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Disinhibition and Persistent Maladaptive Behavior

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Abstract

Objective: There is an urgent need to reduce overpopulation in U.S. prisons, which are inundated with individuals needing substance use treatment. Research on both substance use and antisocial behaviors highlights maladaptive beliefs and behaviors, while also implicating disinhibition as an important factor. Disinhibition is a dynamic trait that can be targeted with therapeutic interventions. The current study explored the relationships between disinhibition, substance use, and recidivism among incarcerated men. The study hypothesized that disinhibition would be associated with history of substance use, history of antisocial behavior, and institutional misconduct, and that disinhibition would predict recidivism above history of substance use. **Method:** This study analyzed an archival dataset of demographic, clinical, and neuropsychological measures among a sample of incarcerated men (N = 95). **Results:** Descriptive analyses showed meaningful relationships among disinhibition, past substance use, past antisocial behavior, institutional misconduct, and recidivism. Disinhibition was meaningfully associated with history of substance use (ß = 0.33, $t = 3.07$, $p = .003$, adjusted $R^2 = .09$), history of antisocial behavior (ß = .25, $t = 2.19$, $p = .032$, adjusted $R^2 = .18$), and institutional misconduct (ß = .270, $t = 2.04$, $p = .047$, adjusted $R^2 = .30$), but not recidivism outcome ($df = 1$, $X^2 = 0.73$, $p = .393$). **Conclusion:** Statistical and other methodological limitations may have contributed to a lack of support for all hypothesized associations. Nonetheless, disinhibition represents a worthwhile construct for further research on both assessment and treatments for incarcerated and substance use populations incorporating a biopsychosocial approach.

Keywords: disinhibition, substance use, criminal recidivism, neuroprediction, forensic assessment.

Disinhibition and Persistent Maladaptive Behavior

There is an urgent need for a solution to the overpopulation in U.S. prisons, which are inundated with individuals in need of mental health services, particularly substance use treatment. The U.S. prison population is comprised of a substantial portion (85%) of individuals who either have a Substance Use Disorder (SUD) or were using substances during their crime (NIDA, 2020a). Mass incarceration was made especially apparent during the COVID-19 pandemic as it contributed to the disproportionate infection and death rate among incarcerated individuals (Burkhalter et al., 2021; Minkler et al., 2020), rendering those with substance use disorders especially vulnerable (Mukherjee & El-Bassel, 2020; Ornell et al., 2020). Thus, the utility of finding a reliable underlying thread between substance use and antisocial behaviors is immense, and designating it as a target of treatment may simultaneously reduce both behaviors.

Substance abuse is a multifaceted concept related to a variety of factors. Research on substance use highlights its relationship with early maladaptive schemas (EMS), which illustrate how the persistence of dysfunctional self- and world-beliefs can impact an individual's emotional regulation, coping strategies, and resilience (McDonnell et al., 2018; Shorey, Elmquist, et al., 2015). Similarly, research on antisocial behaviors (e.g., acting out in reactive or angry aggression or engaging in activities that violate the norm) echoes the complex emotional and social problems that can accompany such maladaptive behaviors, implicating disinhibition as an important factor (Krueger et al., 2007). Given that disinhibition has also been implicated in substance use research (Moeller et al., 2016), further exploration of the relationship of all three is warranted. For the purpose of this paper, further discussion of "maladaptive behaviors" will refer to substance use and antisocial behaviors.

This study will explore the relationship between disinhibition and maladaptive behaviors, through the lens of substance use and antisocial behaviors. This study will discuss the characteristics and measurement of disinhibition, substance use, and antisocial behavior, then summarize the existing research highlighting the relationships between the three variables. This study will go on to address the gaps in the research and further propose that the persistence of maladaptive behaviors is better explained by measurements of disinhibition, through the use of a preliminary neurocognitive battery, as opposed to measurements of current or historical substance use. Higher rates of disinhibition are expected to be meaningfully associate with higher rates of substance use and antisocial behaviors.

Disinhibition

Disinhibition is a general difficulty with impulse control and behavioral restraint, affecting an individual's ability to regulate their urges; they struggle with planning and foresight, often succumbing to immediate gratification (Patrick et al., 2009). As a personality trait, this can manifest as sensation-seeking, venturesome behaviors (Stevens et al., 2014), or impulsive actions that appear irresponsible, impatient, and reactive, often leading to negative consequences (Patrick et al., 2009).

Measurement

From a personality perspective, disinhibition is perceived as a relatively stable trait and can be measured through the use of self-report questionnaires that encompass broad periods of time (Stevens et al., 2014). This would require the individual to subjectively assess their own impulsive thoughts and behaviors using such measurements as the Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995), varying subsections of the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1984; Eysenck & Eysenck, 1985), the Sensation Seeking Scale (Zuckerman,

1994), and the Urgency, Premeditation, Perseverance, Sensation-Seeking, Positive Urgency (UPPS-P) Impulsive Behavior Scale (Whiteside & Lynam, 2001; Cyders et al., 2007; Lynam et al., 2006). Nevertheless, self-report measures, are prone to biased, or socially desirable, responding (Fisher, 1993).

Despite being a self-report measure of subjective impulsivity, the UPPS-P (Lynam et al., 2006) was developed as a result of a factor analysis of ten different self-report measures of impulsivity, resulting in five subscales that reflect the multifaceted nature of disinhibition. The Positive and Negative Urgency scales account for the propensity to act impulsively in the face of either positive or negative emotions. The Sensation Seeking scale accounts for the risk-taking component, and the Lack of Premeditation scale accounts for the disregard of potential consequences. The Lack of Perseverance scale measures the inability to focus on and complete multiple ongoing tasks. Such factor analysis approaches can reduce the variability or repetition within and across measures to create a more targeted measure (Floyd & Widaman, 1995).

Neurocognitive Disinhibition

To counteract the subjective nature of personality assessments, disinhibition has also been assessed from a neurocognitive standpoint, conceptualizing it as a transitory state that can be measured using more objective behavioral tasks that capture spontaneous reactions to instructions or relevant stimuli (Stevens et al., 2014). Neurocognitive tests are typically acknowledged as proximate reflections of underlying biological processes; therefore, the measured behaviors can potentially serve as endophenotypes, that is, biological traits that are specific and reliable indicators of various disorders (Stevens et al., 2014).

Neurocognitive disinhibition is an aspect of cognitive control encompassing impulsive actions (motor and cognitive disinhibition) and impulsive choices (response disinhibition), each

measured in different ways (Stevens et al., 2014). *Motor disinhibition* is captured by an individual's ability to restrain a not-yet-initiated action or cease an already-initiated, ongoing action (Stevens et al., 2014). This is typically measured using such paradigms as a Go/No-Go task (Donders, 1969), Stop-Signal Task (SST; Logan, Cowan, & Davis, 1984), Continuous Performance Test (CPT; Rosvold et al., 1956), or an Immediate and Delayed Memory Task (IMT/DMT; Dougherty, Marsh, & Mathias, 2002). *Cognitive disinhibition* is captured by an individual's ability to maintain response performance in the presence of competing, distracting information (Stevens et al., 2014). Such interference control is often measured using the Stroop Color Word Test (Stroop, 1935) or a Stroop-like task in which there is conflict between an automatic response and a more controlled response, including "drug versions" which replace the color words with relevant substance-related words (Stevens et al., 2014).

Although the source of disinhibition is unclear, neuroimaging studies show that reduced volume and thickness of the brain cortices involved with cognition show poorer performance on related tasks (Yuan & Raz, 2014). Individuals with ADHD often have reduced gray matter, white matter, and functional connectivity in the areas associated with disinhibition (e.g., prefrontal cortex; Kasparek et al., 2014; Mehta et al., 2019). ADHD also affects the production, transportation, and absorption of relevant neurotransmitters (e.g., dopamine and norepinephrine; Mehta et al., 2019). Childhood ADHD is also a risk factor for substance use, considering their shared impact on such brain chemicals (Charachel et al., 2011; Yalisov & Berry, 2016). Other possible contributors, considering their impact on brain volume and functioning, are traumatic brain injuries (Belanger et al., 2017; Roebuck-Spencer & Sherer, 2017), low socio-economic status (Hyde et al., 2020), childhood abuse (Gold et al., 2016), and traumatic stress (Bremner, 2006).

With multiple potentially relevant contributions to disinhibition, a broad conceptualization and measurement of disinhibition is a worthy consideration. As such, the theoretical framework of this study is that disinhibition can be characterized by longstanding personality traits and momentary states, which both contribute meaningfully to the larger picture.

Maladaptive Behavior: Substance Use

The National Institute on Drug Abuse (NIDA) defines substance use as "any scope of use of illegal drugs," including alcohol and tobacco (2020b). NIDA specifies that *use, misuse,* and *addiction* are defined separately, and use or misuse does not imply addiction. Substance addiction is a chronically cyclical pattern of behaviors dedicated to obtaining and consuming licit or illicit substances, despite persistently experiencing negative consequences thereof (Moeller & Paulus, 2018; Moeller et al., 2016; NIDA, 2020b; Parvaz et al., 2011). Addiction is characterized by craving, intoxication, bingeing, and withdrawal from one or various substances, which becomes a primary focus of time and resources even months or years after cessation and abstinence (Moeller & Paulus, 2018; Moeller et al., 2016; Parvaz et al., 2011). Drug cue exposure and subsequent substance use behaviors involve brain networks that govern social-emotional processing, inhibitory control, and decision making (Zilverstand et. al., 2018). For the purpose of this paper, the term "substance use" will refer to the problematic consumption of licit or illicit substances such that its consumption interferes with the individual's daily life, including but not limited to maladaptive behavior and involvement with the criminal justice system.

Research on substance use seeks to understand the experience of the individual and also its underlying brain mechanisms. Neuroimaging research explores brain activation patterns associated with substance use and implicates six relevant networks (Zilverstand et al., 2018). These networks include: (1) the *self-directed network* (otherwise known as the *default network*), which

is implicated in self-awareness and self-reflection; (2) the *habit network*, which is associated with automatic and repetitive behaviors; (3) the *memory network*, which governs voluntary, goal-directed behavior as a result of flexible learning from multiple stimuli; (4) the *salience network*, which directs attentional resources to highly relevant stimuli, regardless of positive or negative valence; (5) the *reward network*, which appraises the subjective value of various stimuli, more strongly with positive stimuli; and (6) the *executive network*, which is implicated in the process of cognitive self-regulation in which the motivational goal is maintained to select a behavioral response. The expansive effect of substance use on various brain networks highlights the importance of developing a more nuanced understanding of the associated neurological and behavioral components.

Measurement

Substance use is often measured through clinical interviewing measurements like the Addiction Severity Index (ASI-5; McLellan et al., 1992), the Severity of Dependence Scale (SDS; Gossop et al., 1992), and the Structured Clinical Interview for *DSM-5* Disorders (SCID-5; American Psychiatric Association, 2015). Alternatively, substance use can be measured using self-report questionnaires, which vary substantially in terms of the quantity and content. The use of standardized instruments is a preferred strategy of psychological research (Kiehl et al., 2018; Moeller et al., 2014), whereas criminological research may only include a few questions or statistics about its use (e.g., substance use during crime, substance-related crime, substance use diagnosis; Kopak & Proctor, 2016; Kopak et al., 2016; Link & Hamilton, 2017).

Maladaptive Behavior: Antisocial Behavior

Antisocial behavior is broadly defined and measured according to several categories, including aggressive or violent behavior, violation of legal or social norms (e.g., fraudulence,

deceit), and clinical psychiatric disorders (Ogilvie et al., 2011). The *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (*DSM-5*; APA, 2013) includes several diagnoses characterized by antisocial behavior (i.e., conduct disorder, oppositional defiant disorder, antisocial personality disorder). Antisocial behaviors can be measured using the *DSM-5* criteria, including the alternative model for personality disorders in which psychopathy can be used as a specifier (Ogilvie et al., 2011). Psychopathy measures capture both personality traits and antisocial behaviors (e.g., manipulativeness, callousness, deceitfulness, hostility, lack of empathy or remorse; APA, 2013), and are used widely, especially among justice-involved populations (Dargis et al., 2017; Paison et al., 2018; Sleep et al., 2019; Weidacker et al., 2017). Alternatively, antisocial behaviors are measured through official criminal records or using self-report instruments regarding aggression, violence, or criminal behavior (Ogilvie et al., 2011). The presence of antisocial behavior does not guarantee the presence of legal consequences, thus supporting the measurement of both behavioral and legal facets.

Relationships Among Variables of Interest

Research implicates an existing relationship among disinhibition and maladaptive behaviors. The foundational literature detailing this relationship is outlined below.

Disinhibition and Substance Use

Based on the neuroscientific literature on whole brain activity of individuals with substance use problems, inhibitory control appears associated with impairment in executive (response selection), salience (attention), and memory (flexible learning) networks (Zilverstand et al., 2018). Researchers have used neuroimaging measurements of disinhibition as indicators of risk or resilience for developing SUD, such that less inhibitory control is a risk factor for developing SUD (especially in the context of a family history of SUD; Martz et al., 2018; Moeller et al., 2016;

Tarter et al., 2003). Furthermore, impaired inhibitory control also appears to be a consequence of substance use, suggesting a reciprocal relationship between disinhibition and substance use (Zilverstand et al., 2018).

Disinhibition measurements can predict relapse or sustaining abstinence. For example, measurements of impulsive action significantly predict treatment outcomes, both in isolation and paired with neuroimaging, while measurements of impulsive choice have been unrelated or have varied results across substances and treatment setting (Moeller & Paulus, 2018; Moeller et al., 2016). Ultimately, such measurements have indicated impairments in disinhibition that can be targeted for successful outcomes in substance abuse treatment programs (DeVito et al., 2019; Moeller et al., 2014; Zilverstand et al., 2018).

Substance Use and Antisocial Behaviors

The long-standing association between substance use and antisocial behaviors appears to be reciprocal (Link & Hamilton, 2017). This has driven the development of court-based interventions such as Drug Treatment Courts (DTC), which are therapeutic alternatives to incarceration for those with non-violent drug-related crimes (Wilson et al., 2018). These programs are individualized and have varying degrees of legal contingencies for their completion, aimed at treating substance use and subsequently reducing crime. Such variability is also associated with the variability of successful DTC outcomes (Wilson et al., 2018), which leads researchers to explore various means of standardizing treatment with evidence-based practices, specifically the jail-to-community transition (Van Dorn et al., 2017). Additionally, some treatment models are incorporating neuroscientific theories about addiction, such as the Interaction of Person-Affect-Cognition-Execution (I-PACE) Model, which specifically acknowledges the role of impulsivity in substance use and addiction (Brand et al., 2019).

Antisocial Behaviors and Disinhibition

Researchers have explored how disinhibition plays a role in antisocial behaviors, typically alongside other commonly significant covariates such as age, current or past substance use, and psychopathy scores (Aharoni et al., 2013; Arantes et al., 2013; Reiser et al., 2019; Weidacker et al., 2017). Much of this research is by way of psychopathy research (Paison et al., 2018; Weidacker et al., 2017), as disinhibition is one of the defining characteristics of psychopathy (Patrick et al., 2009). The Triarchic Psychopathy Measure (TriPM; Patrick, 2010) was intended for use in an incarcerated population, and its disinhibition measure encompasses impulsivity, irresponsibility, anger/hostility, and oppositionality (see Sleep et al., 2019 for a meta-analysis of TriPM literature). The model's conceptualization is partially grounded in the cognitive neuroscience theories of underlying cortical and subcortical impairments (Patrick et al., 2009). The neurological understanding of disinhibition provides a more ecological view of antisocial behaviors.

Disinhibition, Substance Use, and Antisocial Behaviors

Disinhibition, substance use, and antisocial behaviors merge in the literature through the research aimed at neuroprediction models for substance use relapse and/or criminal recidivism. Prediction models are particularly advantageous in risk assessment, for which disinhibition has been demonstrated as a useful predictor of future antisocial behaviors (Aharoni et al., 2013, 2014). Wilson et al. (2018) looked at DTC programs across twelve states to identify predictors of relapse and recidivism and found that substance abstinence was predicted by gender, employment, and those with a higher baseline substance use, while rearrest rates were predicted by age. Though age is a frequently significant predictor of rearrest, Kiehl et al. (2018) created a brain-age model (based on volume/density) whose prediction accuracy allowed for removing chronological age from the prediction model, but showed better accuracy with other clinical variables such as substance use

and a Go/No-Go paradigm. Steele et al. (2014) found a Go/No-Go task to predict completion of a prison substance use treatment program. These studies support this study's inclusion of age as a covariate, and the use of a paradigm conceptually similar to a Go/No-Go task (i.e., measuring similar constructs, utilizing similar brain mechanisms).

In a study exploring the relationship between psychopathy and executive functioning (using the TriPM), disinhibition measurements were higher in the forensic sample and explained both recidivism rates and history of substance use (Paison et al., 2018). In support of the theory of subtypes of psychopathy, the researchers noted that impairments in inhibitory control were associated with "antisocial-impulsive" psychopathy, whereas "adaptive" psychopathy was characterized more by its fearlessness and better executive functioning (Paison et al., 2018). Interestingly, despite disinhibition playing a significant role in substance use (Moeller et al., 2014; Wilson et al., 2018; Zilverstand et al., 2018) and psychopathy (Patrick et al., 2009; Weidacker et al., 2017), the related executive process known as reversal learning (also measured by the Go/No-Go paradigm) has been found to be more attributable to psychopathy than substance use (Dargis et al., 2017; Magyar et al., 2011). This finding again highlights the importance of studying disinhibition among individuals involved in substance use, rather than executive functioning more broadly.

Gaps in the Research

Forensic populations are less frequently represented in many lines of research, for both ethical and practical reasons. Vanderhoff et al. (2011) outlined the unique challenges presented in this special population, specific to neurocognitive assessments, and noted the importance of including forensic populations in the normative samples. Without forensically-normed assessments, one risks the validity of the clinical interpretation of its results (LaDuke et al., 2017;

Vanderhoff et al., 2011). Unfortunately, much of the research in the areas of interest described above, including this study, combines instruments and paradigms that vary regarding forensic norming and validation. The original sample from which this study was drawn appeared markedly more impaired across a range of cognitive domains when compared to the normative populations; importantly, this spurred a call for group-specific norms for justice-involved populations due to their distinct differences on a number of neuropsychological measures (LaDuke et al., 2017). Within existing research that includes forensic populations, the targeted subpopulation for disinhibition measurements is often individuals with significant antisocial behavior, psychopathic personality traits, or substance abuse diagnoses. The forensic participants in this study were randomly included in the study irrespective of antisocial, psychopathic, or substance abuse diagnoses.

Given the nature of neuroimaging studies, many of the studies are limited to brief paradigms compatible with the neuroimaging tests. Conversely, in the absence of neuroimaging, neuropsychological research emphasizes the use of a battery of tests to capture all cognitive domains or the specificities therein (Cassaletto & Heaton, 2017). This study includes conceptually similar paradigms used in the neuroimaging studies, but as components of a statistically-supported battery of behavioral, self-report, and clinical measures capturing several facets of disinhibition. Accordingly, this study seeks to support the growing literature on neuroprediction of rearrest through the use of a preliminary disinhibition-focused neuropsychological battery, and the preliminary findings can further inform research in biopsychosocial treatment and forensic risk assessment.

This study aims to corroborate the current literature supporting an important association between disinhibition and a range of maladaptive behaviors. This study will assess past

maladaptive behaviors (i.e., history of substance use, history of antisocial behavior, and prior institutional misconduct), short-term sustained maladaptive behavior (i.e., current institutional misconduct), and long-term sustained maladaptive behavior (i.e., recidivism; see Figure 1). For the purposes of this study, *institutional misconduct* refers to institution-specific metrics indicating problematic behavior of increasing severity. Additionally, *recidivism* refers to rearrest within approximately 1-2 years in the state of data collection or neighboring two states. Of particular note, this study seeks to enhance the existing research by adding the distinction that disinhibition plays a more significant role than substance use history as it relates to the persistence of antisocial behaviors. In doing so, this study hopes to support the growing research recommending disinhibition-informed substance use treatment protocols, which may consequently reduce criminal involvement.

Hypothesis 1. There will be meaningful associations between disinhibition and past maladaptive behavior, such that increasing scores of disinhibition will be significantly associated with greater history of substance use (as measured by the Simple Screening Instrument–Substance Abuse; SSI-SA), controlling for relevant covariates (i.e., age and education).

Hypothesis 2. There will be meaningful associations between disinhibition and past maladaptive behavior, such that increasing scores of disinhibition will be significantly associated with a more extensive history of antisocial behavior (as measured by the composite score of prior juvenile/adult convictions), even after controlling for relevant covariates (i.e., age, education, and history of substance use).

Hypothesis 3. There will be meaningful associations between disinhibition and present (short-term sustained) maladaptive behavior, such that increasing scores of disinhibition will be

significantly associated with greater levels of institutional misconduct, controlling for relevant covariates (i.e., age, education, history of substance use, and history of antisocial behavior).

Hypothesis 4. There will be meaningful associations between disinhibition and future (long-term sustained) maladaptive behavior, such that increasing scores of disinhibition will significantly predict criminal recidivism, controlling for relevant covariates (i.e., age, education, history of substance use, history of antisocial behavior, and institutional misconduct).

Hypothesis 5. Disinhibition will account for significantly more variance than substance use history when predicting criminal recidivism.

Methods

The current study focuses on whether neurocognitive disinhibition plays a role in maladaptive behaviors (i.e., substance use and antisocial behaviors) using an archival dataset from a forensic sample (see LaDuke, 2015). This study proposes that the persistence of maladaptive behaviors is better explained through measuring disinhibition, as opposed to current or historical measures of maladaptive behavior. This study expects to see a relationship between disinhibition, substance use, and antisocial behaviors. The hypothesis is that disinhibition increases one's likelihood of engaging in maladaptive behaviors; specifically, higher rates of disinhibition will be meaningfully associated with (a) greater substance use history, (b) greater criminal history, (c) a more troublesome incarceration, and (d) higher recidivism. This study expects to find that disinhibition will be a stronger predictor of recidivism than prior substance use. The methods described here are summarized in reference to the current study for which secondary analyses were conducted.

Participants

Inclusion/Exclusion Criteria

All study participants were recruited from a private correctional facility located in a large mid-Atlantic state. Individuals were excluded based on (a) being a woman; (b) placement at the facility directly from a county jail or after a parole violation; (c) major mood or psychotic disorder; (d) upper extremity impairments that interfere with range of motion necessary to complete informed consent and measurements; (e) visual, hearing, and English comprehension deficits that interfere with completion of informed consent and measurements.

Sampling Procedures

All participants were randomly selected to recruit for participation in the study. Given the ethical considerations regarding their special population status (see Vanderhoff et al., 2011), participants were not offered compensation in exchange for participation. Of the 217 individuals approached between February 2014 and April 2015, 122 individuals self-selected to participate in the study. A total of 100 individuals successfully consented to participate thereafter, of which 96 successfully completed one or both testing sessions. With one individual serving as a pilot participant, the remaining sample consisted of 95 men, representing 43.78% of those approached.

Demographics

The average age of the participants was 33.85 years (N = 95, SD = 10.67, *range* = 20-64). The average education equivalent of the participants was 11.89 years (N = 95, SD = 1.48). Participants were able to self-identify as multiple races or ethnicities, identifying as Black or African American (n = 53, or 56%); White or Caucasian (n = 26, or 27%); Hispanic, Latino, or Spanish (n = 18, or 19%); American Indian or Native Alaskan (n = 7, or 7%); Asian or Asian American (n = 1, or 1%); and Other (n = 7, or 7%).

Measures

Several rigorously tested measures were selected from the archival database that measure the variables of interest in this study, specifically disinhibition, history of substance use, history of antisocial behavior, institutional misconduct, and criminal recidivism. These measures are described below.

Disinhibition

Barkley Adult ADHD Rating Scale (BAARS-IV). The BAARS-IV (Barkley, 2011) is a self-report instrument indicating current and past symptoms of ADHD, such as hyperactivity, inattention, sluggish cognitive tempo, and impulsivity. The BAARS-IV demonstrates good convergent validity with the *DSM-IV* diagnostic criteria from which it was based, as well as high internal consistency and test-retest reliability. The childhood Impulsivity score and the adult Impulsivity score will each be included in the disinhibition composite score.

Dysexecutive Questionnaire (DEX). The DEX is a self-report questionnaire included within the Behavioral Assessment of the Dysexecutive Syndrome (BADS; Wilson et al., 1996), a behavioral measure of executive dysfunction. The DEX has demonstrated satisfactory evidence of internal consistency (Cronbach's α = 0.90-0.91; Shaw et al., 2015), test-retest reliability, and ecological validity (Shaw et al., 2015; Hellebrekers et al., 2017). This study will include the DEX score within the disinhibition composite score, as its components encompass cognitive and behavioral disinhibition (Shaw et al., 2015).

Triarchic Psychopathy Measure (TriPM). The TriPM is a self-report instrument measuring psychopathy (Patrick, 2010), based on a model that delineates components of Meanness, Boldness, and Disinhibition (Patrick et al., 2009). The TriPM was intended for use with incarcerated populations, and has demonstrated satisfactory evidence of internal consistency

(Cronbach's α = 0.80-0.87; Blagov et al., 2016) and convergent validity with similar measures of general or pathological impulsivity (Sleep et al., 2019). The Disinhibition measure will be used in this study within the disinhibition composite score.

Porteus Maze Task (PMT). The PMT (Vineland Revision; Porteus, 1965) is a paper-and-pencil measure in which the individual completes mazes of increasing difficulty. The PMT is a widely used measure demonstrating satisfactory evidence of internal consistency (Cronbach's α = 0.81; Krikorian & Bartok, 1998) and convergent validity with other measures of executive functioning (Strauss et al., 2006). The Qualitative (Q) score is a measurement of disinhibition calculated based on error rates (e.g., lifting the pencil off the paper, reversing direction, or crossing boundaries) and has been used to successfully discriminate between antisocial and comparison groups (*d* = .71, *SE* = .03; Ogilvie et al., 2011). This study will include the PMT Q score in the disinhibition composite score.

Color-Word Interference Test (CWIT). The CWIT is a measurement of processing speed, cognitive flexibility, and inhibition within the Delis-Kaplan Executive Functioning System (D-KEFS; Delis et al., 2001), and is a modified version of the traditional Stroop Test. The CWIT has demonstrated satisfactory evidence of test-retest reliability, internal consistency, and convergent validity (Delis et al., 2001). The Stroop test has been used with incarcerated populations to discriminate between violent and nonviolent offenders (*d* = .35, *SE* = .03; Ogilvie et al., 2011). For the conditions relevant to this study, participants are required to inhibit a routine behavior to respond with a new behavior (Condition 3: Inhibition), then alternate between the routine and new behaviors during a timed session (Condition 4: Inhibition/Switching). Given that much of the neuroscientific literature utilizes error-related indices (e.g., Aharoni et al., 2013; Moeller & Paulus, 2016; Moeller et al., 2014; Weintraub et al., 2014), this study will include the

raw error scores for Inhibition (Condition 3) and Inhibition/Switching (Condition 4) within the disinhibition composite score.

Maladaptive Behavior

Simple Screening Instrument for Substance Abuse (SSI-SA). The SSI-SA (Center for Substance Abuse Treatment [CSAT], 1994) is a self-report screening measure to assess substance abuse and risk for future abuse. The SSI-SA has demonstrated satisfactory evidence of internal consistency (Cronbach's $\alpha = 0.85$; Boothroyd et al., 2015), convergent validity, sensitivity, and test-retest reliability, and it has been widely validated with individuals in the criminal justice system (CSAT, 2005). The total score will be included in this study as a measure of substance use history.

Antisocial behavior. Institutional records were used for data regarding antisocial behavior in the past (i.e., prior to their current incarceration), present (i.e., during current incarceration), and future (i.e., following release to the community). Specifically, this study used: (a) total number of prior juvenile and adult convictions, to represent a history of antisocial behavior; (b) a weighted composite score of institutional misconduct comprised of institution-specific metrics (i.e., demerits, minor incidents, major incidents, and behavioral contracts), used to indicate problematic behavior of increasing severity, to represent short-term sustained maladaptive behavior; and (c) recidivism comprised of rearrest over the approximately 1-2 years following release in the state of data collection and two neighboring states, to represent the long-term persistence of maladaptive behaviors. Of note, the exact dates of participants' release from the correctional institution were not included in the archival database used in this study, precluding calculation of exact time at risk in the community. In general, time at risk for the sample is therefore estimated to be 12-25 months (i.e., approximately 1-2 years).

Procedure

The archival dataset was re-created between September 2019 and March 2020. Five research assistants were trained to code the quantitative raw data from the original study into an electronic database. Each participant's data was randomly assigned to two coders. The individual datasets were merged, compared, and rectified, resulting in a 100% double-coded dataset.

Statistical Plan

Statistical analyses were performed using IBM SPSS Statistics. All selected raw scores from the disinhibition measures were converted to a standardized score (i.e., *z*-score) based on the sample distribution, and transformed (i.e., reverse scored) as needed so higher scores indicate higher levels of disinhibition. Preliminary correlations were run between each transformed disinhibition variable to support the use of an averaged composite score. Similar procedures were done to support the use of a composite score for history of antisocial behavior (i.e., juvenile and adult convictions) and institutional misconduct (i.e., demerits, minor incidents, major incidents, and behavioral contracts).

Hypothesis testing explored the relationships between disinhibition, substance use, and antisocial behavior. All hypotheses will be tested for assumption violations (i.e., linearity, outliers, normality, homogeneity of variance, independence of errors) and goodness of fit (i.e., Pearson's correlation coefficients, F-ratios, *t*-tests). Hypotheses 1–3 each required hierarchical linear regressions, through which disinhibition was assessed for its unique contribution to the model. The covariates entered in Block 1 were as follows: (H1) age and education; (H2) age, education, and history of substance use; (H3) age, education, history of substance use, and history of antisocial behavior. Hypotheses 4 and 5 were tested using hierarchical logistic regressions. The covariates for Hypothesis 4 were age, education, history of substance use, history of antisocial behavior, and

institutional misconduct. Hypothesis 5 used these same covariates, but separated history of substance use to its own block to compare its unique contribution to that of disinhibition.

Results

All variables were assessed for normality, and results supported the use of composite scores; specifically, individual measures of disinhibition had non-normal distributions, whereas the disinhibition composite score had a normal distribution. Any further deviations from normality (e.g., skewness, kurtosis, outliers) were conceptualized as accurate representations of the nature of the variable (e.g., positive skew because fewer people engage in institutional misconduct) or the sample (e.g., upper-extreme outliers for substance use in an incarcerated population). Due to meaningfully questionable comparisons to group norms (LaDuke et al., 2017), further interpretation of results are relative to individuals in the study sample.

Table 1 describes the relevant variables in this study. All missing data were considered non-random and were the result of: (a) lack of proficiency in written English comprehension (n = 4); (b) lack of interest or ability to complete Session 2 (n = 6); and (c) unavailable institutional outcomes upon review date (n = 57). Due to the exploratory nature of this study, missing data were excluded pairwise for Hypotheses 1–3, whereas limitations in SPSS hierarchical logistic regression analyses required that missing data were excluded listwise for Hypotheses 4 and 5.

All study variables were assessed for correlational significance and multicollinearity (Table 2). No variables were determined to be collinear, but several demonstrated meaningful correlations, supporting their inclusion in this study. Age was positively correlated with history of antisocial behavior, and negatively correlated with institutional misconduct and recidivism. Education equivalence was an included covariate due to historical significance, but was not significantly correlated with the other relevant variables in this study.

In order of magnitude, institutional misconduct was significantly correlated with recidivism outcome, history of substance use, disinhibition, and age (negatively). Similarly, history of antisocial behavior was significantly correlated with disinhibition, history of substance use, age, and recidivism. History of substance use was significantly correlated with institutional misconduct, disinhibition, history of antisocial behavior, and recidivism. Disinhibition was significantly correlated with institutional misconduct, history of antisocial behavior, history of substance use, and recidivism outcome. Recidivism outcome was significantly correlated with institutional misconduct, disinhibition, age (negatively), history of antisocial behaviors, and history of substance use. The strongest correlations appear to be among institutional misconduct and recidivism outcome, as well as institutional misconduct and history of substance use.

Hypotheses 1–3 were tested using hierarchical linear regressions. Hypothesis 1 resulted in a significant model (adjusted R^2 = .09, R^2_{change} = .11, *SE* = 1.84, *p* = .003), in which disinhibition was significantly associated with history of substance use (ß = 0.33, *t* = 3.07, *p* = .003) with a small effect size (Cohen, 1988); age and education were no more predictive than the mean, *F*(2, 79) = 0.57, *p* = .566. Hypothesis 2 resulted in a significant model (adjusted R^2 = .18, R^2_{change} = .06, *SE* = 2.54, *p* = .032) in which disinhibition was significantly associated with history of antisocial behavior (ß = .25, *t* = 2.19, *p* = .032) with a medium effect size; both models were significant, but the addition of disinhibition accounted for another 5.5 percent of the variance in the model. Hypothesis 3 resulted in a significant model (adjusted R^2 = .30, R^2_{change} = .06, *SE* = 10.41, *p* = .047) in which disinhibition was significantly associated with institutional misconduct (ß = .270, *t* = 2.04, *p* = .047) with a medium effect size; again, both models were significant, but disinhibition accounted for an additional 6 percent of the variance. Hypotheses 1-3 were therefore supported.

Hypotheses 4 and 5 were tested using hierarchical logistic regressions. Due to the conservative limitations of SPSS, missing data were excluded listwise, thus capturing only 8 of the 15 total recidivism cases. The model summaries for both hypotheses are shown in Table 3. For Hypothesis 4, the addition of disinhibition did not meaningfully contribute to the prediction model, but the overall model had a strong effect size. For Hypothesis 5, history of substance use meaningfully contributed to the prediction model with a strong effect size, whereas disinhibition did not. History of substance use improved the model's classification accuracy for all outcomes (i.e., No Recidivism, Recidivism, Total), as shown in Table 4. Overall, disinhibition reduced both of the models' total classification accuracy, including cases of recidivism. Therefore, Hypotheses 4 and 5 were not supported.

Discussion

The current study explored whether neurocognitive disinhibition plays a role in maladaptive behaviors using an archival dataset from a forensic sample. A preliminary battery of self-report, behavioral, and clinical measures was included to capture various facets of disinhibition, and the use of a composite score was statistically supported. Disinhibition, substance use, and antisocial behaviors were meaningfully related constructs in this sample, which further supports the existing literature (Aharoni et al., 2013, 2014; Kiehl et al., 2018; Paison et al., 2018; Zilverstand et al., 2014). Consistent with hypotheses, the findings of this study show preliminary support for disinhibition increasing one's likelihood of engaging in maladaptive behaviors. Specifically, higher rates of disinhibition were meaningfully associated with (a) greater substance use history, (b) greater criminal history, and (c) a more troublesome incarceration, even controlling for age and education. These preliminary findings further support the literature on risk factors for criminal recidivism (Aharoni et al., 2013, 2014).

This study also expected to find that disinhibition strongly predicted recidivism, more so than prior substance use. However, statistical barriers limited the inclusion of all recidivism cases in the sample, thereby restricting the range of data for the prediction model. Specifically, of the 15 cases of recidivism in this sample, only 8 were used in the regression. As seen in Table 4, the addition of substance use to the model improved the classification accuracy by two cases, whereas adding disinhibition reduced the classification accuracy by one case. Given the overall sample size and the restricted sample used for Hypotheses 4 and 5, it appears reasonable that the statistical measure was unable to capture an existing effect for disinhibition (Field, 2013). It was further proposed that the persistence of maladaptive behaviors is better explained through measuring disinhibition, as opposed to current or historical measures of maladaptive behavior. Support for Hypotheses 1–3, with low-to-moderate effect sizes, suggests that continued exploration of the role of disinhibition is warranted.

This study adds meaningful contributions to the field through its use of a randomized forensic sample with diverse demographics, included in the study irrespective of psychopathic traits or antisocial diagnosis. The use of a preliminary disinhibition-focused assessment battery meaningfully adds to the field of neuropsychology, combining behavioral and self-report measure and including paradigms used in neuroimaging studies; its statistically supported composite score may improve statistical validity and support researchers using complex statistical analyses. Clinicians working with substance users or working in forensic settings are further informed by the meaningful associations among disinhibition, substance use, and antisocial behavior. Clinicians can continue to broaden their scope of interventions to support the reduction of disinhibition, which is both targetable and treatable. Consequently, the findings also inform policy makers aiming to invest in infrastructure that supports individuals on both micro and macro levels;

with an apparent reciprocal relationship between disinhibition and substance use (Zilverstand et al., 2018), as well as substance use and antisocial behaviors (Link & Hamilton, 2017), investing in treatments or programs that reduce neurocognitive disinhibition may be a worthwhile investment.

Limitations

The study sample is not a full representation of justice-involved individuals. Specifically, more than half of individuals approached for this study chose not to participate, suggesting meaningful differences among those choosing to participate. There is no representation of justice-involved individuals with severe mood or psychotic disorders, for which disinhibition is likely present. The physical and intellectual requirements for completing informed consent and the test battery further limited the scope of individuals included. More broadly, the correctional institution from which the current sample was drawn was a minimum-security transitional facility for individuals nearing the end of their sentence, which had its own inclusion criteria (e.g., no arson charges) and logistical constraints (e.g., limited female population). Additionally, recidivism based on official records is a limited variable in the sense that it measures only those who get caught by law enforcement, rather than those who commit illegal actions more broadly. Measurements of disinhibition, substance use, antisocial behaviors, and recidivism may meaningfully differ among individuals with more violent charges, high-security behaviors, severe mood or psychotic disorders, or relevant demographics.

Despite findings that relatively higher disinhibition was meaningfully associated with several variables, results of this study may have limited generalizability beyond its theoretical implications. The disinhibition variable was a composite score of a preliminary disinhibition-focused test battery, and the selected measures included measures not yet forensically validated or

normed; thus, scores were not compared to group norms due to questionable validity and interpretability among forensic samples. Additionally, listwise exclusion for SPSS logistic regressions was potentially limiting to the strength and accuracy of the recidivism prediction models, despite theoretical support from three preceding prediction models. Further, recidivism data was also limited by the lack of specific time at risk in the archival dataset; although the period of 1-2 years seen in the current study spans relatively common outcome periods used in recidivism research, not knowing the exact time at risk in the community for each participant limits our understanding of how comparable the current results are to other recidivism research more directly, and prevents more advanced analyses based on person-time data.

Future Directions

The primary focus of this study was to explore disinhibition and maladaptive behaviors with hopes of informing treatment interventions. In substance use research, continued use of standardized measures of substance use is recommended, and pursuing disinhibition- or neuroscience-informed treatment may be beneficial for biopsychosocial research, treatment allocation, and progress measurement. Van Dorn et al. (2017) proposed a jail-to-community treatment model for co-occurring substance use and mental disorders in which they use the ASI and TriPM as assessment measures; unfortunately, the model does nothing to address inhibitory control. On the other hand, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model is a neuroscience-informed treatment model for addictive behaviors that acknowledges diminished inhibitory control as a meaningful processual factor (Brand et al., 2019). Mindfulness-based interventions (MBIs), although diverse in nature, are growing in the field and gaining preliminary support in incarcerated and substance use populations (Auty et al., 2017; Chiesa & Serretti, 2014; Per et al., 2020). Varying MBIs (i.e., yoga, meditation, mindfulness) appear promising in the

reduction of substance consumption and cravings across various controlled substance use studies (Chiesa & Serretti, 2014). Although MBIs within incarcerated populations are reducing psychological distress, substance use, and impulsive or self-control behaviors, particularly for those of longer duration and less intensity (Auty et al., 2017), more controlled studies are needed (Per et al., 2020).

Perhaps the emerging gold standard of research and assessment approaches is the National Institutes of Mental Health (NIMH) Research Domain Criteria (RDoC), which is a revisable framework designed to refine the assessment, diagnostic, and treatment processes; specifically, the RDoC is comprised of 39 functional constructs across various biologically-validated neuropsychological domains (Yücel et al., 2018). A group of 44 international addiction experts agreed that the Cognitive Control System is one of the primary constructs in addiction, identifying inhibition as a neutral-valenced construct integral to both the vulnerability and chronicity of the illness (Yücel et al., 2018). Ideally, research and clinical practice that aligns with the RDoC framework will contribute to a more refined understanding of symptoms that span many diagnoses, such as disinhibition.

Further exploration of a disinhibition-focused battery, used separately or within a full neuropsychological assessment, may be beneficial for capturing various facets of disinhibition (i.e., cognitive, motor, and response disinhibition). Ideally, it would be beneficial to understand the risks associated with specific levels of disinhibition (both trait and state), which can inform risk assessments and treatment programs, particularly those involving substance use, alternatives to incarceration, or jail-to-community reentry.

There may be utility in exploring differences in disinhibition between civil and forensic populations to get a more accurate and nuanced understanding of its prevalence and degree of

severity. Further, researchers should include participants with relevant conditions that impact neuropsychological functioning (e.g., substance abuse, attention-deficit/hyperactivity disorder, traumatic brain injury, trauma exposure, learning deficits), as they are purportedly overrepresented in justice-involved populations (LaDuke et al., 2017) and may provide meaningful information as to whether disinhibition is related. In doing so, information can also be gleaned regarding disinhibition interventions' success rates across conditions; ideally, this would be captured through longitudinal research in which levels of disinhibition are measured repeatedly throughout the study. Importantly, none of these recommendations are of use without neuropsychological measures being normed and validated with justice-involved individuals. It is pertinent to making accurate clinical interpretations and for researchers, clinicians, and forensic psychologists to continue using measures in accordance with relevant ethical practice guidelines (LaDuke et al., 2017).

Conclusion

Preliminary results suggest that neurocognitive disinhibition, substance use, and antisocial behaviors appear to be meaningfully and reciprocally interrelated. Among this forensic sample, disinhibition was meaningfully associated with a range of maladaptive behaviors, supporting further research in this domain. A neuropsychological understanding of maladaptive behaviors can inform and shape treatments on a deeper level. Fortunately, disinhibition is a dynamic and treatable state through such interventions as mindfulness and meditation. Biopsychosocial research and treatment approaches that target the reduction of substance use and antisocial behaviors may perhaps move us away from mass incarceration and more toward wellness.

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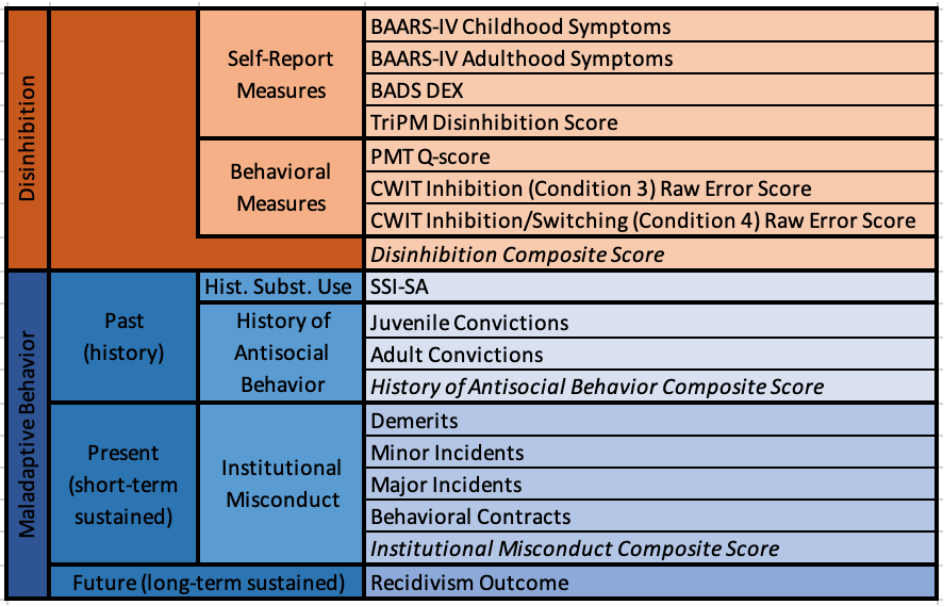
Figure 1

Conceptualization of Study Constructs and Measures



Note. BAARS-IV Child = Barkley Adult ADHD Rating Scale (Barkley, 2011); BADS DEX = Behavioral Assessment of the Dysexecutive Syndrome, Dysexecutive Questionnaire (Wilson et al., 1996); TriPM = Triarchic Psychopathy Measure (Patrick, 2010); PMT Q-score = Porteus Maze Task, Qualitative score (Vineland Revision; Porteus, 1965); CWIT = Delis-Kaplan Executive Functioning System Color-Word Interference Test (Delis et al., 2001); SSI-SA = Simple Screening Instrument for Substance Abuse (Center for Substance Abuse Treatment, 1994)

Table 1

Descriptive Statistics for Study Variables

Study Variable	*N*[b]	*M*	Median	σ	Skewness[c]	Kurtosis[c]	Normality[d]
Age (years)	95 (0)	33.85	32.00	10.67	0.80 (0.25)	– 0.10 (0.49)	< .001
Education equivalence	95 (0)	11.89	12.00	1.48	0.01 (0.25)	2.16 (0.49)	< .001
Institutional misconduct	57 (38)	9.21	2.00	12.10	1.64 (0.32)	2.09 (0.62)	< .001
History of antisocial behavior	81 (14)	3.53	3.00	2.80	1.30 (0.27)	1.42 (0.53)	< .001
History of substance use	86 (9)	1.60	1.00	1.93	1.76 (0.26)	4.10 (0.51)	< .001
Disinhibition	80 (15)	.005	– 0.07	0.51	0.10 (0.27)	– 0.74 (0.53)	.176
Recidivism outcome[a]	90 (5)	.167	0.00	0.37	1.82 (0.25)	1.34 (0.50)	< .001

[a] 0 = No recidivism, 1 = Recidivism

[b] Cases with missing data presented in parentheses

[c] Standard errors presented in parentheses

[d] Shapiro-Wilk's test of normality

Table 2

Correlations for Study Variables

Study Variables		1	2	3	4	5	6	7
1. Age (years)	*r*	–						
	p	–						
	n	95						
2. Education equivalence	*r*	.109	–					
	p	.146	–					
	n	95	95					
3. Institutional misconduct	*r*	–.277*	–.076	–				
	p	.018	.286	–				
	n	57	57	57				
4. History of antisocial behavior	*r*	.225*	–.112	.150	–			
	p	.022	.161	.132	–			
	n	81	81	57	81			
5. History of substance use	*r*	.019	.121	.417**	.300**	–		
	p	.431	.134	< .001	.004	–		
	n	86	86	56	78	86		
6. Disinhibition	*r*	.074	–.082	.365**	.352**	.318**	–	
	p	.256	.236	.004	.001	.002	–	
	n	80	80	53	73	80	80	
7. Recidivism outcome	*ρ*	–.312**	–.143	.507**	.208*	.191*	.314**	–
	p	.001	.089	<.001	.032	.039	.002	–
	n	90	90	57	81	86	80	90

Note. *r* = Pearson's Correlation; *ρ* = Point-biserial correlation; *p* = significance (one-tailed); *n* = listwise comparisons. * Significant at $p < .05$. ** Significant at $p < .01$.

Table 3

Model Summary Tables for Hierarchical Logistic Regressions

Study Variables (H4)	Block			Model				
	df	χ^2	*p*	*df*	χ^2	*p*	R_N^2	*–2LL*
Covariates	5	26.42	<.001***	5	26.42	<.001***	.686	18.56
Disinhibition	1	0.73	.393	6	27.15	<.001***	.701	17.83
Study Variables (H5)	Block			Model				
	df	χ^2	*p*	*df*	χ^2	*p*	R_N^2	*–2LL*
Covariates	4	21.07	<.001***	4	21.07	<.001***	.573	23.92
History of substance use	1	0.54	.021*	5	26.42	<.001***	.686	18.56
Disinhibition	1	0.73	.393	6	27.15	<.001***	.701	17.83

Note. H4 = Hypothesis 4; H5 = Hypothesis 5. * Significant at $p < .05$. *** Significant at $p < .001$.

Table 4

Classification Tables for Hierarchical Logistic Regressions

Study Variables (H4)	Recidivism outcome	Prediction accuracy	Misclassified
Covariates	No	97.8 (44)	2.2 (1)
	Yes	75 (6)	25 (2)
	Total	94.3 (50)	5.7 (3)
Disinhibition	No	97.8 (44)	2.2 (1)
	Yes	62.5 (5)	37.5 (3)
	Total	92.5 (49)	7.5 (4)
Study Variables (H5)	Recidivism outcome	Prediction accuracy	Misclassified
Covariates	No	95.6 (43)	4.4 (2)
	Yes	62.5 (5)	37.5 (3)
	Total	90.6 (48)	9.4 (5)
History of substance use	No	97.8 (44)	2.2 (1)
	Yes	75 (6)	25 (2)
	Total	94.3 (50)	5.7 (3)
Disinhibition	No	97.8 (44)	2.2 (1)
	Yes	62.5 (5)	37.5 (3)
	Total	92.5 (49)	7.5 (4)

Note. H4 = Hypothesis 4; H5 = Hypothesis 5; Recidivism outcome: No (n = 45), Yes (n = 8), Total (n = 53); Number of individual cases are in parentheses. All other values reflect percentages.