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Psychopathic heroin addicts are not uniformly impaired across neurocognitive domains of impulsivity

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ABSTRACT

Background: Impulsivity is a hallmark characteristic of drug addiction and a prominent feature of externalizing disorders such as psychopathy that are commonly comorbid with drug addiction. In a previous study (Vassileva et al., 2007) we have shown that psychopathic heroin addicts evidence more impulsive decision-making on the Iowa Gambling Task relative to non-psychopathic heroin addicts. The goal of the current study was to investigate whether the observed impulse-control deficits in psychopathic heroin addicts would generalize to other neurocognitive domains of impulsivity, such as delay discounting and behavioral inhibition among a group of relatively "pure" heroin addicts in Bulgaria who participated in our previous study.

Methods: We tested 92 currently abstinent male heroin addicts, classified as psychopathic or non-psychopathic based on the Hare Psychopathy Checklist – Revised (PCL-R). We administered two neurocognitive tasks of impulsivity: (1) Delayed Rewards Discounting Task, a measure of temporal discounting of rewards; and (2) Passive Avoidance Learning Task, a measure of behavioral inhibition.

Results: Psychopathic heroin addicts were not impaired relative to non-psychopathic heroin addicts on the Delayed Rewards Discounting Task and the Passive Avoidance Learning Task, on the latter of which they showed better attentional capacity.

Conclusions: These results indicate that psychopathic heroin users are not uniformly impaired across neurocognitive domains of impulsivity. Combined with our previous findings, results suggest that the presence of psychopathy may exacerbate decision-making deficits in psychopathic heroin addicts, but it may not have significant effect on other neurocognitive domains of impulsivity in this population.

1. Introduction

Drug addiction is conceptualized as a chronic relapsing disease characterized by long-term neuroadaptive changes in the brain and associated long-lasting impairments in neurocognitive functioning (Koob and Volkow, 2010). Some of the most notable neurocognitive deficits in substance dependent individuals (SDIs) are observed in the area of inhibitory and impulse control, proposed to be the core mechanisms underlying the compulsive pattern of drug seeking and use that persists despite negative health and social consequences for the drug user (Goldstein and Volkow, 2002; Jentsch and Taylor, 1999). There is accumulating evidence that drug users consistently show neurocognitive deficits in impulse control, yet compared to other drugs of abuse such as stimulants, cocaine, or cannabis, the long-term neurocognitive effects of opiates have received considerably less research attention, even though opiates continue to account for the largest proportion of people in drug treatment worldwide (United Nations Office on Drugs and Crime, 2008).

Evidence from the few studies available to date indicates that heroin users show impairments in impulse control that include impulsive decision-making (Brand et al., 2008; Fishbein et al., 2007; Verdejo-Garcia and Perez-Garcia, 2007; Verdejo-Garcia et al., 2007), impaired behavioral inhibition (Mintzer and Stitzer, 2002), increased risk-taking (Bornovalova et al., 2005), and increased discounting of delayed rewards (Kirby et al., 1999; Kirby and Petry, 2004; Madden et al., 1997). However, findings are often hard to interpret, given that with few exceptions (Fishbein et al., 2007; Vassileva et al., 2007), most neurocognitive studies of heroin users are based on polysubstance users, which makes it impossible to dissociate the neurocognitive effects of heroin from the confounding effects of other drugs.

Further, neurocognitive studies of heroin users often fail to control for the confounding effects of common comorbid psychiatric

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conditions such as Antisocial Personality Disorder (ASPD) or psychopathy, known to adversely affect neurocognitive functioning in a fashion similar to drug addiction. In a previous study of neurocognitive functioning in heroin users (Vassileva et al., 2007), we successfully circumvented these methodological challenges by conducting the study in Bulgaria, where patterns of heroin use are unique in that polysubstance dependence among heroin users is still relatively uncommon. We found that the presence of psychopathy among relatively "pure" heroin users with no significant history of dependence on other substances is associated with impulsive decision-making, as indexed by impaired performance on the Iowa Gambling Task (IGT). Yet, given the multidimensional nature of impulsivity, the question still remains of whether the observed neurocognitive deficits in impulsivity among psychopathic heroin addicts are limited to impulsive decision-making in particular, or whether they would generalize to other neurocognitive domains of impulsivity. In the current study, we expand our investigation of impulsivity among psychopathic heroin addicts, by examining patterns of performance in two additional neurocognitive domains of impulsivity, namely delay discounting and behavioral inhibition.

Impulsivity, clinically defined as "an individual's predisposition toward rapid, unplanned reactions to internal or external stimuli without regards to the negative consequences of these reactions to themselves or others" (Moeller et al., 2001) is implicated in virtually all kinds of addictive behaviors (de Wit and Richards, 2004; Jentsch and Taylor, 1999). Although there has been a notable interest in impulsivity in the addiction literature, research has been plagued by the multifactorial nature of the construct (Evenden, 1999), which has presented a significant problem for investigating its biological underpinnings (Evenden, 1999). Although impulsivity is often thought of as a personality trait or a symptom of various psychiatric disorders, many contemporary conceptualizations of impulsivity involve distinct performance-based neurocognitive manifestations of the construct. Generally, neurocognitive measures typically capture one of three domains of impulsivity. The first domain is that of impulsive decision-making (Bechara et al., 1994), which reflects impaired ability to make decisions in accordance with long-term rather than short-term goals (Bechara et al., 2001) and is considered to reflect myopia for future consequences (Bechara, 2005). This type of impulsivity is sometimes referred to as "cognitive impulsivity" (Verdejo-Garcia et al., 2008) and is typically measured in the laboratory with gambling or betting tasks such as the Iowa Gambling Task (Bechara et al., 2001), the Cambridge Gambling Task (Rogers et al., 1999), or the Game of Dice Task (Brand et al., 2005). Conceptually similar is the domain of delayed rewards discounting, referring to the reduction in the present value of a future reward as the delay to that reward increases (Kirby et al., 1999). It is measured in the laboratory with delayed rewards discounting tasks, which involve making a selection between smaller immediate rewards and larger delayed rewards (Bickel and Marsch, 2001). The third major domain of impulsivity captured by neurocognitive tasks is related to impaired behavioral inhibition, manifested as inability to inhibit or withhold a prepotent or an already initiated response. This type of impulsivity is sometimes referred to as "motor impulsivity" (Bechara et al., 2000; Dougherty et al., 2003) and is measured with tasks as the Go/No-Go Discrimination Task or the Stop Signal Task. Substance dependent individuals show deficits on virtually all of these tasks (Bechara et al., 2001; Bechara and Damasio, 2002; Bornovalova et al., 2005; Fishbein et al., 2007; Kirby and Petry, 2004; Lejuez et al., 2004; Petry, 2003; Rogers et al., 1999; Verdejo-Garcia and Perez-Garcia, 2007; Verdejo-Garcia et al., 2007), whereas heroin users in particular appear to be impaired primarily on delayed reward discounting and decision-making tasks (Fishbein et al., 2007; Kirby et al., 1999; Madden et al., 1997; Odum et al., 2000), although research employing tasks of behavioral inhibition in this population is very limited.

In addition to its involvement in addictive behaviors, impulsivity has also been implicated in externalizing disorders that are highly comorbid with drug addiction, such as Antisocial Personality Disorder (ASPD) and psychopathy. In fact, drug and alcohol addiction were part of the original criteria for antisocial personality disorder (at the time called sociopathic personality disorder) in the DSM-I (American Psychiatric Association, 1952). The prevalence of lifetime substance use disorders in individuals with ASPD has been reported to be as high as 90% (Regier et al., 1990). The extremely high comorbidity of substance abuse and ASPD has led some to question whether ASPD should be viewed as independent of substance abuse (Gerstley et al., 1990; Regier et al., 1990), as it has been argued (Darke et al., 1998; Reardon et al., 2002) that it is possible to meet diagnostic criteria for ASPD on the basis of illicit drug use alone. A potentially more informative alternative to the somewhat over-inclusive diagnosis of ASPD is the construct of psychopathy (Hare, 1991): a disorder characterized by poor behavioral controls and antisocial lifestyle much at a par with ASPD, but also characterized by personality style consisting of distinct affective and interpersonal characteristics, not covered by the ASPD criteria. In fact, the proposed draft criteria for the upcoming revision of the Diagnostic and Statistical Manual (DSM-V) include many of the affective and interpersonal characteristics of psychopathy that are not currently covered by the ASPD criteria, and it has been proposed that the disorder be renamed to "Antisocial/Psychopathic Type" (American Psychiatric Association, 2010). ASPD and psychopathy have been associated with neurocognitive deficits in impulsivity, predominantly in the domain of behavioral inhibition (Dolan and Park, 2002; Newman and Kosson, 1986; Vollm et al., 2010). With regards to decision-making and delayed reward discounting, research still appears inconclusive with some studies reporting impulse control deficits (Blair et al., 2001; van Honk et al., 2002; Vassileva et al., 2007), whereas in other studies (Losel and Schmucker, 2004; Schmitt et al., 1999) psychopaths fail to exhibit such deficits.

The goal of the present study was to determine whether psychopathy in heroin addicts would be associated with neurocognitive deficits in two domains of impulsivity, which we did not investigate in our earlier study on decision-making in this population. In order to avoid the confounding effects of polysubstance use, we conducted the study in Bulgaria, where heroin addiction is highly prevalent but polysubstance dependence is still relatively rare. We administered two neurocognitive tasks, measuring two different dimensions of impulsivity: (1) Delayed Rewards Discounting Task, a measure of temporal discounting of monetary rewards; and (2) Passive Avoidance Learning Task, a "motivated Go/No-Go" type of task, measuring one's ability to inhibit inappropriate motor responses based on different reward and punishment contingencies. We hypothesized that the presence of psychopathy in heroin addicts would be associated with greater impairments in the two neurocognitive domains of impulsivity evaluated in the current study.

2. Methods

2.1. Participants

Participants were 92 currently abstinent male heroin users, ages 18–50, who were tested at St-Naum University Hospital of Neurology and Psychiatry in Sofia, Bulgaria. Participants were recruited by informational flyers distributed at outpatient drug treatment centers. The study was approved by the Institutional Review Boards of University of Illinois – Chicago and St-Naum University Hospital and written informed consent was obtained from all participants prior to any study procedures.