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Factors related to correctional facility incarceration among active injection drug users in Baltimore, MD

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Abstract

Aim—We investigated the moderating effect of impulse control on the association between drug use and incarceration among active injection drug users (IDU).

Methods—The study sample consisted of 282 IDUs aged 15 to 50 years from the Baltimore metropolitan region who reported injection drug use within the past 6 months and indicated that heroin or speedball was their drug of choice. Impulse control was measured using commission error standardized scores from the Test of Variables of Attention (TOVA). Incarceration was obtained using self-reported lifetime history of incarceration in correctional facilities.

Results—Findings indicated that impulse control moderated the association between years of injection drug use and incarceration in correctional facilities adjusting for ethnicity, gender, estimated pre-morbid intelligence, and age of first injection use. Specifically, among individuals that were intact in impulse control, four or more years of injection drug use was associated with incarceration (AOR=4.97, 95% CI: 2.02–12.23). This finding was not observed among individuals with impaired impulse control (AOR=0.57, 95% CI: 0.10–3.23). Furthermore, impulse control moderated the association between regular cocaine use and incarceration. Among individuals that had a history of cocaine use, individuals with low impulse control but not impaired were more likely to have reported time in a correctional facility (AOR=6.28, 95% CI: 1.68–23.60). There was no association among individuals with impaired or intact impulse control.

Conclusion—Results highlight the importance of considering cognitive measures of impulse control in addressing negative outcomes associated with drug use.

Keywords

Impulse control; incarceration; injection drug use

1.1 Incarceration for drug crimes in the United States

The United States of America (USA) incarcerates a greater proportion of its citizens than any other Western country (Drucker, 1999). Estimates from 2005 indicate that the USA incarcerated over 2 million individuals (Harrison and Beck, 2006). Current estimates suggest that there are 433 prisoners for every 100,000 USA residents (Harrison and Beck, 2006). From 2000 to 2004 admissions to state prisons rose 11.5%. The rise was about 14% from 1995 to 2005 (Harrison and Beck, 2006). These increases continued a trend that began in the 1980s.

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From around 1985 to 1996, the number of prisoners more than doubled within the USA (Haney and Zimbardo, 1998).

The rise in the number of incarcerated individuals may be partially attributed to changes in drug policy. In a review of incarceration trends and drug use, Drucker (1999) highlights the dramatic change that took place in the 1980s. Between 1980 and 1990 there was a 1055% increase in new admissions to state prisons for drug crimes. Between 1980 and 1995, there was a four fold increase in the proportion of state prisoners incarcerated for drug related offenses. While these numbers do include violent offenses, approximately 90% of arrests are for possession or taking part in what is considered small scale drug deals (Drucker, 1999). A variety of factors may explain the increases in the number incarcerated for drug offenses. Some researchers attribute these changes to the harsher enforcement of drug laws, mandatory minimum sentences, and an increase in the desire to incarcerate rather than rehabilitate individuals that commit drug-related crimes (Austen et al., 2001; Drucker, 1999; Haney and Zimbardo, 1998). These changes may also reflect a change in the strategies of law enforcement agencies beginning in the 1980s. During this time drug crimes were classified separately from public order crimes for the first time. In addition, a distinct executive branch position entitled the “Drug Czar” was named (Haney and Zimbardo, 1998). Perhaps in response to public opinion and the political environment, aggressive policies with regard to policing drugs may have lead to both harsher sentences for individuals convicted of drug crimes as well as a greater numbers of crimes being classified as drug related offenses.

It should also be noted that the change in incarceration policies for drug offenses has disproportionately affected African Americans. Findings indicate that African Americans comprise a large number of correctional prisoners convicted of a drug crime in the USA. Although African Americans represent an estimated 13% of the USA population, 46% of inmates with drug convictions in 1999 were African American (Austin et al., 2001). Furthermore, while the rate of incarceration of white drug offenders rose 306% between 1985 and 1995, the rate rose 707% for African Americans during the same time period (Haney and Zimbardo, 1998). Drug crimes were unique in that this category represented the largest disparity by race in the increase in incarceration rates between 1985 and 1995 (Haney and Zimbardo, 1998).

1.2 Incarceration resulting from heroin and cocaine use

Given changes in drug policy and enforcement over the past 25 years, it is not surprising that drug abuse and dependence are significant problems among incarcerated populations. Belenko and Peugh (2005) estimate that one third of male inmates and half of female inmates require residential treatment for drug use disorders. In USA prisons, research suggests that approximately one-third of prisoners have a history of injection drug use (Reindollar, 1999). Approximately 34% of prisoners report using cocaine or crack at least weekly for a month at some point in their life and 12% reported use at the time of a criminal offense (Mumola and Karberg, 2006). In addition, more than half of all state prisoners that are serving time for a drug offense are serving time for cocaine (Mumola and Karberg, 2006).

While all legal and illicit drugs may result in incarceration, extant studies suggest that heroin and cocaine use represent two independent and potent predictors of repeated incarcerations among drug using adult populations. Among individuals that use heroin, Ball and colleagues (1983) demonstrated that sustained heroin use over a period of years results in an escalation of criminal behavior often resulting in multiple incarcerations among Baltimore city heroin users. Nurco and colleagues (1989) found that while criminal activity prior to addiction to narcotics was predictive of behaviors during addiction, criminal activity intensified after the onset of addiction for all users. Among heroin users with co-morbid cocaine use there appears to be a further increase in criminal activity. Fishbein and Reuland (1994) in an assessment of

jail inmates found that regular cocaine users were more likely to commit property crimes and to score higher on measures of hostility than those that did not use cocaine frequently. Grella and other researchers (1995) found that opiate users at treatment entry that used cocaine were at increased risk for arrest. Specifically, individuals that used cocaine and particularly crack cocaine were more likely to have engaged in criminal activity.

1.3 Modifying effect of cognitive function on associations between drug use and adverse outcomes

A growing base of research has documented how sustained heroin and cocaine use result in impaired executive functions (e.g. Bolla, et al., 1998; Verdejo-Garcia et. al., 2004), that impaired cognitive functioning is correlated with initiation of substance use (Hinshaw, 1992; Moffitt, 1990) and that disrupted impulse control is associated with persistent use and addiction (Lubman et al., 2004). In addition, commission errors on continuous performances tasks have been shown to be associated with antisocial behaviors (Raine et al., 2005) and hostile aggression (Atkins et al., 1993). Furthermore, poor impulse control is shown to be related to criminal activity (see Miller and Lyman, 2001 for a review).

A much smaller yet growing base of research suggests that intact executive functions might serve a protective function against adverse outcomes among high-risk populations such as drug using adults. For example, Mitchell and colleagues (in press) found that performance on a measure of pre-morbid intellectual functioning among injection drug users moderated the association between knowing someone with HIV and engaging in HIV risk factors. Lau and colleagues (1995) found that individuals within the lowest quartile on an executive function measure became increasingly more aggressive on a laboratory task when provoked while intoxicated with alcohol when compared to individuals that performed in the highest quartile on the same measure. These findings were replicated among men in a study by Giancola (2004). Finally, Tapert and colleagues (1999) found that neurocognitive impairment moderates the association between coping and treatment outcomes among adolescents such that negative treatment outcomes were associated with poor coping skills among those with impaired cognitive function but not among those with intact cognitive function.

1.4 The current study

Based on the reviewed literature that poor impulse control is associated with criminal activity (e.g. Miller and Lyman, 2001), it was anticipated that individuals with severe impairments on a cognitive measure of impulse control would be more likely to be incarcerated. Though we acknowledge many factors moderate the association between criminal activity and incarceration, the hypothesized associations are based on the assumption that there is a positive relationship between criminal activity and incarceration in a correctional facility after adjusting for potential confounders. Therefore the relationship between impulse control and incarceration will reflect either engagement in more severe criminal activity, greater likelihood of apprehension and conviction while engaging in criminal behaviors, and/or more chronic and repeated criminal offenses among individuals with poor performance on a measure of impulse control.

We anticipated different findings with respect to length of heroin use and co-morbid regular cocaine use. It was anticipated that individuals without impairment in impulse control would report less incarceration in the early stages of injection drug use. However, consistent with previous literature (Ball et al, 1983), continued use would lead to significant increases in incarceration among this population. Among those with co-morbid regular cocaine use, we anticipated individuals that performed in the lowest half on this measure of impulse control would be more vulnerable to the adverse effects of co-morbid cocaine use and consequently report greater levels of incarceration. This is consistent with previous research suggesting

increased risk for arrest among heroin users that also use cocaine (e.g. Grella et al, 1995) and vulnerability to aggressive responses among those with poor impulse control (e.g. Giancola, 2004). Furthermore, we anticipated that among intact impulse control individuals, the greater ability to inhibit responses would protect against higher incarceration proportions associated with regular cocaine use. In addition to the stated hypotheses, the current study sought to replicate previous findings with respect to gender, race, and other covariates. A theoretical model for the current study is displayed in Figure 1. Understanding the differences within injection drug use populations in lifetime incarceration could aid in developing effective interventions in reducing drug use problems and perhaps reduce the proportion of prisoners incarcerated for drug related offenses.

2. Methods

2.1. Study Population

The current study used the baseline data from injection drug users included in the NEURO-HIV Epidemiologic Study. The NEURO-HIV Epidemiologic Study is a longitudinal epidemiological investigation funded by the National Institute on Drug Abuse (NIDA) designed to evaluate neurocognitive and social-behavioral risk factors of contracting HIV, hepatitis A, hepatitis B, and hepatitis C among injection and non-injection drug users. Study participants were recruited using a variety of community-based outreach strategies, including street recruitment, referrals, and advertisements in local newspapers. Participants were enrolled if they reported recent (within the past 6 months) injection or non-injection illicit drug use. Upon arrival to the assessment location at the Johns Hopkins University Campus, participants were given detailed information about the study and informed consent was obtained by trained clinical staff that administered the assessment. Participants received a \$45 check for completion of the baseline assessment. Baseline interviews lasted approximately three to five hours. The entire Baltimore sample consists of 632 participants between the ages of 15 and 50. The baseline assessments were conducted between 2002 and 2004. The study was monitored by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health.

Only participants who reported heroin or speedball as their drug of choice and reported injecting a drug within the past 6 months were represented, yielding a sample of 310. Sixteen participants were excluded due to insufficient effort using validity checks of the Test of Variables of Attention described below. Furthermore, participants with missing data ($n=12$) of variables of interest were excluded from the final analysis. The final sample was comprised of 282 participants. Sample characteristics are presented in Table 1.

2.2 Measures

2.2.1 HIV-Risk Behavior Interview—The HIV-Risk Behavior Interview included questions about sociodemographics, medical, educational, neurodevelopmental histories, and detailed behavioral information about drug use and sexual behavior practices. The interview obtained data on illicit drug use (injection and non-injection), sexual activity (steady, casual, sex-trade partners), and clinical symptoms related to HIV infection, viral hepatitis, and other sexually transmitted diseases.

The baseline assessment evaluates each participant's history of drug use, including drug type, route of administration, frequency of administration, and quantity used per administration for a number of time periods. The drug use section begins by detailing all of the drugs used by participants in their lifetime. Next, a record is taken of each drug used in the participants' lifetime in terms of their use of each drug by route of administration, frequency, and quantity used during the 24 hours, week, month, and 6-months preceding the assessment.

2.2.2 Neuropsychological Measures—Participants completed a battery of neuropsychological tests with most tests focusing on prefrontal executive functions. The tests of interest in the current study included the Test of Variables of Attention (TOVA; Greenberg et al., 1996) as a measure of impulse control and the Shipley Institute of Living Scale (SILS; Zachary, 1996) as an estimate of pre-morbid intellectual functioning. The TOVA is a computer-based continuous performance task lasting approximately 20 minutes. During a practice phase, the respondent is presented with a stimulus of a square in which a separate square is presented at the top or bottom of the square. The respondent is told to press the clicker when the stimulus square with the hole at the top is presented and told to ignore and not press the clicker when the stimulus square with a whole at the bottom is presented. There is a 3 minute practice test followed by the approximately 20 minute test. There is a 2 second gap between presented stimuli and stimuli are presented for 100 milliseconds. Commission errors, omission errors, and response time variables are recorded. Commission errors occur when the respondent presses the clicker incorrectly when presented with the stimulus to which they are not supposed to press the clicker (i.e., square with the box present on the bottom). Neuropsychological measures of impulsivity are associated with aggression and other poor outcomes (e.g. Raine et al, 2005). The current study used the age and gender corrected standard score of commission errors as an estimate of impulse control.

Previous research utilizing the TOVA has found that excessive omission errors (failing to respond to the target stimuli) are most sensitive to poor effort and probable malingering (Henry, 2005). Results of the TOVA are considered invalid with excessive omission or commission errors. In the current study, all 16 participants excluded for insufficient effort on the TOVA committed excessive omission errors; indicating that they failed to respond to at least 90% of targets presented in one five-minute quarter.

The SILS is a brief measure of intellectual functioning with a verbal and abstraction component. The age corrected total standard score of the sum of both of the SILS components was used as an estimate of pre-morbid intellectual functioning. Though a variety of measures and methods have been used to assess pre-morbid functioning, abilities assessed with the SILS, such as vocabulary, are most resistant to decline from disorders such as dementia or brain injury (see Vanderploeg and Schinka, 1995). For this reason the SILS was thought to be a reasonable assessment of functioning prior to the initiation of drug use. Other studies have used the SILS scores as a proxy for pre-morbid intellectual functioning among substance using samples (e.g. Bolla et al., 2002).

2.2.3 Measure of Incarceration—The current study limited the definition of incarceration to individuals who reported being imprisoned at some point in a correctional facility, not including those reporting time served in jail only. This method of assessing incarceration has been used in previous research among injection drug using populations (e.g. Kerr et al., 2007; Wood et al., 2005).

Participants were asked if they had ever spent any time in their lifetime in juvenile detention, jail, or correctional facility. Participants were provided with multiple examples of regional facilities in Baltimore city and throughout Maryland to aid respondents when making distinctions between jails and correctional facilities. Definitions used by the U.S. Department of Justice base the distinction between correctional facilities and jails primarily on the time of incarceration. As is the case in Maryland, jails in the USA are managed locally and typically house individuals with sentences less than one year or those who are awaiting trial (Harrison and Beck, 2006). In Maryland, stays in correctional facilities are typically for 12 months or longer for serious status offenses, repeat offenses, and sometimes for repeated parole violations. Self-report of incarceration during the respondent's lifetime has been used in previous studies of injection drug using populations (e.g. Kerr et al., 2007; Wood et al.,

2005). Nonetheless, we examined the distributions of the self-report of incarceration given by the present study sample of injection drug users and also ran a series of simple cross tabs as one means to evaluate response consistency across items on incarceration. Out of the sample of 282 injection drug users, 224 (79.4%) reported having a jail stay in their lifetime, 95 (33.7%) reported having a correctional facility stay during their lifetime. Overall, the pattern of participant self-report of incarceration across types of facility appeared to be consistent. For example, of the 95 reporting a correctional facility stay, 86 also reported having a jail stay. We defined incarceration in the present study sample as respondents who reported having a correctional facility stay in their lifetime. This was done mainly for reasons related to base rates of incarceration by facility type in this population, the seriousness of crimes resulting in correctional facility stays, and the possibility to improve public health because the length of correctional facility stay might facilitate application of suitable prevention interventions and treatments targeting drug dependent populations. Specifically, as anticipated the base rates of jail incarceration during participants' lifetimes were too high, respectively to use as criterion measures. Additionally, incarceration in a correctional facility typically reflects relatively serious crimes yet still occurs often enough among injection drug users. Further, the length of stay in a correctional facility is typically of sufficient length and is usually the focus of investigations into prevention interventions or treatments needs for incarcerated drug dependent populations (e.g. Belenko and Peugh, 2005).

2.3 Statistical Analysis

The primary purpose of this study was to investigate the moderating effect of impulse control on the relationship between drug use variables (i.e., years of injection drug use and regular cocaine use) and incarceration among injection drug users. Both years of heroin injection drug use and age of initiation of injection drug use were positively skewed distributions. Age of initiation of drug use was transformed to the log normal scale so that it more closely approximated a normal distribution. Years of injection drug use was dichotomized into two categories following a method used by Chitwood and colleagues (2000) with one group comprised of drug users with 4 years or less of heroin injection and the second group comprised of drug users with more than 4 years of heroin injection. Individuals that reported daily or nearly daily use of cocaine, speedball, or crack-cocaine for a period of three months or more were characterized as regular cocaine users.

Respondents were organized into three groups based on standard scores of TOVA commission errors: 1) Impaired Impulse Control was comprised of participants who performed below the 5th percentile, 2) Low Impulse Control was comprised of participants who performed above the 5th percentile yet below the 50th percentile, 3) and Intact Impulse Control comprised of participants who performed above the 50th percentile. These separation points were based, in part, on clinical standards such that performance below the 5th percentile is often a marker for significant impairment. Initially, each covariate was incorporated into a simple logistic regression analysis with the outcome variable being reported history of incarceration in a correctional facility during the respondent's lifetime to obtain unadjusted odds ratios. Multiple logistic regression analyses were then used with all variables included in the final model to obtain adjusted odds ratios. Finally, interaction terms were added to the multivariate models to test for the modifying effects of impulse control on the association between years of injection drug use and incarceration as well as the modifying effects of impulse control on regular cocaine use and incarceration.

3. Results

3.1 Unadjusted associations with incarceration

Table 2 presents the unadjusted odds ratios for each covariate with incarceration in a correctional facility. Consistent with previous literature, individuals that reported injecting drugs for more than four years were more likely to have been incarcerated than those injecting for less than four years (Odds Ratio [OR]=4.31, 95% Confidence Interval [CI]: 2.44–7.63). In addition, those that reported a history of regular cocaine use were more likely to have been incarcerated than those that did not report a history of cocaine use (OR=1.96, 95% CI: 1.19–3.24). Other variables of interest included higher Shipley scores (OR=0.97, 95% CI: 0.95–1.00) and later onset of injection drug use (OR=0.35, 95% CI: 0.14–0.90) being protective against incarceration. The strong associations with respect to race and gender were consistent with previous research. Specifically, African Americans were nearly three times more likely than other ethnicities to have a history of incarceration (OR=2.98, 95% CI: 1.73–5.11) and males were twice as likely as females (OR=1.84, 95% CI: 1.08–3.14) to have a history of incarceration.

3.2 Adjusted associations and interactions

The next step of the analysis allowed for the assessment of the adjusted odds ratios with and without the interaction terms. The adjusted model without the interaction term is presented in Table 2. The pattern of significance remained relatively unchanged from the unadjusted to the adjusted model. One notable difference was the Shipley t-score, which no longer achieved statistical significance (Adjusted Odds Ratio [AOR]=0.98, 95% CI: 0.95–1.01) in the adjusted model.

The next step in the analysis was to test for the interaction effects of interest with all covariates included. The third model in Table 2 includes interaction terms for both years of injection drug use and regular cocaine use by impulse control. Because impulse control was set into three categories with two indicator variables, both of the hypothesized interactions are being tested with two interaction terms. Therefore, a total of four terms were added to the interaction model. Consistent with the methods described in Jaccard (2001), all interaction terms were fit and the models were compared using the likelihood ratio test. The LRT was statistically significant ($\chi^2=10.93$, $df=4$, $p=.03$), indicating one or both of the interaction terms was statistically significant. A backward selection process was then used to determine if one or both interactions should be included in the final model with the threshold set at $p<.10$. Both interaction terms met this criterion, suggesting the model with both terms was the best fit. Table 2 presents the model with the inclusion of all interaction terms. It is noteworthy that the LRT for both interaction terms for years of injection heroin use and impulse control did exceed the $p<.05$ ($p=.09$) level, though one term was statistically significant in the model alone. It was determined that dropping one or both of the interaction variables would lead to inappropriate inferences and therefore interpretation is based on the inclusion of all interaction terms.

Based on these findings and for ease of interpretation, analyses were stratified by impulse control. Table 3 presents the AORs at the different levels of impulse control. A graphic display of the predicted probability of the stratified logistic regression models is displayed in Figure 2 with the probabilities estimated using the mean values of the covariates. Notable findings include the association between years of injection drug use and history of incarceration among individuals who are intact in impulse control (AOR=4.97, 95% CI: 2.02–12.23), with long term injectors having greater odds of incarceration. Though not statistically significant, there was a trend in a similar direction among individuals low in impulse control (AOR=3.50, 95% CI: 0.76–16.10). As can be observed in Table 2 and in Figure 2, these results did not indicate a protective effect for low impulse control. The probability of incarceration was higher among

individuals low in impulse control at both levels of years of injection drug use, suggesting the lack of a significant finding may be an issue of sample size. The association was not statistically significant among individuals with impaired impulse control (AOR=0.57, 95% CI: 0.10–3.23). As demonstrated graphically in Figure 2, individuals with impaired impulse control had higher levels of incarceration in comparison to individuals in the low and intact groups at the early stages of injection drug use but not in the later stages. These findings are consistent with the stated hypothesis that impaired impulse control is associated with an increased risk of incarceration at the early stages of use, but this effect disappears as injection drug use persists.

Consistent with the hypothesis with respect to regular cocaine use, regular cocaine use did not predict history of incarceration among individuals with intact impulse control (AOR=0.97, 95% CI: 0.43–2.17) or impaired impulse control (AOR=1.92, 95% CI: 0.45–8.13). However, among individuals with low impulse control, history of cocaine use predicted self-reported incarceration (AOR=6.29, 95% CI: 1.68–23.60).

A sensitivity analysis was performed including the participants excluded using TOVA validity measures. Participants were categorized according to their commission error standard score. As anticipated, the results were toward the null with the inclusion of these individuals, with the interaction terms value higher in the full model ($p=.05$). Results were similar in the stratified analyses. Since individuals that were excluded due to poor effort failed to respond to a large number of items, it is likely that the number of commission errors were underestimated.

4. Discussion

Consistent with a broad base of previous research, years of heroin injection and regular cocaine use among heroin injectors were associated with a history of correctional facility incarceration (e.g. Ball et al., 1983, Fishbein and Reuland, 1994). When examining main effects, relationships between demographic variables and incarceration status were also consistent with extant research with African American injectors in our sample reporting higher rates of correctional facility incarceration when compared to other ethnicities, and males reporting higher rates of incarceration than females.

The pattern of results with respect to moderating effects of intact impulse control was also noteworthy. For example, as a main effect, four or more years of injection drug use was associated with elevated correctional facility incarceration as expected. However, this association was not maintained among injectors with impaired impulse control. That is, among injectors with substantial impairments in impulse control, drug users with a history of four or fewer years of injection were equally likely to have a history of correctional facility incarceration when compared to drug users with four or more years of injection. This suggests that the salience of gross impairment in impulse control may take precedence over the more traditional and comparatively well-documented salience of years of injection when predicting incarceration status.

Injectors with intact impulse control exhibited a different pattern of results. Namely, intact impulse control appeared to protect injectors against correctional facility incarceration during the initial (i.e., first four years of drug injection) but not later (more than four years injection) years of drug injection. This pattern of results adds a possibly important dimension to the extant findings documenting relationships between indicators of heroin injection severity, such as years of injection, and incarceration risk. Specifically, the present study findings suggest that more years of heroin injection is associated with heightened incarceration risk but mainly among injectors with intact impulse control. The findings suggest this may be the case because injectors with major impairment in impulse control are already at heightened incarceration risk even at the beginning of their use of injection drugs. The impaired group may reflect a type of

drug user with a greater tendency toward criminal behavior independent of drug use. As Nurco and colleagues (1985) note, there are different patterns of criminal behavior among those addicted. Specifically, some individuals were more prone to delinquent and criminal behavior prior to injecting drugs and others engage in criminal behavior to support their addiction. This is consistent with the observation that early career injectors are protected against correctional facility incarceration when they possess intact impulse control. The protective effect of intact impulse control, however, wanes as the number of years of drug injection progresses. The waning protective effect of intact executive functions against incarceration might be attributable to well-documented adverse effects of drugs on cognitive executive functions (Verdejo-Garcia et al., 2004) such that there are too few drug users having intact executive functions among late career injectors thus precluding the possibility of a protective effect. It is also possible that a sub-group of injectors with more-than four years of injection drug use who also have intact impulse control exist but that the wide range of negative sequelae associated with heroin addiction essentially attenuates or overtakes this protective effect of cognition.

The pattern of results pertaining to the modifying influence of impulse control on the relationship between cocaine use and incarceration status is also noteworthy though somewhat different than that evidenced for years of drug injection. First, at the most impaired level of impulse control, injectors who also use cocaine daily or nearly daily do not appear to be at elevated incarceration risk. As such, this relationship is similar to the findings for years of injection drug use again suggesting that the salience of gross impulse control impairment outweighs the salience of years of injection or regular cocaine use, two typically significant and clinically relevant drug use problem severity indicators in their own right. However, among injectors with intact executive functions, being a regular cocaine user while holding the remaining covariates constant did not appear to elevate incarceration risk. These findings might suggest that the addition of regular cocaine use in a population of injection drug users already using heroin does not elevate incarceration risk when the drug user has intact functions nor does it affect incarceration risk when impulse control is essentially absent. Figure 2 provides some direction on these phenomena such that in the former case, the incarceration prevalence is stable and low despite the presence of regular cocaine use and in the latter instance the incarceration prevalence is relatively stable and high despite the presence of regular cocaine use. However, regular cocaine use may represent a unique and independent incarceration risk factor among the subgroup of injectors in our sample characterized by a range of impulse control that includes those with substantial impairment (i.e., those close to the 5th percentile) to those with modest impairment (i.e., those close to the 50th percentile). As shown in Figure 2, the significant increase in correctional facility incarceration among those with impaired impulse control associated with regular cocaine use is also present as a trend among the grossly impaired subgroup. While the addition of regular cocaine use by a heroin injector was associated with an increase in incarceration, the extent of the increase was not substantial enough to achieve significance perhaps because the incarceration prevalence was already comparatively high when impulse control was grossly impaired.

Limitations of the current study include the few inferences that can be drawn from cross-sectional, self-report data. Incarceration in this study is self-reported lending to the possibility of recall biases; however, as previously noted, this method has been used in other studies (Kerr et al., 2007; Wood et al., 2005). In addition, the severity of crimes was not assessed. Perhaps individuals with intact impulse control, though they are possibly equally likely to be incarcerated, are less likely to commit or be convicted of violent or severe crimes than those that are impaired in impulse control. Finally, the direction of the association between impulse control and incarceration at the early stages of use is difficult to identify. For example, though the proportion of incarceration increases, the current data can not identify whether this incarceration took place prior to or after the initiation of injection use. In addition, there is a

possibly that the results reflect cohort or period effects. Despite these limitations, the results are consistent with previously reviewed literature of the relationship between ethnicity, gender, impulse control and incarceration among drug users. Furthermore, while the current study cannot address the casual relationship between drug use and criminal activity, it does present findings that show important individual level correlates of an outcome that is associated with several negative health outcomes.

While acknowledging the noted limitations, the current study does highlight the importance of considering cognitive factors, specifically impulse control, in understanding incarceration among injection drug users. Understanding the role of cognition may also help to identify subgroups of drug users who are resilient to adverse outcomes like incarceration and as such may be less motivated over time to change their behavior. If such were the case, cognitive strength might serve both a protective function (i.e., against incarceration) while thereby also serving as risk factor of other outcomes (motivation to change drug taking behavior). Understanding relationships between cognition, drug use, and various social-behavioral outcomes may also help to inform targeted prevention interventions and treatments. For example, incarceration may be an ideal opportunity to intervene with individuals with impaired impulse control to prevent exposure to infectious disease.

The current study is the first step in the analysis of the association between cognitive impairment and adverse outcomes associated with injection drug use. Future analyses can investigate the observed associations between impulse control in relation to similar outcomes using longitudinal data and track the different trajectories of individuals who inject drugs. In addition, more research can examine the possibility of different vulnerability to adverse outcomes among those that use cocaine in addition to heroin. Considering cognitive differences among injection drug use populations may aid in identifying and understanding risk factors among already high risk individuals and lead to effective strategies for harm reduction programs aimed at reducing exposures to infectious diseases in prison and among high risk populations.

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Figure 1.

Figure 2.

Table 1

Descriptive statistics (n=282).

Variable	N	% of sample
Gender		
Male	176	62.41
Female	106	37.59
Ethnicity		
White or other ethnicity	203	71.99
African American	79	28.01
Regular Cocaine Use (inject or snort)		
Yes	89	31.56
No	193	68.44
Regular Speedball * Use (inject or snort)		
Yes	92	32.62
No	190	67.38
Regular Crack Use		
Yes	67	24.76
No	215	76.24
Any Regular Cocaine Use		
Yes	132	46.81
No	150	53.19
Age		
Mean (SD)	31.39 (7.16)	
SILS t-score		
Mean (SD)	42.87 (9.52)	
Age of first injection		
Mean (SD)	23.08 (6.35)	
Years of injection		
Mean (SD)	7.71 (6.75)	
TOVA commission errors		
Mean (SD)	96.86 (21.20)	
Education in years		
Mean (SD)	10.49 (1.91)	

Note:

* =Speedball is the use of heroin and cocaine at the same time.

Table 2

Adjusted and unadjusted logistic regression models for incarceration.

Variables	N (% incarcerated) or Mean-SD (% incarcerated)	Unadjusted OR (95% CI)	Adjusted OR (95% CI) No interaction terms	Adjusted OR (95% CI) With interaction terms
Gender				
Female	106 (25.5%)	1.00	1.00	1.00
Male	176 (38.6%)	1.84 (1.08–3.14) *	2.38 (1.26–4.51) **	2.71 (1.39–5.28) **
Ethnicity				
White or other	203 (26.6%)	1.00	1.00	1.00
AA	79 (51.9%)	2.98 (1.73–5.11) **	2.88 (1.50–5.57) **	2.92 (1.48–5.75) **
SILS t-score	42.87–9.52 (33.7%)	0.97 (0.95–1.00) *	0.98 (0.95–1.01)	0.98 (0.95–1.01)
Age of first injection (natural log)	3.10–0.27 (33.7%)	0.36 (0.14–0.90) *	0.36 (0.14–0.90) *	0.28 (0.09–0.87) *
Years of injection				
4 or less	120 (16.7%)	1.00	1.00	1.00
More than 4	162 (46.3%)	4.31 (2.44–7.63) **	3.05 (1.60–5.82) **	4.70 (1.94–11.35) **
Regular Cocaine Use				
No	150 (26.7%)	1.00	1.00	1.00
Yes	132 (41.7%)	1.96 (1.19–3.24) *	1.70 (0.95–3.03) ^	0.97 (0.44–2.12)
Impulse Control				
Intact	162 (29.6%)	1.00	1.00	1.00
Low	79 (36.7%)	1.38 (0.78–2.43)	1.42 (0.74–2.72)	0.60 (0.10–3.43) *
Impaired	41 (43.9%)	1.86 (0.92–3.75) ^	2.23 (1.00–4.98) *	4.46 (1.07–18.49) *
Impulse Control × Years of Injection				
Low × More than 4	---	---	---	0.91 (0.17–4.97)
Impaired × More than 4	---	---	---	0.18 (0.3–0.89) *
Impulse Control × Regular Cocaine Use				
Low × regular cocaine use	---	---	---	5.85 (1.48–23.16) *
Impaired × regular cocaine use	---	---	---	1.66 (0.36–7.68)

Note:

^
=p<.10,*
=p<.05,**
=p<.01

Table 3

Adjusted odds ratios for incarceration stratified by years of impulse control.

Variables	Impaired Impulse Control (<5 th percentile)	Low Impulse Control (5 th –50 th percentile)	Intact Impulse Control (>50 th percentile)
	N (% incarcerated) or Mean-SD (% incarcerated)	N (% incarcerated) or Mean-SD (% incarcerated)	N (% incarcerated) or Mean-SD (% incarcerated)
Gender			
Female	15 (33.3%)	41 (29.3%)	50 (20.0%)
Male	26 (50.0%)	38 (44.7%)	112 (33.9%)
Ethnicity			
White or other	30 (40%)	58 (25.9%)	115 (23.5%)
AA	11 (54.6%)	21 (66.7%)	47 (44.7%)
Shipley t-score	43.98–9.36 (43.9%)	5.12 (1.31–20.02) *	2.81 (1.09–7.26) *
Age of first injection (natural log)	3.11–0.31 (43.9%)	0.96 (0.90–1.03)	0.96 (0.92–1.00)
Years of injection		3.07–0.29 (36.7%)	3.11–0.25 (29.6%)
4 or less	22 (40.9%)		
More than 4	19 (47.4%)		
Regular Cocaine Use			
No	22 (36.4%)	43 (23.3%)	85 (25.9%)
Yes	19 (52.6%)	36 (52.8%)	77 (33.8%)

Note:

$$\wedge_{p \leq 10},$$

*
=p<.05,

**
=p<.01