersonal Problems, Aggression Subscale (IIP-AG; Horowitz, Rosenberg, Baer, Ureno, & Villasenor, 1988). This measure has been shown to predict impulsivity, depression, bulimia, and perfectionism in college students, and externalizing and problem behaviors in a sample of inner-city drug users (Lejuez et al, 2003). Further, IIP-AG predicts symptom severity of borderline personality disorder, a disorder well-known for poor impulse control (Pilkonis, Kim, Proietti, & Barkham, 1996; Ryle & Beard, 1993; Yeomans, Hull, & Clarkin, 1994).

The use of global personality questionnaires has provided statistically significant prospective predictions of future risk behaviors (i.e., RSB and substance use), but the variance accounted for by these variables, alone or in combination, has been small (Bartlett et al., 1995), and the use of such self-report measures is plagued with several problems. First, the results of these studies have been inconsistent across settings, limiting their clinical significance at the practical or applied level. These findings also are concerning for methodological reasons. Specifically, when the same mode of assessment is employed to index a construct of interest (e.g., multiple self-report methodologies to assess impulsivity), there is the concern that this approach exaggerates correlation coefficients across questionnaires, when the correlation coefficients are due to little more then the influence of the same modality (e.g., Cohen, 1988; Lane et al., 2003). Further, behaviors that are representative of a trait may vary across ethnic or cultural groups and may not be applicable to some ethnic minorities (Kagan, 1998). Additionally, self-reporting may be affected by automatic (e.g., failure to remember) and/or strategic (e.g., lying) distortions in responding (e.g., Leigh & Stall, 1993). Finally, due to the effects of chronic drug use, some inner-city drug users may lack the insight or cognitive ability to understand questions or provide an accurate report of their own behavior. Thus, when assessing a multi-dimensional construct, a multi-trait, multi-method approach similar to the approach suggested by Campbell and Fiske (1959) brings psychologists closer to understanding the processes of behavior and provides a more comprehensive framework then a single modality alone.

Behavioral Measures: Given the aforesaid criticisms of self-report instruments, it is appropriate to consider a different measurement modality of impulsivity. Along with

self-report measures of impulsivity, several behavioral measures have been developed. A well-known operationalization of impulsivity concerns the concept of *delay discounting* (Ainslie, 1975, 1992; Kirby et al., 1999). This model attempts to address impulsivity in a behavioral manner, and states that chronic drug users tend to choose immediate and short term rewards of drug use (i.e., instantaneous euphoria and relief from withdrawal/negative affect) over possible larger, delayed rewards and/or the avoidance of negative consequences resulting from drug abstinence. Such delayed consequences concern financial, social, and legal negative outcomes, consequent negative affect, and even the contraction of such diseases as HIV (Kirby et al., 1999). Thus, the delay-discounting model is based on the tenet that as a reward is delayed, its value is systematically discounted, such that impulsive individuals prefer smaller immediate rewards over larger delayed rewards. Past work has found drug users to have substantially high rates of delay discounting. As an example, Coffey, Gudleski, Saladin, & Brady (2003) compared impulsivity in crack/cocaine users and normal controls by presenting hypothetical immediate and delayed rewards (i.e., money). Crack/cocaine users were found to discount delayed rewards at a higher rate then a control group. Using a similar design and measures, this effect was also found in heroin users (Kirby et al., 1999). Interestingly, when heroin users were presented with delay discounting scales concerning drugs or money, these individuals discounted delayed heroin significantly more then delayed money (Madden, Petry, Badger, & Bickel, 1997).

Targeting yet another subtype of impulsivity is Logan's (1994) "Stop Signal" paradigm, defined as response inhibition, where the dependent variable is the ability to stop a motor response after its execution has been initiated. The Stop Signal Task is based

on a quantitative model of behavioral inhibition known as the 'race' model, in which the ability to inhibit a response is viewed as a 'race' between a go process (the initial reaction time to execute a response) and a stop process (the time needed to inhibit the response; Logan, 1994). A large number of studies have shown that Stop Signal task performance is impaired in children with ADHD (e.g., Oosterlaan, Logan, & Sergeant, 1998b; Quay, 1997), and is correlated with self- report measures of impulsivity among normal volunteers (e.g., Logan, Schachar, & Tannock, 1997). Further, data have shown that in chronic cocaine users, acute cocaine administration impairs response inhibition (Fillmore, Rush, & Hays, 2002) and long-term cocaine self-administration impairs inhibitory functions and leads to a loss of control over behavioral impulses (Fillmore & Rush, 2002). These data are especially significant in their implications for RSB. Specifically, one can hypothesize that long-term cocaine self-administration may compromise the ability to control impulses (i.e., sexual arousal) long enough to engage in alternative safe behavior.

The Balloon Analogue Risk Task (BART; Lejuez et al., 2002) concerns the behavioral measurement of impulsive risk-taking. This task has been shown to correlate with addictive, health, and safety risk behaviors, beyond the variance accounted for by self-report measures of risk-related constructs such as sensation seeking and impulsivity. In this task, participants weigh potential gains against potential losses (for a more detailed description, see below). In the past, findings have shown that the level of risk-taking on the BART was correlated with self-reported sensation seeking, venturesomeness, and impulsivity. Further, the level of risk-taking on the BART also was highly correlated with reported participation in regular smoking, alcohol abuse, polysubstance use, and

gambling, as well as an aggregate of non-addictive risks including unsafe sexual intercourse, infrequent seat belt use, and stealing. Additional studies using the BART suggest that in addition to correlating with risk behaviors, the BART has predictive value in regard to these risk behaviors above and beyond that provided by demographics and self-report measures. Two further studies indicated that the BART differentiates smokers and non-smokers (Lejuez, Aklin, Jones et al., 2003), as well as engagement in sexual risk taking behavior among inner city treatment seeking drug users (Lejuez, Simmons, Aklin, Daughters, & Dvir, in press) over and above the aforementioned self-report measures and a second behavioral risk-taking task. Finally, two additional studies have extended these results to the prediction of risk-taking behavior in inner-city high school student samples (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, in press; Lejuez, Aklin, Zvolensky, & Pedulla, 2003). Although recently developed, this task is well applicable in samples of drug users and preliminary pilot data suggests that crack/cocaine users evidence greater levels of impulsive risk taking than heroin users ($n = 39$; $p < .05$).

Summary and Rationale for Current Study:

As rates of HIV infection continue to increase, it becomes increasingly necessary to create prevention programs for risk behaviors that are both effective and efficacious (e.g., Fergerson, 1998; Ramirez, Gossett, Ginsberg, Taylor, & Slap, 2000).Given the limited success of current "one size fits all" programs, a targeted intervention and treatment approach, namely one targeting mechanisms that result in HIV-risk behavior and RSB in particular will likely be critical in the future development and overall success of HIV prevention programs. Before such programs can be created and put into motion, however, researchers must identify factors that underlie the engagement in RSB, and

elucidating the individual difference variables, namely impulsivity, may be a first step in identifying these key mechanisms.

Following from suggestive findings in the literature, there is a clear need to provide further clarification regarding the relationship between drug choice and engagement in RSB. Specifically, there is plentiful evidence to suggest that (a) drug use is related to engagement in RSB, with this relationship differing across drug of choice; (b) this data can be taken to suggest the possibility that crack/cocaine presents a unique risk factor for RSB; (c) the existing research lacks both a theoretical framework as well as groups clearly separated by drug of choice; (d) a true test of the role of drug choice requires independent groups (e.g., crack/cocaine vs. heroin users) to more clearly isolate resulting differences, as well as an examination of individual differences (i.e., personality variables) to develop a tentative theoretical framework; and (e) when assessing personality variables (i.e., impulsivity) one must recognize the multi-faceted and possibly unrelated nature of such variables and utilize multiple modalities to present a well-developed framework.

Past research has provided suggestive data that begins to address the issues outlined above. A recent study by our group (Lejuez, Bornovalova, Daughters, & Curtin, 2004) indicated that crack/cocaine users compared to heroin users evidenced higher levels of sexual risk behavior as measured by the HIV Risk Behavior Survey (Darke, Hall, Heather, Ward, & Wodak, 1991) and impulsivity as measured by the Eysenck Impulsiveness self-report questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985). This study utilized individuals in residential drug treatment who were currently abstinent from drug use, but the study focused on patterns of behavior prior to beginning treatment.

Therefore, it is difficult to determine if the resulting differences in sexual risk and impulsivity across heroin and crack/cocaine users were lasting, or whether the results were due simply to the acute pharmacological effects of crack/cocaine during periods of drug use. To address this issue, Bornovalova, Daughters, Hernandez, Richards, and Lejuez (in press) sought to examine differences in impulsivity and risk taking among crack/cocaine and heroin groups in a manner that would not include the influence of acute drug effects. Specifically, using inner-city drug users in residential treatment, Bornovalova and colleagues focused on differences in behavioral measures of risk and impulsivity. Findings indicated that compared to heroin users, crack/cocaine users were both more risky and impulsive then heroin users. Unfortunately, this study did not examine RSB as an outcome variable, and thus, it is not clear how behavioral differences in impulsivity, even in the absence of acute drug effects, are predictive of RSB.

Extending previous research (e.g., Bornovalova et al, in press; Joe & Simpson, 1995; Lejuez et al, 2004), the current study proposes to utilize more clearly differentiable groups of heroin and crack/cocaine users and a comprehensive battery of impulsivity assessment measures to examine the role of this construct. To truly elucidate whether the relationship between RSB and drug choice is due to a preexisting disposition to impulsivity or the pharmacological effects of the drug, it becomes necessary to utilize both global and situational measures of RSB that consider contextual factors (Chawarski et al, 1998; Leigh & Stall, 1993). For the purpose of construct validity and in accordance with the recommendations of Campbell and Fiske (1959), it is necessary to utilize more then one measure of RSB, one providing detailed information about contextual influences and one providing brief information about quantify and frequency of RSB. In a related

manner, given the lack of consensus on the conceptualization and measurement of impulsivity, the proposed study allows for the isolation of several dimensions of impulsivity and more importantly, these components' relationship to our criterion variable. Although several other variables could be examined, the investigation of impulsivity serves as a reasonable first step, following up previous research suggesting that disinhibition processes including impulsivity may underlie the development of risk-taking behaviors including drug use and RSB.

Thus, in the current study, we compared level of RSB across the following three groups of individuals beginning residential drug use treatment: a) primary crack/cocaine users defined as crack/cocaine dependent and using crack/cocaine on at least a weekly basis over the past three months and not heroin dependent using heroin no more then once monthly over the past three months; b) primary heroin users defined as heroin dependent and using heroin on at least a weekly basis over the past three months and not crack/cocaine dependent using crack/cocaine no more than once monthly over the past three months; and c) primary both heroin and crack/cocaine user defined as heroin dependent using both drugs on at least a weekly basis over the past three months. Further, when appropriate, we controlled for the moderating effects of demographics and level of other drug use including marijuana, alcohol, and hallucinogens, as well as the mediating effects of impulsivity across several domains of this construct. Finally, we utilized three measures of RSB: the HIV Risk Behavior Scale (HRBS, Drake et al, 1991), the TCU AIDS Risk Assessment (ARA, Joe, Menon, Copher, & Simpson, 1990), and the "communicable disease" subscale of the AIDS Risk Inventory (ARI, Chawarski et al, 1998). Whereas the HRBS provides a "quick and dirty" measure of RSB, the ARA allows for more thorough information on partner type as

well as information on RSB in individuals across the following contexts: a) sexual behavior under the influence of drugs/alcohol, b) sexual behavior NOT under the influence of drugs/alcohol. To provide additional information on the consequences of risk behavior, the ARI allows determination of a history of communicable diseases, including Hepatitis (A, B, and C), HIV/AIDS, and any STD. Finally, several potential confounds and/or covariates, including pathways to treatment (i.e., if participant was legally mandated into treatment), other indices of risk, such as "dirty" needle use, and the presence of impulse-control-related personality disorders, namely, borderline and antisocial personality disorders.

Hypotheses:

We proposed that primary crack/cocaine users, compared to primary heroin users, would evidence higher levels of overall RSB (as indexed by score on the Sexual Behavior Subscale of the TCU AIDS Risk Assessment and the AIDS Risk Inventory), even after controlling for demographic variables and level of other drug use. Elevated RSB was evidenced by variables including, but not limited to condom non-use across partners, exchange of sex for money or drugs, and anal sex. To assess the consequences of RSB, we hypothesized that primary crack/cocaine users would evidence a greater history of communicable diseases then heroin users. Additionally, we hypothesized that primary crack/cocaine users, compared to primary heroin users, would evidence higher levels of impulsivity as indexed by both self-report and behavioral measures across the following domains: (a) Self-reported pathways to impulsivity including sensation seeking, urgency, and non-planning (Barratt's Impulsiveness Scale and Whiteside and Lynam's UPPS); (b) Self-reported behavioral constraint (Tellegen's Multidimensional Personality Questionnaire); (c) impulsive aggression (IIP, Horowitz, 1988), (d) Delay discounting

(Kirby's Money/Drug Choice Questionnaire); (e) Response inhibition (Logan's Stop-Go Task), and (f) Impulsive Risk Taking (Lejuez's Balloon Analogue Risk Task). Finally, after controlling for demographic variables and level of other drug use, we predicted that the group differences in RSB would be mediated by level of impulsivity across each domain above.

As a secondary goal, we aimed to provide exploratory data on the inter-relationship among the self-report and behavioral measures of impulsivity. Although available data suggest that each domain of impulsivity should be related to drug choice and RSB, data also indicate that these domains themselves aren't necessarily intercorrelated. In this way, this study aimed to provide Thus, this study aimed to provide useful information for clarifying the multidimensional construct of impulsivity. Because a large body of literature has repeatedly shown a lack of relationship between components of impulsivity (e.g., Lane et al, 2003), and because there is an abject paucity of literature regarding impulsivity and RSB, we did not have specific hypothesis regarding the expected relationships.

Chapter 2: Research Design and Methods

Overall Design and Procedure:

Prospective participants were sampled form 153 consecutive admissions in a substance use residential treatment facility in the DC Metropolitan area. At the beginning of the session the participant was given a more detailed explanation of the procedures and asked to provide written informed consent. Given issues of reading comprehension, efforts were made to ensure that participants understand all facets of the consent form and the study itself. During the time that the participants were completing the questionnaires, individuals trained in administering the diagnostic interviews took the participants one by one into an adjacent room where they completed the interview in accordance with the recommendations of First et al (2003). A similar procedure was employed for the computerized behavioral measures (Stop/Go, Delay Discounting, and BART; for more details, see below). The order of completion of the behavioral measures was counterbalanced across participants. Each participant was reminded before the task that the better they perform on the task the more money they would earn. After completion of the tasks, the participant returned to the classroom and finished completing the questionnaires. A proctor was in the classroom at all times to provide instruction and answer any questions the participants had. Following completion of the diagnostic interview, the behavioral measures, and the questionnaires, participants were told how much money they have earned and they signed a receipt. The money was then deposited in their personal account at the Salvation Army Harbor Lights facility on the next business day. In total, the entire session lasted about 120 minutes.

Inclusion/Exclusion and Design Considerations:

We made several decisions regarding the experimental design and inclusion/exclusion criteria. One consideration was whether to include or exclude individuals with Axis I disorders and/or use of psychotropic medications. Due to the high rate of Axis I co-morbidity in drug dependence (DeJong, van den Brink, Harteveld, & van der Wielen, 1993; Ziedonis et al., 1994), it was clear that including such individuals would maximize external validity (Rounsaville, Weiss, & Carroll, 1999), and in contrast, excluding individuals with Axis I comorbidity would greatly limit our sample. Indeed, the recent NIDA Collaborative Cocaine Treatment Study reported that 33% of the individuals met criteria for a substance induced mood/anxiety disorder. Further, when attempting to elucidate an Axis I mood/anxiety disorder that is preexisting from one that is substance induced, we increase the possibility of error in diagnosis. Thus, we elected to include co-morbid conditions and individuals taking psychotropic medications, but included several self-report and interview measures of psychopathology (see Measures section), and used these variables as covariates in subsequent analyses if necessary. As a second consideration, we debated over exclusion criteria based on drug use other then crack/cocaine or heroin. Although excluding individuals who are using, and are possibly dependent on other drugs may have provided even further isolation of drug effects of crack/cocaine and heroin, we decided such exclusion would be unnecessarily restrictive and unreflective of the common occurrence of polysubstance use (Carroll, Rounsaville, Bryant, 1993). Again, we examined this variable in all subsequent analyses.

Our second decision focused on the most appropriate period of time for initial assessment. To ensure that initial withdrawal symptoms do not interfere with an

individuals ability to complete the assessment session or their performance on the behavioral procedures, as well as to control for the effects of time in treatment, participants were assessed no sooner than 48 hours and no later than 7 days after they arrive at the facility. Further, we administered a Mini-Mental Status Exam (MMSE). Any participant deemed unable to participate on the MMSE (whether withdrawal induced or not) was excluded from the study. It should be noted that individuals must have passed through detoxification and were completely free of drugs at intake, thereby limiting the likelihood of extreme withdrawal effects even at the 48 hour period.

Finally, we considered the inclusion of individuals over the age of 59, as well as those who are demonstrating acute psychotic symptoms. We decided to exclude these individuals for two reasons. Regarding age, one finding that is both impulsivity and risky sexual behavior increase throughout youth, peak in young adulthood, and then decline with age (e.g., Stall et al, 1992). Together, it is clear that the inclusion of individuals over the age of 59 would introduce unnecessary variance into the data. Similarly, inclusion of individuals demonstrating acute psychotic symptoms introduces concerns of reporting accuracy, insight, and memory (Heinrichs and Zakzanis, 1998), that is, qualities that are necessary for an accurate completion of the experimental procedures. Thus, individuals that were acutely psychotic were excluded from the study.

Participants:

As shown in Table 1, participants were 86 individuals (*M* age = 42.34; *SD* = 7.35; 63% male; 92% African American, 7% Caucasian, 1% "other"), with a mean income of $21,195 (SD = $2,633). 23% of the participants had an education level of "less then high school", 40 % had a "high school or equivalent" level, and 37% had "some college and

above" level. At the time of testing, all participants were living in a substance use residential treatment facility located in an inner-city area in NE Washington DC. Treatment at this center involves a mix of strategies adopted from Alcoholics and Narcotics Anonymous as well as group sessions focused on relapse prevention and functional analysis. Complete abstinence from drugs and alcohol is required upon entry into the center and through the duration of the program, with the exception of caffeine and nicotine; regular drug testing is provided and any drug or alcohol use results in immediate dismissal from the center. When needed, detoxification from an outside source is required prior to entry into the center. Typical treatment lasts between 30 and 180 days and aside from scheduled activities (e.g., group retreats, physician visits), residents are not permitted to leave the center grounds during treatment.

Of the total included 86 participants, a) 44 were primary crack/cocaine users defined as those who were dependent on crack/cocaine and were using the drug at 2-3 times per week and who reported using heroin less than 2-3 times per week over the past year prior to treatment; b) 18 were primary heroin users, defined as those who were dependent on heroin and reported using at least 2-3 times per week and who reported using crack/cocaine less than 2-3 times per week over the past year prior to treatment, and c) 24 were primary crack/cocaine and heroin users defined as those who were dependent on both drugs in question and reported using both drugs at least 2-3 times per week over the past year prior to treatment. Finally, all individuals must have met dependence criteria (as measured by the SCID-IV-NP, First et al, 2003) for their primary drug of choice.

In addition to the inclusion/exclusion criteria already established, potential

participants were required to be abstinent for at least 3 days prior to starting the center to limit confounding effects of withdrawal symptoms, between the ages of 18 and 59, and to not display any current psychotic symptoms as measured by a semi-structured clinical interview. The 8 participants excluded based on age and the 11 participants excluded based on a psychosis diagnosis, 26 participants who were not dependent on crack/cocaine, heroin, or both drugs, as well as 22 other participants who a) did not complete the full questionnaire packet, or b) were deemed "invalid" (with this score tapping social desirability) via the MPQ scoring program are not part of the total sample of 86.

Measures:

Measures were organized into three domains: (a) demographic and clinical, (b) RSB, and (c) impulsivity. A table outlining each domain and the particular measures assessing each domain is provided below (see following page).

Domain	Measure	Purpose
Demographics and Psychopathology		
	Demographics Sheet	Basic information on age, gender, race, education level, marital status, and total household income.
	SCID-NP	Diagnostic Information (All Axis I Psychopathology, Select Assessment of Character Disorders)
	Medication Sheet	Frequency, Dosage, and Type of Various Medications, including psychotropic, non-psychotropic, and over-the-counter medication
	DUDIT	Further assessment of drug use (quantity/frequency)
	Treatment History Questionnaire	Assessment of pathways to treatment
RSB and Other Indices of Risk	HRBS-RSB	Global Measure of RSB
	ARA	Contextual and Situational Association Measure of RSB, frequency of injection drug use, frequency of "dirty" needle use
	History of Communicable Diseases	Supplemental Measure of RSB
	BIS	Measure of attentional, motor, and non-planning impulsiveness

Impulsivity	Self-Report Measures	MPQ	Assessment of the level of caution, restraint, propensity for risk-taking behavior, and acceptance of conventional society.
		UPPS	Measures of four distinct pathways to impulsive behavior: premeditation, urgency, sensation seeking and perseverance.
		IIP-AG	A subscale of the IIP to measure impulsive aggression
	Behavioral Measures	Stop/GO	Measure of the inability to inhibit prepotent responding
		BART	Measure of Impulsive-Risk-Taking Propensity.
		Delay Discounting	Measure of propensity to discount a reward as a function of delay.

Demographic Information:

A short self-report questionnaire was administered to obtain age, gender, race, education level, marital status, and total household income. These variables were used as covariates to control for variability across scores on behavioral measures.

Assessment of Axis I and II Psychopathology, Structured Clinical Interview for DSM-IV (SCID-NP, non-patient version):

Diagnostic inclusions/exclusions and lifetime prevalence of select Axis I diagnoses (i.e., alcohol dependence, non-alcohol substance dependence, and current psychosis) were determined using the Structured Clinical Interview for DSM-IV (SCID –NP, non-patient version; First, Spitzer, Gibbon, & Williams, 1995), and the Strucutred Clinical Interview for DSM-III-R for Antisocial and Borderline personality disorders (SCID-II-NP). Both measures have previously demonstrated high reliability and validity (Spitzer, Williams, Gibbon, & First, 1989).

Medication Status:

To determine if psychotropic or other medication may influence the expected results, we collected data from the subjects by simply asking which medications they are taking currently, and which ones they have been taking in the past week (if any), as well as dosage and frequency. Medication was coded as a dichotomous variable, and divided into status on the following: selective serotonin reuptake inhibitors, SSRIs; anxiolytics; atypical antipsychotics; other psychotropic medications, and other medications including over-the-counter antihistamines, sleep aids).

Assessment of Drug Use:

Drug use was assessed using both a structured clinical interview for assessment of substance dependence (i.e., SCID-NP), and a self-report measure modeled after the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993), with frequency assessed both in terms of past year use as well as heaviest lifetime use. In addition to crack/cocaine and heroin, substance dependence and substance use frequency also was taken for the following drug classes: a) alcohol, b) marijuana, and c) hallucinogens including PCP.

In addition to the SCID which provides a diagnostic decision on whether an individual fits criteria for substance abuse, dependence, or neither, a quantity/frequency measure of all other drug and alcohol use was assessed with a standard drug use questionnaire (e.g., Babor & Del Boca, 1992). Specifically, participants were asked if they have ever used a particular drug in their lifetime, how often they used it in the past year prior to treatment, and how often they used the drug during the period of their life when they were using it most frequently. Development of a composite score was guided by the work of Kirischi et al (2002).

Treatment History:

The treatment history questionnaire assessed treatment history such that individuals were asked if they were or were not mandated to enroll into substance abuse treatment.

Assessment of RSB

HIV Risk Behavior Scale (HRBS): The 5-item sexual risk behavior subscale of the HIV Risk-taking Behavior Scale (HRBS-SRB; Darke et al., 1991) was used as a global index of engagement in RSB. For each item on the HRBS-SRB, participants provided answers on a six point scale, with higher scores indicating higher risk. Specific questions address total number of sexual partners, the frequency of risky sexual behavior including condom nonuse with regular partners as well as with acquaintances, condom nonuse when money/drugs were exchanged and total instances of anal sex. The HRBS-SRB measures sexual risk behavior across either 6 months or 1 month timeframes. In every version, the timeframe is clearly stated as "prior to beginning of treatment." The reliability and validity for this measure have been well established (Darke et al., 1991) give alpha; however, when all five items were analyzed for psychometric properties in the current study, reliability was relatively poor ($\alpha = .52$). In contrast, reliability was acceptable when one apparently extraneous variable (i.e., frequency of unsafe sex with primary partner) was taken out ($\alpha = .65$). As such a total score without primary partner also was considered.

AIDS Risk Assessment (AIA, Simpson, 1997). The ARA is a brief and well-validated measure of HIV-risk behavior including "dirty works" and RSB, specifically measuring sex without condoms with risky partners, previous HIV tests and results, and concerns and attitudes toward condom use. This measure assesses for drug use patterns and history as well as risk behavior in 30-day and 6-month time frames. Regarding dirty

needle use in particular, this measure obtains an index of the following for the last 6 months: the number of times using dirty needles and the number of times sharing cooker, rinse water, or cotton. This specific index is measured on a likert-type scale with responses ranging from 0 (none) to 8 (4 times a day). Using the same timeframe (i.e., last 6 months), the scale also obtains a total number of partners in the six months before treatment, as well as number of partners across relationship, that is, with a regular partner, stranger, or for commercial trade. These variables are coded as follows: 0=0; 1=1; 2=2-4; 3=5-7; 4=8-14; 5=15-20; 6=21-30; 7=30+. Further, the scale includes an index of RSB items as measured by the times the individual engaged in sex without a condom with an injection drug user, stranger, or for trade. Finally, several items added to this measure assess if RSB in each relationship context occurred in the presence or absence of acute pharmacological effects of drugs and alcohol. In doing so, the scale now includes both "quantity" (raw number of instances that the individual engaged in sexual contact), and "frequency" counts, where responses for this scale range from 0 (never) to 5 (every day). Using the 30 day timeframe, the measure obtains the index of risky sex without a condom, with an injection drug user, with a stranger, for trade, with a cocaine user, or while "high". This measure has demonstrated adequate reliability and validity (see Joe & Simpson, 1995; Simpson 1997), with Cronbach's alpha ranging from .59 to .71.

AIDS Risk Inventory (Chawarski et al, 1998). We utilized the "communicable diseases" section of the ARI. Specifically, this section of the measure allows for the assessment of a history of sexually transmitted diseases such as Hepatitis, Gonorrhea, or Chlamydia. The ARI has demonstrated good internal and test-retest reliability and is

currently in use in a number of studies with inner-city drug users (e.g., Avants et al, 2003). The reliability and validity for this measure have been well established (Darke et al., 1991) and reliability in the current study was acceptable across both the past-month ($\alpha = .69$) and past-year versions ($\alpha = .77$).

Measures of Impulsivity and Related Constructs

Barratt (BIS-11) Trait-Impulsivity. Trait-impulsivity was assessed using the Barratt Impulsiveness Scale, version 11 (BIS-11; Patton, Stanford, & Barratt, 1995). The BIS-11 is a 30-item, self-report questionnaire that asks participants to rate how often a series of statements applies to them, based on the following scale: rarely/never, occasionally, often, or always/almost always. Item scores range from one to four. Cumulative scores range from 30 (low in trait-impulsivity) to 120 (high in trait-impulsivity). The BIS-11 has been normed on a variety of sample populations, including college students ($M = 63.82$, $SD = 10.17$), inpatient substance abusers ($M = 69.26$, $SD = 10.28$), and prison inmates ($M = 76.30$, $SD = 11.86$). The BIS-11 contains three subscales, which have been termed Motor Impulsiveness, Cognitive Impulsiveness, and Nonplanning. The BIS-11 has been shown to be reliable in both clinical and community samples, with Cronbach's alpha coefficients ranging from .79 to .83 (Patton et al., 1995). In the current study, we analyzed the BIS-NP (which is conceptually similar to the measure in Lejuez et al, 2004) as well as the BIS-total score. Reliability in the current sample was marginally adequate for BIS-NP ($\alpha = .57$), and acceptable for the total score ($\alpha = .83$).

Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982). In the current study, we utilized the Constraint superfactor of the MPQ. This self-report subscale was used at to assess individual differences in self-control and impulsivity.

Specifically, high scores on the constraint scales indicate someone who is restrained, cautious, and avoids dangerous types of excitement. The measure has high internal consistency (alpha coefficient = .85) and high 30-day test re-test reliability (r = .89). The MPQ has strong psychometric properties and good behavioral genetic data from twin studies (Tellegen et al., 1988). Reliability in the current study was acceptable, ranging from .8 to .9.

UPPS Impulsive Behavior Scale (Whiteside and Lynam, 2001). To measure impulsive pathways and motivations for drug use, we administered the UPPS Impulsive Behavior Scale (UPPS), which assesses four distinct facets of personality associated with impulsive behavior: urgency, (lack of) premeditation, (lack of) perseverance, and sensation seeking. This scale represents the personality approach to understanding impulsive behavior and is based on a factor analysis of frequently used impulsivity scales (Whiteside and Lynam, 2001). The UPPS consists of 44 items and has been derived from well-known impulsivity scales. The scale has been found to have good internal consistency as well as divergent and external validity. The alpha reliabilities have been found to be .87, .89, .85, and .83 for (lack of) Premeditation, Urgency, Sensation Seeking, and (lack of) Perseverance, respectively (Whiteside and Lynam, 2001). The reliability and validity for this measure has been shown to be good (Whiteside & Lynam, 2001) and reliability in the current study was acceptable (α = .82, .86, .80, .78 for the respective subscales). The current study focused on two subscales in the UPPS, namely Urgency and Sensation-Seeking, as well as the total UPPS score. The reliability and validity for this measure has been shown to be good (Whiteside & Lynam, 2001) and reliability in the current study was acceptable (α = .82, .86, .80, .78 for the respective subscales).

Inventory for Interpersonal Problems (IIP; Horowitz, 1988; Pilkonis et al, 1996) is a 47-item measure that provides a marker of Axis-II psychopathology and impulse-control problems (e.g., Pilkonis, Kim, Proietti, & Barkham, 1996; Scarpa et al., 1999). Items are rated on a five point scale, with each item focused on a behavioral deficit (e.g., "It is hard for me to trust other people") or behavioral excess (e.g., "I am too sensitive to criticism"). The measure is comprised of 5 subscales: (a) interpersonal sensitivity, (b) interpersonal ambivalence, (c) aggression, (d) need for social approval, and (e) lack of sociability. Internal consistency was established, with $\alpha \geq .80$ for each subscale. In the current study, the most relevant subscale concerned impulsive aggression, which was comprised of 7 items. The reliability and validity for this measure have been well established (Pikonis et al, 1996) and reliability in the current study was acceptable ($\alpha = .89$).

Delay Discounting Procedure (Kirby & Marakovic, 1996; Monterosso et al, 2001). Delay discounting refers to the degree to which an individual shows preference for either small, readily available rewards or larger, delayed rewards (i.e., the rate at which the subjective value of deferred rewards decreases as a function of the delay until they are received). This procedure is a computer-administered version of the original monetary-choice questionnaire (Kirby & Marakovic, 1996) which has extensively been used in research on sensation-seeking, impulsivity, and risk-taking, and has been found to correlate highly with other behavioral measures of impulsivity (Monterosso et al, 2001; Madden, et al, 1997). This task consists of a fixed set of 27 choices between smaller, immediate rewards and larger delayed rewards. For example, on the first trial participants were asked "Would you prefer $54 today, or $55 in 117 days?" The presentation order is

contrived so as not to correlate choice amounts, ratios, differences, delays or discount-rate implied by indifference to the two rewards. Participants are instructed to show preference by clicking a mouse on the appropriate option. From the responses an estimate "k" is derived to indicate level of impulsivity.

Stop/Go (Logan) Stop and Go Task (Logan, Schachar, & Tannock, 1997). The Stop/Go task is based on the hypothesis that impulsive behavior is reflected by the inability to inhibit prepotent responding. Research using the Stop and Go Task has corroborated this hypothesis showing a direct relationship between stop-signal reaction time and impulsivity as measured by self-report (Logan et al., 1997). This suggests that the Stop and Go Task is an accurate measure of impulsive behavior. This task begins with the presentation of either an *X* or an *O* in the center of the computer screen. Subjects are instructed to press the "*z"* key when the *X* appears and the "*/"* key when the *O* appears. The letters are presented at 2-s intervals, and reaction times (RTs) are recorded. On 25% of the trials (25% of the *X* trials and 25% of the *O* trials), a tone (stop signal) sounds after the presentation of the *X* or *O.* Subjects are instructed to refrain from pressing any keys when they hear the sound. The delay from the onset of the letter presentation to the onset of the tone (stop-signal delay) is systematically adjusted in 50-ms increments. If the subject fails to refrain from pressing a key after hearing the tone, the stop-signal delay is decreased by 50 ms on the following stop-signal trial. If the individual successfully refrains, the stop-signal delay is increased by 50 ms on the next trial. Eventually, the stop-signal delay will reach a duration at which the subject will inhibit his or her key press responses on approximately 50% of trials. Stop reaction time is computed by subtracting the average stop-signal delay at which the individuals are able to inhibit their

response 50% of the time from the average key pressing RTs. The task consists of 256 total trials. The task provides a measure of four potential dependent variables including: the latency in milliseconds to respond to the letter presentation, the individual's accuracy in responding appropriately to the go signal (*X* or *O*), the percentage of trials on which the individual fails to inhibit the response when the stop signal is presented, and the time in milliseconds needed to refrain from responding. Individuals characterized by greater impulsivity should require a shorter delay to reach the point at which they are able to inhibit their responses 50% of the time.

Balloon Analogue Risk Task (BART; Lejuez et al., 2002). As a measure of impulsive risk-taking, The Balloon Analog Risk Task (BART; Lejuez et al., in press) was administered. This measure has been successfully used to describe currently occurring risk behaviors in inner-city drug using adults (Lejuez et al., in press), young adults (Lejuez et al. 2002; 2003), and middle adolescents (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, in press; Lejuez, Aklin, Zvolensky, & Pedulla, 2003). The BART was presented on the computer in the experimental room. Specifically, the computer screen displayed a small simulated balloon accompanied by a balloon pump, a reset button labeled "Collect $$$," a permanent money earned display labeled "Total Earned," and a second display listing the money earned on the last balloon and labeled "Last Balloon." Participants were directed to pump the simulated balloon to earn as much money as possible, taking into consideration that the balloon can pop at any time. Each click on the pump inflated the balloon one degree (about .125" in all directions). With each pump, 5 cents were accumulated in a temporary bank (this amount was not indicated to the participant). After a balloon is pumped past its individual explosion point, a "pop" sound effect was

generated from the computer. When a balloon explodes, all money in the temporary bank was lost and the next uninflated balloon will appear on the screen. At any point during each balloon trial, the participant can stop pumping the balloon and click the "Collect $$$" button. Clicking this button will transfer all money from the temporary bank to the permanent bank, during which the new total earned was incrementally updated cent by cent while a slot machine payoff sound effect plays. After each balloon explosion or money collection, the participant's exposure to that balloon will end, and a new balloon will appear until a total of 30 balloons (i.e., trials) are completed. These 30 trials were comprised of different balloon types, all with the same probability of exploding. Participants will not be given any detailed information about the probability of an explosion, but was told that at some point each balloon will explode and this explosion can occur as early as the first pump all the way up to the point at which the balloon expands as large as the computer screen (see instructions below). The probability that a balloon will explode is arranged by constructing an array of N numbers. The number "1" is designated as indicating a balloon explosion. With each pump of the balloon, a number was selected without replacement from the array. The balloon explodes if the number 1 is selected. For this experiment N will equal 128. Thus, the probability that the balloon will explode on the first pump is 1/128. If the balloon does not explode after the first pump, the probability that the balloon will explode is then 1/127 on the second pump, 1/126 on the third pump and so on up until the 128^{th} pump at which the probability of an explosion was 1/1 (i.e., 100%). According to this algorithm, the average breakpoint is 64 pumps. Modeling real-world situations in which excessive risk often produces diminishing returns and increasing threats to one's health and safety, each successive pump on any

particular balloon trial (a) increases the amount to be lost due to an explosion and (b) decreases the relative gain of any additional pump. For example, after the first pump the next pump risks only the 5 cents accrued in the temporary bank and would increase the possible earnings on that balloon by 100%, yet after the 30^{th} pump, the next pump risks 3 dollars accrued in the temporary bank and would increase possible earnings on that balloon trial only by 1.6%.

Chapter 3: Results

Demographic characteristics and other drug classes

As shown in Table 1, drug choice groups (i.e., primary crack/cocaine, primary heroin, and both) were compared on several demographic characteristics and other drug use in the past year (ranging from 0 = never used to 5 = used 4 or more times per week) across alcohol, marijuana, and hallucinogens including PCP. Drug group did not differ across any of the above variables with *p*'s >.25 for all except gender ($p = .10$)[1].

Diagnostic and Medication Status

The presence of Axis II disorders [i.e., Borderline Personality Disorder (BPD) and Antisocial Personality Disorder (ASPD)] as well as medication status (if the subject was taking one of the following medications: selective serotonin reuptake inhibitors, SSRIs; anxiolytics; atypical antipsychotics; other psychotropic medications, pain medication, and other medications including over-the-counter antihistamines, sleep aids) are presented in Table 2. Drug group did not differ across any of the above variables, with *p*'s >.25 for all except Borderline Personality Disorder ($p = .066$) and Antisocial Personality Disorder ($p = .132$), with the former indicating a trend of higher rates of BPD in the crack/cocaine sample, and the latter indicating a trend for higher rates of ASPD in the heroin sample. As an aside, there was also a non-significant trend indicating higher rates of ASPD in the both group, compared to the primary crack/cocaine group ($p = .079$)[2].

Treatment History Questionnaire

Table 2 presents non-parametric analyses that were conducted on differences between drug groups and treatment legal status (i.e., if a subject was legally mandated to attend residential treatment, or of he or she entered of his or her own volition). None of

the drug group differed as a function of treatment legal status.

Sexual risk behavior (SRB) among drug groups

Analyses were conducted on several items from the TCU/ARA and HRBS to examine global (total scores and total number of partners), event-level (partner type), and situational (sober vs. intoxicated) factors across 6 months prior to treatment. Prior to the primary and secondary data analysis, data screening was performed. This included descriptive statistics to check for data-entry errors (e.g., out of range values) and scatter plots and observation of skewness to check for data irregularities and outliers. Measures with skew above 2.0 were square root transformed. Transformed variables included number of commercial partners as well as number of causal partners, with transformations resulting in adequate levels of skew in both cases.

Global Measures of RSB:

As in Lejuez et al (2004), we created an HRBS "risky sex composite" (HRBS-RSB). Item-by-item analyses suggested that one variable was greatly detracted from the overall internal consistency (namely, unsafe sex with a regular/primary partner), thus leading us to exclude this variable from the HRBS-RSB. Thus, the HRBS-RSB included a score based on the total number of partners, frequency of anal sex, and frequency of unsafe sex with individuals who were not one's regular partner. A univariate ANOVA was conducted to examine differences among drug choice groups on HRBS-RSB. The drug choice group (primary crack/cocaine vs. primary heroin vs. both) was included as an independent variable (see figure 1). Again, because no demographic or drug use frequency variables were significant, none were included as covariates. A significant effect of drug choice group was observed, [$F(2, 83) = 4.84$, $p = .01$, $\text{eta}^2 = .105$]. Follow-up LSD contrasts indicated that the primary crack/cocaine group reported significantly

higher RSB scores than the primary heroin group ($p < .004$). The group using both drugs also reported RSB composite scores that were significantly higher than the primary heroin group ($p = .009$) and virtually identical (not significantly different) to the primary crack/cocaine group ($p = .973$). It should be noted that although regular partners were excluded from analyses, recalculating HRBS total score with this variable included a similar pattern of results remained similar, with a somewhat weaker overall effect ($p = .037$, $eta^2 = .076$). Based on these results, we decided that the exclusion of this variable was appropriate and used the shorter RSB composite in further analyses.

As discussed above, another measure of RSB that may be considered "global" is the total number of partners across a particular period in time; this variable, although not providing extensive detail, often is considered a "quick-and-dirty" measure of RSB. Thus, a univariate ANOVA was conducted to examine differences among drug choice groups regarding total number of partners on the HRBS-RSB. A significant effect of drug choice group was observed, [$F(2, 83) = 5.20$, $p = .007$, $eta^2 = .111$]. Follow-up LSD contrasts indicated that the primary crack/cocaine group reported significantly higher number of partners than the primary heroin group ($p < .011$). Similarly, the group using both drugs reported significantly higher number of partners than the primary heroin group ($p < .002$); however, no significant differences were observed between the crack/cocaine only and the group using both drugs ($p = .33$).

Finally, a univariate ANOVA was conducted to examine differences among drug choice groups regarding total number of partners on the TCU. This variable has more of a range than the HRBS, and thus, allows for greater detail. A significant effect of drug choice group was observed, $F(2, 83) = 4.99$, $p = .009$, $eta^2 = .107$. Follow-up LSD

contrasts indicated that the primary crack/cocaine group reported significantly higher number of partners than the primary heroin group ($p < .003$). Similarly, the group using both drugs reported significantly higher number of partners than the primary heroin group ($p < .018$); however, no significant differences were observed between the crack/cocaine only and the group using both drugs ($p = .635$).

Event-level (partner type) Measures of RSB

Number of partners across type, TCU-ARA: A univariate ANOVA was conducted for number of regular, commercial, and casual partners on the TCU-ARA, with drug choice group as an independent variable. As expected, no significant effects of drug choice group were observed for number of regular partners in the past six months before treatment, $F(2, 83) = .262$, $p = .769$, $eta^2 = .006$. With regard to commercial partners, the omnibus F did not achieve significance $F(2, 83) = 2.49$, $p = .09$, $eta^2 = .056$. Given the limited sample size for the heroin group, we conducted follow-up LSD contrasts, which indicated that primary crack/cocaine group reported significantly higher number of commercial partners than the primary heroin group ($p < .033$), but not the group using both drugs ($p = .834$). The group using both drugs had more commercial partners than the primary heroin group, but this difference did not achieve significance ($p = .079$). Finally, number of casual partners in the past six months before treatment was not significant ($p = .08$); yet again, given the limited number of heroin users, we conducted follow-up tests. Contrast analyses for number of casual partners revealed that crack/cocaine users had more casual partners then heroin users ($p = .046$). Moreover, those individuals using both classes of drugs also indicated more casual partners then heroin users ($p = .041$), with no differences between those who were using both drugs versus primary crack/cocaine ($p = .751$).

Instances of unsafe sex on TCU single items: Next, we conducted analyses on several items from the TCU, focusing on those that provide detail on the number of instances of unsafe sex with all relationships pooled together, as well as unsafe sex across relationships. Yet, every variable in these analyses had unacceptable skewness and/or kurtosis, ranging up to 7.65 for the former, and up to 61.7 for the latter. In part, this was due to the very large range of the number of partners and the amount of unsafe sex, as well as a large number of individuals indicating 0. To rectify this problem, we performed a Square Root but unacceptable skew remained. Given these distributional problems, we dichotomized each of these variables. However, this last strategy defeats the purpose of using a measure that provides greater detail then the HRBS, allowing us to determine only if an individual has had unsafe sex or a certain type of partner within the last 6 months, without providing *any* frequency data. Given these limitations, the most appropriate strategy, then, would be to provide the means of each aforesaid variable across drug groups allowing the reader to examine RSB patterns across drug groups (see Table 2 for this information). Moreover, we focused on the HRBS for further statistical analyses.

Frequency of unsafe sex on HRBS-RSB single items: A univariate ANOVA was conducted for each of the five individual items on the HRBS, which provides frequency of unsafe sexual acts across partners as opposed to absolute number as given by the TCU-ARA. Specifically, drug choice group (primary crack/cocaine vs. primary heroin vs. both) was included as an independent variable. Again using $p = .01$ for significance at the omnibus level, the following variables met the significance criteria: infrequency of condom use with commercial partners ($p = .087$) and anal sex ($p = .10$). Follow-up LSD

contrasts were performed for commercial partners indicated significantly higher scores for the primary crack/cocaine group compared to the primary heroin group ($p < .028$), but no difference for any other group comparison (all p's > .01). Finally, contrast analyses for frequency of anal sex revealed that crack/cocaine users engaged in significantly more anal sex then heroin users (p = .05), with no differences between those who were using both drugs versus just crack/cocaine ($p = .343$) or heroin ($p = .336$).

Situational Measures of RSB

Originally, it was our intention to analyze instances of RSB when an individual was in the grip of the "high", compared to instances of RSB when sober. This would allow us to determine if RSB may occur to a pre-existing disposition, or the acute pharmacological effects of drugs and alcohol. However, this analysis was not possible, as the majority of our subjects (all except two) were engaging in RSB with commercial and casual partners only when they were high. Given these limitations, the most appropriate strategy, then, would be to provide the means of each aforesaid variable across drug groups allowing the reader to examine RSB patterns across drug groups (see Table 2 for this information). Moreover, we focused on the HRBS for further statistical analyses.

Supplementary Indices of Risk - HIV and Sexually Transmitted Diseases:

Non-parametric analyses were conducted on differences between drug groups and a history of diseases that are generally associated with high-risk behavior (i.e., tuberculosis, any STD, HIV, hepatitis A, B, or C). In order to capture these differences, two dichotomous "disease" variables were created. The first variable, "any disease" compared participants who had have ever contracted any of the aforesaid diseases. The second "STD/HIV" variable compared those who have ever contracted STDs or HIV only. In the first analysis, significantly higher rates of any disease was evidenced among

those individuals using both classes of drugs (50%), compared to those who were using heroin alone (5.6%; $\chi^2(1) = 4.71$, $p = .026$), with no other differences evidenced among groups. In the second analysis, again significantly higher rates of an STD or HIV was evidenced among those individuals using both classes of drugs (50%), compared to those who were using heroin alone (5.6%; $\chi^2(1)= 4.98$, $p = .026$), with no other differences evidenced among groups

Other HIV-risk Behavior: "Dirty" Needle Use:

To provide supplemental information on HIV-risk behavior, we analyzed two variables, namely an overall frequency of needle use, as well as likelihood of using "dirty" needles. For the first variable, a univariate ANOVA was conducted, with drug group as an independent variable. A main effect of drug group was observed [$F(2, 83) = 35.99$, $p < .001$, $\text{eta}^2 = .464$]. Follow-up LSD comparisons indicated that individuals using both classes of drugs were involved in injection drug use more frequently then crack/cocaine users ($p < .001$), or even heroin users ($p < .001$); further, heroin users were more involved with injection drug use then cocaine users ($p < .05$). More importantly, users of both drugs were more likely to use "dirty" needles (i.e., needles that are used by others and not sterilized prior to subsequent use), when compared to heroin users ($\chi^2(1)= 4.71$, $p < .05$), or crack/cocaine users ($\chi^2(1)= 17.77$, $p < .001$), with no significant differences between primary users of crack/cocaine and primary users of heroin ($\chi^2(1)= 2.17$, $p = .141$).

Impulsivity among drug choice groups

A series of ANOVAs were conducted with the specific types of impulsivity as the dependent variable(s) and drug choice group as independent variable. Again, because

none of the drug groups differed on demographic characteristics or frequency of other drug use, they were not included in the following analyses as covariates.

Barratt Impulsiveness Scale (BIS): The first two univariate ANOVAs were conducted with the BIS total score, and one of its subscales, non-planning subtype of impulsivity (BIS-NP). A significant effect of drug choice group was observed, $F(2, 83) = 3.621$, $p = .031$, $eta^2 = .080$ for the BIS-NP, but not the BIS-total score $F(2, 83) = 2.45$, $p = .092$, $eta^2 = .056$. Follow-up LSD contrasts indicated that the primary crack/cocaine group reported significantly higher BIS-NP scores than the primary heroin group ($p < .05$). The group using both drugs also reported BIS-NP scores that were significantly higher than the primary heroin group ($p = .009$), but not significantly different compared to the primary crack/cocaine group ($p = .228$). Given the limited sample size, we also conducted post-hoc tests for the BIS-total score. These analyses indicated that users of both drugs reported significantly higher BIS-total scores then heroin users ($p = .3$), but not crack/cocaine users ($p = .312$). There were no differences between heroin and crack/cocaine users ($p = .126$).

UPPS: Next, we conducted three univariate ANOVAs with the UPPS total score, and two subscales, sensation-seeking (UPPS-SS) and urgency (UPPS-URG). A significant effect of drug choice group was observed, $F(2, 83) = 5.04$, $p = .009$, $eta^2 = .108$ for the UPPS-total score, as well as UPPS-URG $F(2, 83) = 3.52$, $p = .034$, $eta^2 = .078$, but not UPPS-SS $F(2, 83) = 1.54$, $p = .220$, $eta^2 = .036$. Follow-up LSD contrasts indicated that the users of both drugs reported significantly higher UPPS-total scores than the primary heroin group ($p < .005$) or the primary crack/cocaine group ($p < .01$). However, there were no differences between primary heroin and primary crack/cocaine

groups (p = .396). A somewhat different pattern of results was evidenced on UPPS-URG. Specifically, users of both drugs reported significantly higher UPPS-URG then primary heroin users (p = .010), but not primary crack/cocaine users (p = .151). No differences was found between primary users of crack/cocaine and primary users of heroin (p = .104).

Multidimensional Personality Questionnaire-Constraint: A univariate ANOVA was conducted with MPQ-Constraint as the dependent variable, testing for hypothetical biologically-based differences between drug groups. There were no significant effects of drug group, $F(2, 83) = 1.37$, $p = .260$, $eta^2 = .032$.

Impulsive Aggression (IIP-AGR): A univariate ANOVA was conducted with IIP-AGR as the dependent variable. There was no significant effect of drug group, $F(2, 83) = 1.18$, $p = .312$, $eta^2 = .028$.

Delay Discounting Task: Prior to addressing the results on the delay discounting task, it should be noted that nine participants did not complete the delay discounting task, and thus were not used in the following analyses. The k values were analyzed with a 3x3 repeated measures ANOVA with drug type (heroin vs. cocaine vs. both drug classes) as the between subject variable and magnitude of the delayed reward (low, med, & high) as the within subject variable. There was neither a significant main effect of drug type [$F(2, 75) = 1.60$; p < .209], nor significant effects of reward magnitude [$F(2, 75) = .590$; p < .670].

Stop-Go Task: A univariate ANOVA was conducted to examine differences in stop reaction time as a function of drug class. Although no significant effect of overall drug group was found [$F(2, 82) = 2.1$, p = .12, $eta^2 = .05$], it should be noted that crack

users evidenced higher stop reaction times than heroin users [$F(1, 59) = 3.9$ $p < .05$; $eta^2 = .06$].

Balloon Analogue Risk Task (BART): A univariate ANOVA was conducted to examine differences in BART score as a function of drug type. A significant effect of drug use group was observed [$F(2, 82) = 3.15$, $p = .048$; $eta^2 = .071$]. Follow-up LSD contrasts indicated that primary crack/cocaine users demonstrated significantly higher levels of risk-taking propensity than primary heroin users (.014). However, there were no differences between the group using both drugs and primary crack/cocaine group ($p = .457$) or the heroin group ($p = .109$).

Intercorrelations between Measures of Impulsivity

Table 4 presents the Pearson correlation matrix for all self-report and behavioral measures of impulsivity. Overall, the correlations among the behavioral measures of impulsivity were variable and relatively weak, and none were statistically significant. In contrast to the behavioral test data, most of the psychometric measures of impulsivity were moderately to highly correlated, except that of sensation seeking (correlations between this variable and other impulsivity measure were low). Correlations among the BIS (total score and non-planning subscale) and UPPS total score as well as urgency were significant. Impulsive aggression was significantly correlated with every self-report measure of impulsivity except sensation seeking. Notably, correlations between the behavioral and psychometric measures of impulsivity were uniformly low and highly variable, and some were negative. The only correlation that began to approximate significance is that between the Stop-Go task and the BIS-NP ($r = .20$).

Mediation of Sexual Risk Behavior by Impulsivity

Baron and Kenny (1986) as well as Judd and Kenny (1981) outline the 4 steps to formally demonstrate mediation. First, the independent variable (drug choice group) must significantly predict the dependent variable (RSB). This was demonstrated for almost all RSB variables, except the HRBS variable concerning unsafe sex with regular partners. Second, the independent variable (drug choice group) must significantly predict the mediator (impulsivity). Drug groups differed on the following scales: UPPS total and urgency subscale, BIS-total and BIS-NP, BART score, and Stop/Go score. Third, the mediator (impulsivity) must significantly predict the dependent variable (RSB). For this step, we only considered variables that "passed" the first two steps. Thus, a significant positive correlation was observed between overall RSB as measured by the HRBS total score and impulsivity as measured by UPPS total score ($r = 0.24$, $p = .027$). Further, a significant positive correlation was observed between total number of partners, as measured by the HRBS, and UPPS-total score ($r = 0.25$, $p = .019$), as well as UPPS-urgency ($r = 0.21$, $p = .049$). The latter pattern of results also held for commercial partners ($r = 0.22$, $p = .038$ with UPPS-total, and $r = 0.23$, $p = .036$ with UPPS-Urgency). Additionally, significant correlations were wound between BIS-NP and the number of total partners as measured by the TCU ($p = .032$); the same pattern of results held for the UPPS-total and urgency ($p = .001$, $.004$, respectively). Finally, when both the independent variable and the mediator are included in the same model to predict the dependent variable, the mediator must still significantly predict the dependent variable. If these criteria are met, then the effect of the independent variable must be reduced. If the effect of the IV is reduced to zero, full mediation has been established. To accomplish this fourth step, various dimensions of impulsivity were added as covariates to the

previously described drug choice group ANOVA on RSB. A significant effect was observed for UPPS-total as a covariate and total number of partners on the TCU as the dependent variable, $F(1, 86) = 10.27$, $p = .002$, $ES = .111$; further, another significant effect observed for UPPS-total as a covariate and again, total number of partners on the TCU as the dependent variable, $F(1, 86) = 5.92$, $p = .017$, $ES = .067$. In both cases, the effect of drug group remained significant $F(2, 86) = 4.56$, $p = .013$, ES= .10 with UPPS-total; $F(2, 86) = 3.71$, $p = .026$, $ES = .083$ with UPPS-urgency, establishing the two impulsivity variables as partial mediators in the relationship between drug choice and total number of partners on the TCU. However, the BIS-NP did mediate the relationship between drug group and total number of partners on the TCU $F(1, 86) = 2.231$, $p = .139$, ES= .026. Further, neither UPPS variable mediated the relationship between drug group and scores on the HRBS (total or any of the significant single items).

Gender, RSB, and Impulsivity: Replication of Analyses with Males Only

Although when gender was tested as a coviariate the pattern of results did not change, we decided it was prudent to conduct the analyses with the inclusion of males only. The males-only groups were broken down as follows: a) 24 were primary crack/cocaine users (i.e., individuals dependent on crack/cocaine and not using heroin any more then 2-3 times per week over the past year prior to treatment; b) 15 were primary heroin users (i.e., dependent on heroin and not using crack/cocaine less than 2-3 times per week over the past year prior to treatment), and c) 15 were primary crack/cocaine and heroin users (dependent on both crack/cocaine and heroin).

Risky Sexual Behavior among Drug Groups (Males Only)

The aforementioned analyses with RSB (defined above) as the dependent variable and drug group as the independent variable were conducted with males only. All results remained significant, with most effects becoming even stronger (eta^2 = .136). It should be noted that the pattern of results was now exactly as predicted, with crack/cocaine users engaging in most RSB, heroin users the least RSB, and the "both" group falling in the middle. Finally, results that formerly indicated higher rates of STD or HIV among individuals using both classes of drugs compared to those using heroin only were no longer significant (6.6%; $\chi^2(1)= 3.33$, $p = .068$), with no other differences evidenced among groups.

Impulsivity among Drug Groups (Males Only)

Again, the analyses were re-conducted with females excluded from the analyses. All differences above remained significant, except that now, the BIS-NP did not show differences between crack/cocaine and heroin users, but only between heroin users and users of both drugs ($p < .05$). As a second difference, a significant difference now appeared on the "control" factor of the MPQ (driving scale for the "constraint" superfactor) between users of heroin and users of both drugs [$F(1, 83) = 7.83$, $p = .001$, eta^2 = .235].

Mediation of RSB by Impulsivity

Possibly due to the low power (.3 and less for all impulsivity analyses), no variables met criteria for mediation when only males were analyzed. One variable began to approach meeting the aforesaid criteria (namely, "control"). However, it should be noted that all RSB differences were only now significant between crack/cocaine only and heroin only users. In contrast, the "control" variable was different only when comparing

"heroin" and "both" groups. This odd pattern of results leads us to conclude that conducting a mediational analysis with "control" as a mediator would not be useful or interpretable.

Chapter 4: Discussion

Summary of Main Findings:

In a sample of 86 chronic, inner-city drug users entering residential treatment, we examined the relationship between RSB (as evidenced by HRBS-RSB total, HRBS-RSB item scores, and history of communicable diseases) and drug choice (primary crack/cocaine, primary heroin, and both drugs). Further, we investigated the role of impulsivity (defined via multiple instruments and modalities) as a mediator of this relationship. Results indicated that when comparing drug groups across HRBS-total scores, RSB was significantly higher in the primary crack/cocaine group and group using both drugs than in the primary heroin group. Item-by-item analyses revealed several patterns that may be of use in understanding the relationship between drug choice and RSB. First, compared to heroin users, individuals primarily using crack/cocaine as well as individuals using both drugs evidenced a higher overall number of partners. A somewhat different pattern emerged when considering differences in unsafe commercial sex engagement. Specifically, crack/cocaine users evidenced more instances of unsafe commercial sex then heroin users, with the group using both drugs falling somewhere in the middle. Finally, and similar to the results in the commercial partner domain, when compared to heroin users, crack/cocaine users engaged in more instances of anal sex then heroin users, with the group using both drugs evidencing intermediate levels of anal sex. This pattern of results allows for the conclusion that the significance between drug groups on the HRBS-total score was mainly driven by the items above. More importantly, these results allow us to conclude that the hypothesized differences between primary heroin and primary crack/cocaine users are a) not driven by the total amount of

drugs used because the group using both drugs did not evidence more RSB than either group using only one of the drugs, and b) specific to total number of partners, unsafe commercial sex, and anal sex. Thus, data from this sample are consistent with other research examining the relationship of drug choice and RSB (e.g., Bux et al, 1995; Camacho et al., 1997; Grella et al., 1995; Joe & Simpson, 1995, Lejuez et al, 2004), and clearly establish a difference between distinct groups of crack/cocaine and heroin users. Specifically, these data suggest that elevated RSB is unique to crack/cocaine as compared to heroin and not simply the additive effects of additional drugs as represented by the group using both drugs. That is, although one may have expected users of both crack/cocaine and heroin to engage in the highest levels of RSB, the current data suggest the users of crack/cocaine engaged in at least as much RSB as the former group.

When considering actual consequences of RSB (i.e., history of communicable diseases), a different pattern of results emerged. Compared to primary heroin users, those who were using both drugs were significantly more likely to have had contracted a communicable disease and/or sexually transmitted disease (i.e., an STD and HIV). Thus, although individuals using both crack/cocaine and heroin engage in as much or even slightly less RSB as crack/cocaine users, they are suffering the brunt of the consequences. One plausible hypothesis for this unexpected finding is the frequency of injection drug use among individuals who are using both classes of drugs. That is, individuals using both classes of drugs were involved in injection drug use more frequently then crack/cocaine users. These results are not surprising, as crack/cocaine is generally smoked, rather then injected. However, beyond these differences, users of both drugs injected more frequently then heroin users. More importantly, users of both drugs were

more likely to use "dirty" needles (i.e., needles that are used by others and not sterilized prior to subsequent use), when compared to heroin users. Finally, those who were using dirty needles were significantly more likely to have a history of any communicable disease (but not sexually transmitted disease). In turn, these findings imply that within those who are using both classes of drugs are significantly more at-risk due to the frequency of dirty needle use. These findings cannot be accounted for by severity of substance-related problems, since all participants were classified into drug groups based upon dependence on the drugs in question and no differences across use of other common drugs was observed. These results underscore the fact that risk, as often pointed out by researchers (e.g., Leigh, 1999), is a multi-dimensional construct, and in order to truly capture propensity for infection, it is crucial to investigate several disease transmission vectors.

Beyond differences in RSB, we examined impulsivity across drug groups. Analyses of self-report measures revealed that users of both drugs and crack/cocaine users were more impulsive on the BIS-non-planning scale then heroin users. A different pattern emerged for the UPPS-total score as well as UPPS-urgency. On the former variable, users of both drugs were significantly more impulsive then either crack/cocaine or heroin users. On the latter variable, users of both drugs were only more impulsive then heroin users, with the crack/cocaine users falling somewhere in the middle. Simply, crack/cocaine users may plan less then heroin users, but users of both drugs are more driven to impulsive acts by intense negative affect. Finally, an analysis of the behavioral tasks across drug groups revealed that crack/cocaine users were more risky on the BART then heroin users, with the users of both drugs evidencing intermediate levels of risk.

Similarly, although there was not an overall effect of drug group on the Stop/Go task, crack/cocaine users did evidence significantly higher stop reaction times than heroin users. These results are consistent with our prior findings that even in the absence of acute pharmacological effects of the drugs, crack/cocaine users are more *risky* then heroin users (Bornovalova et al, in press). Further, the results from the Stop/Go task are consistent with the literature suggesting that long-term cocaine self-administration impairs inhibitory functions and leads to a loss of control over behavioral impulses (Fillmore & Rush, 2002). In contrast to these suggestive results, we were not able to replicate our prior findings of differences in the rate of discounting of hypothetical rewards between drug groups (Bornovalova et al, in press). One potential explanation of this inconsistent finding is that of rate of character disorders within each of the drug groups. Specifically, past studies indicated a higher prevalence of impulse-control related personality disorders (i.e., antisocial and borderline personality disorders, ASPD and BPD, respectively) in crack/cocaine rather then heroin groups (Craig & Olson, 1990; Flynn, 1995; Mirin, Weiss, & Michael, 1988; Raimo, Smith, Danko, Bucholz, & Schuckit, 2000). Although in our sample, crack/cocaine users were marginally (albeit not significantly) more likely then heroin users to present with comorbid borderline personality disorder, the rates of antisocial personality disorder were equivalent across crack/cocaine and heroin groups. Given that drug users with comorbid ASPD have repeatedly been shown to discount at higher rates then their non-ASPD counterparts (e.g., Petry, 2002), the higher-then-expected rates of ASPD in the primary heroin group could potentially serve as an explanation for our inability to replicate prior findings.

Our final prediction concerned the role of impulsivity in the relationship between drug group status and RSB. As stated above, Baron and Kenny (1986) outline the 4 steps to formally demonstrate mediation. First, the independent variable (drug choice group) must significantly predict the dependent variable (RSB). This was demonstrated above across both HRBS-total score and several item scores. Second, the independent variable (drug choice group) must significantly predict the mediator (impulsivity). This was demonstrated for several dimensions of impulsivity, including the BART, BIS, UPPS, and the Stop/Go task. Third, the mediator (impulsivity) must significantly predict the dependent variable (RSB). In the current study, only 2 dimensions of impulsivity significantly predicted RSB, namely UPPS-total and UPPS-urgency, and thus, were the only potential mediators in the current data set. Finally, Baron and Kenny suggest that when both the independent variable and the mediator are included in the same model to predict the dependent variable, the mediator must still significantly predict the dependent variable. In the current study, only UPPS total and UPPS Urgency achieved partial mediation in the relationship between drug group and TCU total number of partners. Of note, mediation only was achieved for a small set of possible RSB impulsivity sets. Further, for the two UPPS measures for which it was achieved, the univariate difference in drug group for this variable only was significant between heroin and the group using both drugs, with heroin not differing in impulsivity from crack/cocaine (see Table 3).

The final set of results indicated that, even when gender was experimentally controlled for (i.e., only males were included in the analyses), the pattern of results was not altered. This may seem especially surprising in the light of the finding that the variables related to commercial sex (i.e., prostitution) seem to be the "driving" the

differences between drug groups. However, the current results support the analysis that both the female and male crack/cocaine users are involved in the "sex-for-crack" market. Similarly, differences in impulsivity remained mostly unchanged when gender was experimentally controlled. Finally, in contrast to the analyses across both genders, no variables met criteria for mediation. Thus, the current study provides little evidence to suggest that impulsivity, across any dimension, explains the difference in RSB between heroin and crack/cocaine users. This unexpected pattern of results could occur due to one of several explanations. First, it is possible that again, due to rates of ASPD in the heroin group, the rates of impulsivity were elevated thus restricting the range and limiting our ability to find a correlation between subtypes of impulsivity and RSB. Yet another explanation is that the primary heroin group and primary "both" group were relatively small (N = 18, 24, respectively), especially compared to the sample in Lejuez and colleagues (2004) who utilized 35 heroin users and 33 users of both drugs. Third, although we utilized a variety of impulsivity measures tapping different dimensions of the construct (e.g., non-planning, affect-driven impulsivity), one measure that was missing from the current study is that of I-7, which was the primary measure in Lejuez and colleagues (2004). Although the BIS-NP and the I-7 hypothetically tap the same dimension of impulsivity (i.e., non-planning), slight or moderate differences in the BIS-NP could result in a weaker correlation with the HRBS-RSB.

Implications of Current Findings

The current findings contribute to the understanding of how differences in drug choice moderate the context in which RSB occurs. Specifically, crack/cocaine users were more likely to engage in unsafe commercial sex, anal sex, and have an overall higher

number of partners then heroin users. These results are consistent with the model proposed by Baseman, Ross, and Williams (1999), suggesting that the strong association of crack/cocaine use and exchange of sex for money or drugs may drive the critical relationship, as in the inner-city environment, a sex market coexists with a crack market, where a drug is considered currency, and sex a commodity (Baseman, Ross, and Williams, 1999; Ross, Hwang, Zack, Bull, & Williams, 2002; Ross Hwang, Leonard, Teng, & Duncan, 1999). In addition to the "sex-for-crack" market hypothesis, recent work by the same authors (Ross et al, 2003) has shown that a hypothetical decision to use a condom was influenced by such variables as desire for sex and partner's attitudes toward condom use, rather then crack/cocaine craving or level of intoxication. Together, these results suggest that even within the context of the "sex-for-crack" market, impulsivity (in this case, taking the smaller, immediate reward of obliging a partner, or succumbing to sexual desire despite the potential consequences) may still play a role in the decision to use condoms. Unfortunately, we did not collect data on such variables as attitudes of one's partner toward condom use in the context of primary drug groups, and thus, testing these hypotheses may be a fruitful area for future research.

The current study also provides several interesting findings with regard to the multiple measures of impulsivity and related constructs. The first relates to the intercorrelations between measures and modalities of impulsivity. That is, whereas most self-report measures of impulsivity evidenced high interrelationship, behavioral tasks did not. Further, there was little to no relationship between self-report measures of impulsivity and their behavioral counterparts. This pattern of findings is frequent within the impulsivity literature (e.g., Monterosso et al., 2001), and often is deemed unexpected

and uninterpretable (e.g., Lane et al., 2003). Yet, this seemingly disparate pattern might potentially be explained by considering the specificity of a given impulsivity scale. That is, self-reports are presumably requiring a subject to tap into some global self-representation (i.e., cross-situational patterns, Mischel, 1968, 1984, Caprara, & Cervone, 2000). On the other hand, behavioral tests by their very nature are specific to situational demands. This analysis suggests perhaps the unconventional view that individuals' perceptions of their own trait-impulsivity per se may be difficult or impossible to change, but behavioral aspects of impulsivity may be much more amenable to experimental manipulation and therapeutic intervention. Simply, by manipulating context, it becomes possible to understand situations (broadly defined) that are most predictive of the highest level of impulsivity. The implication of this analysis is that by identifying the context within which certain impulsive acts are occurring we can also affect therapeutic change; indeed, to the degree that a certain impulsive act occurs in a certain context, then the patient can be encouraged not only to identify target context but also to avoid it.

In addition to various measures of impulsivity, the current study also included the assessment of another relevant personality trait that has been previously shown to be related to RSB – that is, sensation seeking (Galizion & Stein, 1983; Milin, Loh, & Wilson, 1992; Compton, 2000). Although sensation seeking and impulsivity have long been considered related variables (Schalling, Edman, & Asberg, 1983; Eysenck, & Eysenck, 1977), the current study indicates that they may be somewhat different. Specifically, we found that although several measures of impulsivity a) differed between drug groups, and b) were correlated with RSB, sensation seeking was not related to either variable. Taken together, these results imply that although sensation may be related to

sexual behavior in community samples, where a lower level of RSB is likely evidenced, differences between inner-city drug groups may be specific to impulsivity.

Yet another interesting (and potentially clinically relevant) finding is in regard to behavioral measures of impulsivity. Specifically, the current results indicate that crack/cocaine users were significantly more risky on the BART and impulsive on the Stop/Go then heroin users, which of course occurred in the absence of acute drug effects. Given that differences between groups were found in the context of a rigorous treatment environment with frequent drug testing as grounds for immediate removal from the center, it is possible to rule out the hypothesis that the results are the result of acute euphorigenic and disinhibitory effects of crack/cocaine. This finding does not indicate that the differing acute pharmacological effects of crack/cocaine and heroin do not differentially influence the behavior of crack/cocaine and heroin users in the natural environment in periods of drug use, but instead that other influences also must be considered. For instance, these results may be due to a pre-existing disposition that leads one to gravitate toward drugs such as crack/cocaine (Miller & Neaigus, 2002). Indeed, it is well-accepted that traits such as impulsivity have biological basis (cf. Cloninger, 1987), and these biologically-based factors render an individual vulnerable to substance use as well as other behavior problems (Krueger, 2002). For example, using the delay of reward paradigm, Poulos, Le, and Parker (1995, see also Morgan, Dess, & Carroll, 2005 for similar results) found that baseline levels of impulsivity in rats accounted for as high as 25% of the variance in ethanol self-administration. Similarly, in human research, Krueger and colleagues (2002) found that both substance use and behavior problems may stem from a heritable propensity to externalizing ("acting-out", impulsive) behavior.

Finally, beyond the finding that impulsivity is a vulnerability to substance use in general, researchers have suggested that impulsivity may predispose some individuals to perceive specific drug classes such as crack/cocaine to be especially rewarding (e.g., Compton, 2000; Carroll and Rounsaville, 1993; Khantzian, 1985; Weiss et al., 1988).

As a second possibility, results also may be due to the unique behavioral patterns associated with the use of the two drugs. Indeed, a number of studies have suggested that behavioral differences across drug classes may be partially accounted for by contextual factors. In other words, the experiences of environmental cues imposed upon crack/cocaine and heroin users may differ dramatically, and therefore may differentially provide opportunities for, and reinforcement of, impulsive and risky behaviors. Because behaviors that develop within the context of drug dependence may persist long into treatment (Rounsaville et al, 1998), the current data are unfortunately not sufficient for isolation of these causal processes; however, it does set the stage for future longitudinal studies that are likely to answer this question.

Finally, results from the Stop/Go task suggest that the current findings may be due to selective brain damage and consequent impairment in decision making resulting from chronic crack/cocaine use. Indeed, there is evidence that chronic cocaine abuse leads to neuropsychological impairments and neuroanatomical abnormalities, such as deficits in the domains of attention, memory, learning and perceptual motor speed (see Strickland & Stein, 1995 for a review). Recent laboratory studies have also shown impairments of behavioral inhibition (Fillmore & Rush, 2002) in chronic cocaine users consistent with increases in impulsive behavior. Relatedly, neuroanatomical studies that utilize cocaine abusers have reported abnormalities in certain brain structures of these individuals.

Specifically, these deficits were found in the frontal lobe area which is generally found to mediate inhibitory processes that are involved in risk taking and impulsivity (Franklin et al, 2002; Volkow et al 1996). As considerably lesser attention in the literature is given to brain damage from chronic heroin use, one must leave open the possibility that the current results could be due, at least in part, to more impairing brain damage induced by chronic cocaine use than heroin use. To further address this issue, future studies should be designed to systematically tease apart the potential contributions of dispositional factors from long-term negative effects of drug use in trying to better understand differences in crack/cocaine and heroin users.

Limitations and Future Directions

Demonstration of the unique role of crack/cocaine in RSB, although an important step, still leaves many questions unanswered. For instance, our design was cross-sectional and ultimately dependent upon self-report data. Results from these types of studies are, of course, important in their own right. That is, the identification of those who are using crack/cocaine could serve as a useful and cost-effective tool for the identification of individuals that are most at risk for engagement in RSB. Of course, one drawback of a cross-sectional design is the inability to determine if drug choice or impulsivity play a causal role in the developmental trajectory to RSB. For instance, despite our efforts to elucidate directionality between impulsivity, drug choice, and RSB, the directionality between the key variables is still not clear. Indeed, the fact that heroin users were less impulsive on the BART and stop-go tasks while clearly not intoxicated suggest that group differences are not completely accountable by acute pharmacological effects, and the difference on stop-go suggest at least some impact of more long-term damaging effects of crack/cocaine on neural structures related to decision-making;

however, much more research is needed to partial out the unique contributions of various factors. One may even argue that in order to test the relationship between behavioral measures of impulsivity and RSB, it is necessary to obtain a measure of RSB that allows the researcher to partial out sex under the influence of drugs and/or alcohol. Although it was our intention to collect and analyze such data, our results indicated that all but two individuals were under the influence of drugs or alcohol when having sex with commercial or casual partners. Although more "sober" data was available for unsafe sex with a regular partner, it is important to note that there were virtually no differences between drug groups in this domain. Clearly, a more appropriate method of teasing apart acute drug effects and personality is through larger-scale, longitudinal studies that follow *successful* graduates of residential treatment (i.e., those who do not relapse) in order to examine changes in RSB, and its relationship to impulsivity.

Yet another limitation of the current study concerns both the modest sample size (especially in the primary heroin group), as well as our choice of sample itself. In the current study, we utilized drug users in a residential drug treatment center, rather then those "at-large." In this way, or sample is both a major strength and a limitation. Specifically, although drug users in residential drug treatment may be most severe and most in need of assistance (and thus, research and consequent prevention and intervention efforts), there is also a chance that the current results may not generalize to individuals who are not seeking treatment, or in a less restrictive form of treatment. Additionally, the sample included a mix of court referred and non court referred individuals. As many of the court-referred individuals may have a history of antisocial behavior, one may argue that this variable artificially inflated differences in impulsivity and RSB between drug

groups. However, results indicated that whereas little more then half crack/cocaine users were court-referred, all but four of the heroin users were court-referred, thus allowing us to conclude that the current results may not be an artifact of the in-treatment, court-referred sample. In fact, this may have actually explained the limited differences especially in terms of impulsivity. As an additional concern, the sample was almost entirely comprised of inner-city African Americans in residential drug treatment. Although inner-city African American drug users are an underserved at-risk population (Avants, Marcotte, Arnold, & Margolin, 2003; DHHS, 2003; Ensminger, Anthony, & McCord, 1997), caution should be taken in applying these findings to drug users in general, and larger-scale studies should be conducted to address issues of generalizability.

Despite limitations, the current study represents an important step in the identification of individuals most vulnerable to engaging in RSB. Improving on the limitations of the current study, future work should include longitudinal or intervention-based studies in order to further investigate the interactive role of drug choice and impulsivity in RSB, including a more comprehensive assessment of relevant variables across personality, developmental, and environmental domains. Most importantly, there is great need to develop the clinical implications of this work including its relevance for the development of targeted HIV prevention and treatment efforts focused on drug use and SRB (Kelly & Kalichman, 2002).

Footnotes:

[1] Because gender did not differ significantly as a function of drug group, we do not present analyses using it as a covariate. However, because the *p* value did approach significance, it should be noted that using it as a covariate in all further analyses changes none of the significant relationships presented.

[2] Because Borderline and Antisocial Personality Disorders did not differ significantly as a function of drug group, we do not present analyses using either as covariates. However, because the *p* value did approach significance, it should be noted that using it as a covariate in all further analyses changes none of the significant relationships presented.

Table 1. Demographics and other drug use across primary drug group.

	Crack/Cocaine (n = 44)	Heroin (n = 18)	Both (n = 24)
Demographics			
Age	42.5 (6.4)	42.1 (9.9)	41.4 (7.9)
Gender	53% male	83% male	58% male
Education	22% < HS 35% = HS 43% > HS	28% < HS 50% = HS 22% > HS	19% < HS 42% = HS 38% > HS
Income	$39,899 ($9,300)	$29,999 ($4,800)	$33,998 ($7,500)
Other Drug Use			
Alcohol	3.80 (1.58)	2.67 (1.94)	3.25 (1.89)
Cannabis	2.16 (1.81)	1.89 (1.94)	2.43 (1.79)
Hall (no PCP)	.32 (.96)	.24 (.44)	.72 (1.51)
PCP	.67 (1.39)	.39 (.61)	.73 (1.19)

Note: The use of other drug classes is based upon self-report usage within the last year. The means are based on the following categorization: Never (0), one time (1), monthly or less (2), 2-4 times a month (3), 2-3 times a week (4), and 4 or more times a week (5).

Table 2. Select Axis II, Medication Status, and Legal Status

	Crack/Cocaine	Heroin	Both
Diagnostic Status			
BPD	34%	11%	25%
APD	25%	44.4%	46%
Medication Status			
SSRIs	9.1%	0%	4.5%
Anxiolytics	0%	5.5%	0%
Mood Stabilizers and/or Atypical Antipsychotics	9.1%	5.5%	4.5%
Other Psychotropic Medications	4.5%	0%	9.1%
Pain Medications	4.5%	0%	9.1%
Other Medications (e.g., antihistamines, over the counter pain medication, etc).	29.5%	33.3%	27.3%
Treatment Status	65.9%	77.8%	83.3%

*percentage mandated into treatment

Table 3. RSB and impulsivity across primary drug group.

	Crack/Cocaine (*n* = 44)	Heroin (*n* = 18)	Both (*n* = 24)
RSB			
Global RSB			
HRBS_#Part	1.93 (1.47) [a]	.89 (.90) [b]	2.26 (1.71) [a]
HRBS _RegU	2.66 (1.90)	2.72 (2.27)	2.78 (2.13)
HRBS _CasU	1.07 (1.32)	.61 (1.46)	1.26 (1.36)
HRBS _ComU	1.0 (1.26) [a]	.28 (.83) [b]	.87 (1.18) [a, b]
HRBS _Anal	.89 (1.54) [a]	.17 (.71) [b]	.56 (1.16) [a, b]
HRBS_Tot	4.89 (3.75) [a]	1.94 (2.84) [b]	4.96 (3.82) [a]
Any Disease	30.2% [a, b]	17% [a]	50% [b]
STD or HIV	21% [a, b]	5.5% [a]	33.3% [b]
# of partners			
# partners total	2.36 (1.81) [a]	.94 (.73) [b]	2.13 (1.79) [a]
#part reg	.82 (.72)	.83 (.62)	.74 (.54)
# part com	1.14 (1.98) [a]	.17 (.51) [b]	1.09 (2.04) [a, b]
# part cas	.75 (1.12) [a]	.17 (.51) [b]	.74 (1.05) [a]
RSB across intoxication			
Unsafe_total	70.09 (10.57)	39.17 (55.54)	68.75 (125.53)
Unsafe_regular	48.30 (69.56)	42.88 (55.30)	73.04 (126.73)
Unsafe_commercial	2.57 (9.87)	.22 (.94)	38.33 (141.04)
Unsafe_casual	9.03 (21.31)	.17 (.58)	11.48 (39.83)
RSB when high			
Unsafe_total	27.70 (57.94)	25.72 (39.64)	55.67 (113.62)
Unsafe_regular			
Unsafe_commercial	1.70 (8.23)	.22 (.94)	38.33 (141.04)
Unsafe_casual	8.10 (20.31)	.17 (.58)	6.90 (21.38)
Impulsivity			
BIS-T	77.51 (10.75) [a,]	71.80 (13.83) [a]	80.14 (13.40) [a]
BISNP	27.0 (3.87) [a]	24.74 (5.25) [b]	28.34 (5.71) [a]
UPPS-T	64.30 (7.51) [a]	62.60 (8.21) [a]	69.65 (7.86) [b]
UPPS-SS	17.66 (3.29) [a]	17.69 (3.27) [a]	19.29 (3.51) [a]
UPPS_Urg	20.18 (3.28) [a, b]	18.89 (4.24) [a]	21.60 (2.58) [b]
BART2	41.18 (15.55) [a]	30.82 (14.53) [b]	37.86 (14.30) [a ,b]
DD			
SG			
MPQ-Con	79.41 (10.88) [a]	83.72 (11.68) [a]	77.65 (9.82) [a]
ImpAgg	1.04 (.89) [a]	.75 (.81) [a]	1.17 (1.11) [a]

Note: Score on the HRBS ranges from 0 to 25, with each item scored on a scale from 0 to 5 (least to most risk)
Number of partners on the TCU scale is scored on a scale from 0 to 7, with 0 equaling 0 partners, and 7 equaling greater then 30.

Table 4. Intercorrelations among independent and dependent variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Demographics																					
1. Age	---	.06	.14	-.19	-.16	-.13	.03	.04	.056	-.02	.09	-.03	-.05	-.12	-.08	-.17	-.04	-.18	-.05	-.06	-.06
2. Gender		---	-.05	.15	-.06	.05	-.17	-.07	-.05	-.12	-.08	-.01	-.21	-.22*	-.24*	.03	-.30**	.03	.01	-.19	-.13
3. Education			---	.29**	-.01	.12	-.06	-.03	-.10	-.07	.06	.05	-.03	-.04	-.04	.08	-.13	.19	-.03	-.18	.01
4. Income				---	-.08	.15	-.08	-.12	.05	-.08	-.14	-.05	-.22*	-.28**	-.10	.18	-.22*	.28*	.01	-.11	-.09
RSB																					
5. HRBS_#Part					---	.19	.47**	.44**	.14	.77**	.23*	.12	.20	.18	.25*	.13	.21*	.08	.11	.08	.30**
6. HRBS_RegU						---	.05	-.06	.02	.08	-.07	.07	.10	-.01	.16	.14	.11	.07	.25*	-.13	.01
7. HRBS_CasU							---	.70**	.05	.80**	.11	.07	.09	.04	.16	.09	.18	-.17	.01	.13	.16
8. HRBS_ComU								---	.08	.77**	.23*	.09	.20	.10	.22*	.17	.23*	-.02	-.03	-.05	.25*
9. HRBS_Anal									---	.45**	-.04	-.04	.05	.07	.02	.09	-.07	.12	-.08	.09	.12
10. HRBS_Tot										---	.19	.09	.15	.19	.24*	.17	.20	.01	.01	.09	.26*
11. Any Disease											---	.74**	.21	.21	.17	.12	.14	.12	-.02	.21	.13
12. STD or HIV												---	.08	.16	.11	.09	.03	.07	-.09	.21	.13
Impulsivity																					
13. BIS-T													---	.81**	.69**	.01	.63**	.09	.13	.11	.59**
14. BISNP														---	.59**	-.01	.54**	.08	.04	.20	.45**
15. UPPS-T															---	.39**	.82**	.07	.11	.11	.55**
16. UPPS-SS																---	.08	.01	.02	-.06	.06
17. UPPS_Urg																	---	.09	.08	.19	.44**
18. BART2																		---	.05	-.08	-.01
19. DD																			---	-.23	-.02
20. SG																				---	.15
21. ImpAgg																					---

Figure 1. HRBS across drug groups: score on the Risky Sexual Behavior Subscale of the HIV-Risk Behavior Scale as a function of primary drug group across the past six months timeframe. Vertical bars represent standard errors of the mean.

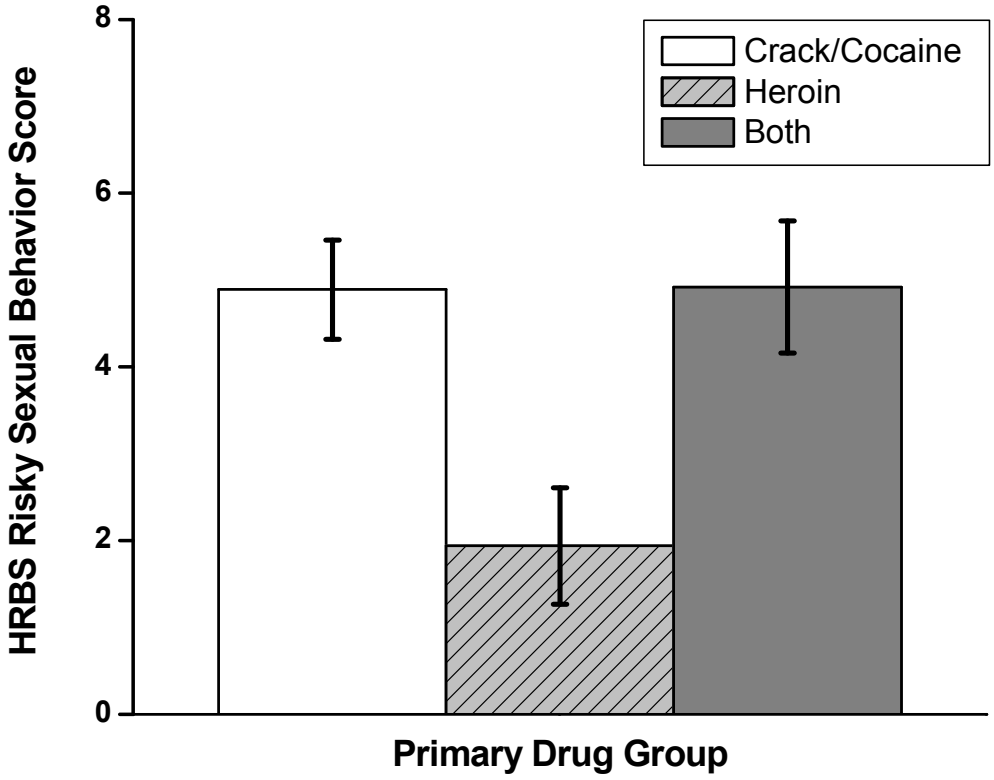


Figure 2. Sex with a commercial partner as a function of primary drug group.

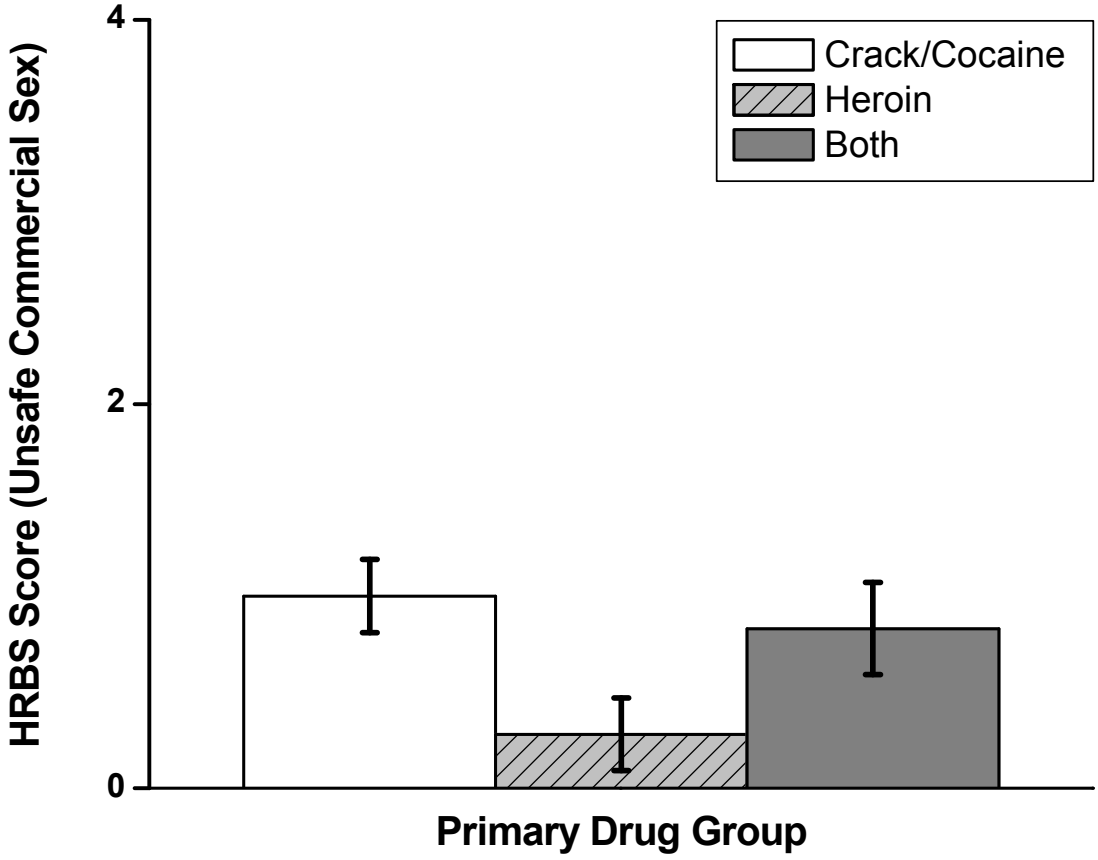


Figure 3. Sex with a regular partner as a function of primary drug group.

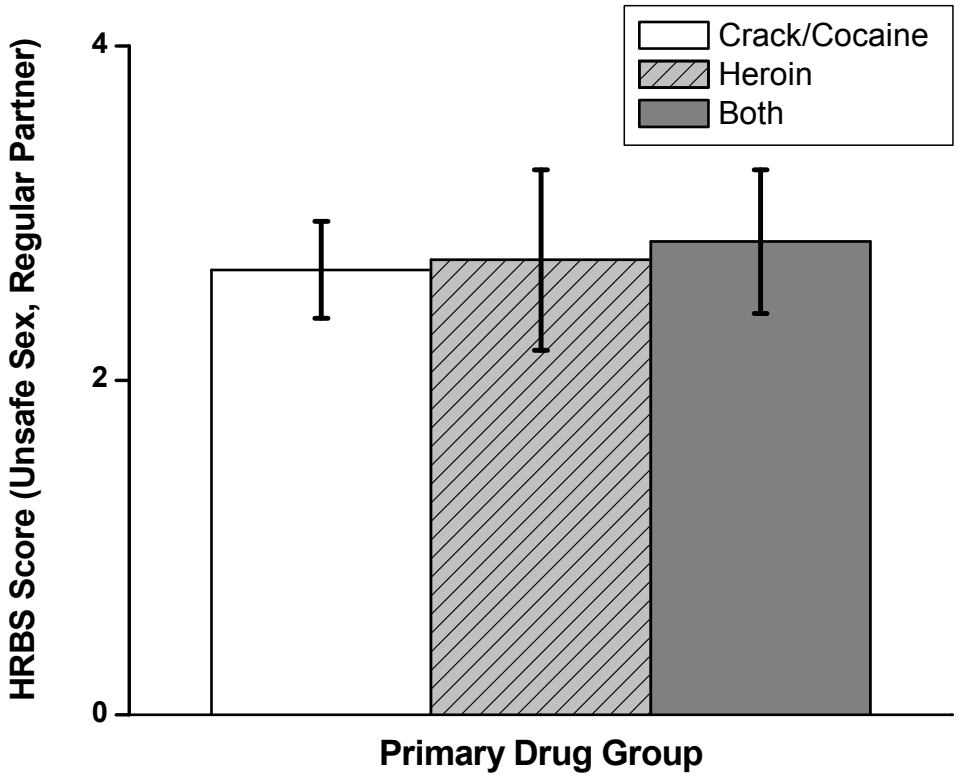


Figure 4. Total number of partners as a function of primary drug group

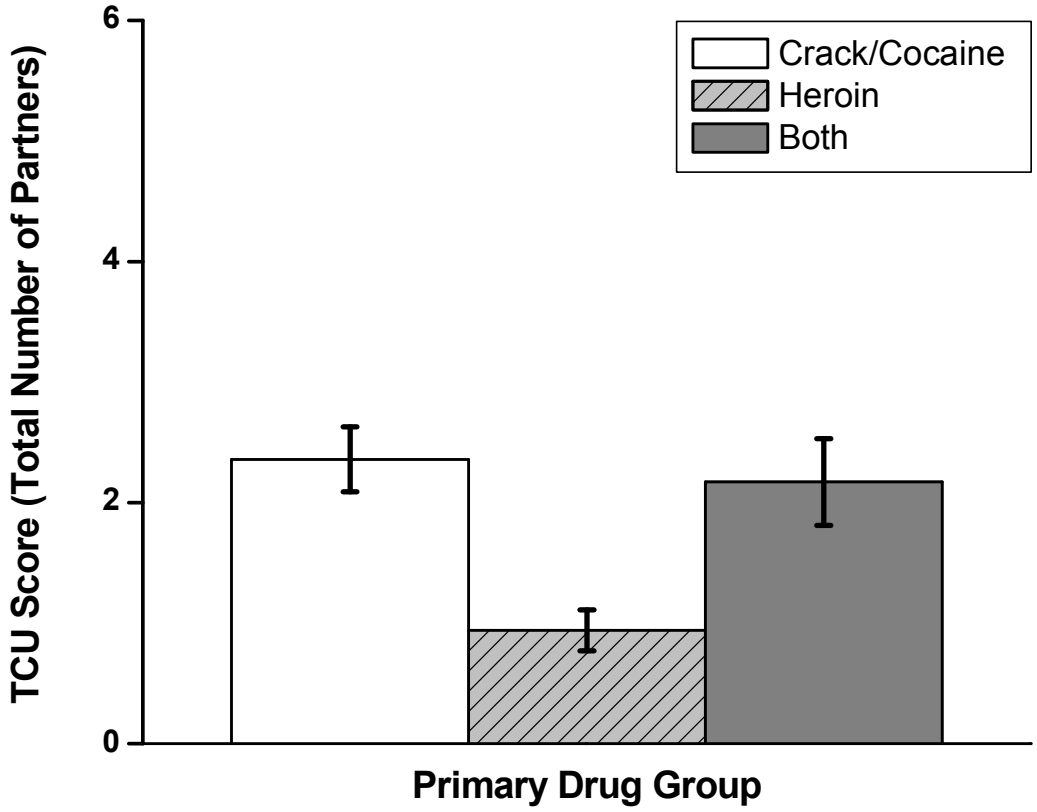
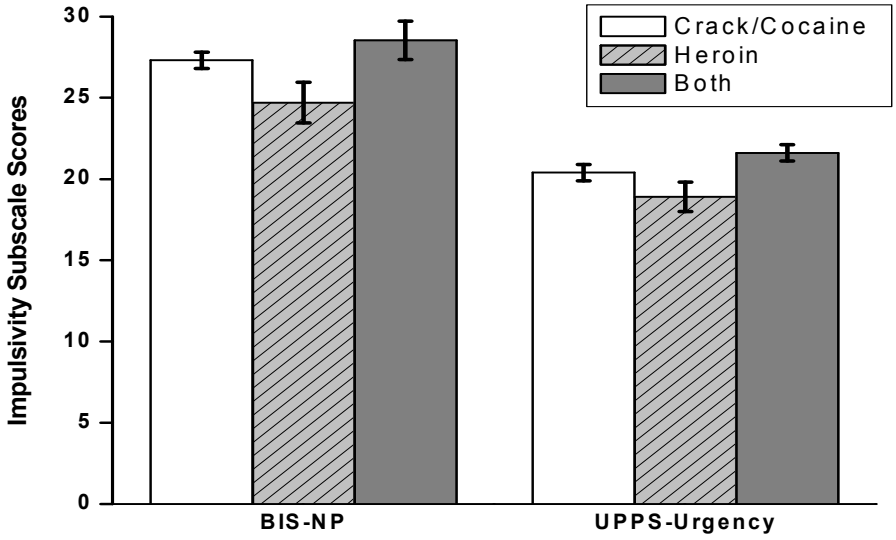


Figure 5. Impulsivity score as a function of primary drug group.



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