Cognitive–affective factors underlying disinhibitory disorders and legal implications

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Abstract | Disinhibited behaviours such as aggression, criminality and substance misuse are ubiquitous. In the USA, a violent crime occurs every 25 s, a non-violent crime every 4.1 s, an incidence of domestic violence every 3 s and substance misuse every 2.4 s. These behaviours are widespread, but more commonly exhibited by individuals with specific psychological problems, namely disorders characterized by disinhibition. Although individuals with disinhibitory disorders display similar behaviours, the underlying cognitive–affective factors are distinct and must be taken into account when developing scientifically informed interventions. In this Review, we provide a summary of key cognitive–affective factors associated with four disinhibitory disorders: substance use disorders, borderline personality disorder, antisocial personality disorder and psychopathy. We focus on these four disorders given their phenotypic overlap and because individuals with these disorders disproportionately find themselves ensnared in the legal system. We discuss the implications of integrating an understanding of cognitive–affective functioning for more successful interactions between individuals with these disorders and the police, courts and correctional facilities. To protect all members of society, we must consider how psychological science can have a greater role at various stages of legal intervention.

Disinhibited acts can manifest as verbal or physical aggression, impulsive choices, substance misuse and criminality. When disinhibited behaviour is repetitive and impacts functioning, adults may be diagnosed with a mental illness, such as substance use disorders (SUDs), or subtypes of personality disorders, such as borderline personality disorder (BPD) and antisocial personality disorder (ASPD). The adverse consequences of such behaviours and diagnoses produce great physical, emotional and economic burdens for the individuals themselves, victims, family members and society at large. In 2019, more than 20 million individuals in the USA aged 12 years and older received a substance use diagnosis, exacting an annual cost of more than US $700,000 million related to crime, lost work productivity and healthcare expenses[1]. That same year, official counts of violent and non-violent crime in the USA were, on average, more than 22,000 per day[2]. The financial impact of these violent and non-violent crime on society, estimated to have been more than US $3,000,000 million, included economic losses to victims and government expenditures on policing, legal activities and corrections. Thus, disinhibited behaviour can have grave societal and individual costs, including those related to mortality, health, marginalization and incarceration.

Disinhibited behaviours must be understood in the context of the ways in which underlying cognitive–affective factors influence such acts. Psychological research at multiple levels of analysis, from behaviour to the brain, documents the role of cognitive–affective factors in disinhibited behaviour[3–6], the specification of cognitive–affective factors in distinguishing among particular disorders[7–9] and the effectiveness of treatment that targets disorder-specific cognitive–affective factors[10]. Despite this wealth of knowledge, there is a disconnect between what is established by psychological science and the implementation of interventions. This is particularly important in the context of the criminal legal system, where individuals with some disinhibitory disorders are over-represented[11–13].

In this Review, we focus on four disinhibitory disorders (SUDs, BPD, ASPD and psychopathy) because of their behavioural overlap and elevated representation across the criminal legal system. We first describe these disorders and their relevance to the criminal legal system. We then summarize research on underlying cognitive and affective factors, with a focus on those that might be especially relevant for distinguishing among disorders: negative emotionality, reward processing, executive functioning and selective attention. Next,

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given the close link between these disinhibitory disorders and legal system involvement, we discuss how these disorders are often handled in legal settings. Specifically, we outline several ways in which practices by the police, courts and correctional facilities fall short in managing those with disinhibitory disorders and propose avenues for future legal interventions that incorporate psychological science. We conclude by arguing that using psychological science to understand disinhibitory disorders is important for improving justice and broader societal outcomes.

Subtypes of disinhibitory disorders

Disinhibition broadly reflects an inability to self-regulate. People can engage in single disinhibited acts, people can have periods of disinhibited behaviours or disinhibition can be characteristic of a person[14]. For example, in certain psychological disorders, such as bipolar disorder, individuals may engage in brief periods of impulsive purchasing, especially during a manic state. As another example, some individuals with schizophrenia display aggressive behaviour, particularly as positive symptoms (for example, hallucinations) emerge[15]. By contrast, some psychological disorders include disinhibition in the diagnostic criteria and reflect a more chronic, not periodic, pattern of disinhibition.

There is a spectrum of disinhibited psychological diagnoses. It commonly includes diagnoses with characteristic substance misuse and antisocial behaviour in adulthood (for example, SUDs, ASPD and BPD) and conduct disorder, oppositional defiant disorder and attention deficit hyperactivity disorder in childhood[14,16,17]. Attention deficit hyperactivity disorder often co-occurs with disinhibited disorders in childhood and adulthood; however, it is unclear whether attention deficit hyperactivity disorder reliably predicts other disinhibited disorders in adulthood and legal system outcomes by itself, or is a modulator of disinhibited behaviours and legal system involvement[18–23]. Finally, some models acknowledge the callous unemotional aspects of disinhibited behaviours in a subset of individuals, and separate ASPD and psychopathy[14,16,24].

SUDs, BPD, ASPD and psychopathy are considered archetypes of disinhibited disorders[13,14,16]. Characteristics of these four disorders and classification criteria according to the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-5)[25], International Classification of Diseases 11th Revision (ICD-11)[26] and Hierarchical Taxonomy of Psychopathology (HiTOP)[14,27] are summarized in TABLE 1. The overlap in behavioural tendencies among these disorders (FIG. 1) has been attributed to common genetic and environmental risk factors[14,16,28,29]. Furthermore, in part due to the characteristic nature of disinhibition associated with these disorders, SUDs, BPD, ASPD and psychopathy are predictive of engagement in criminal activity, legal system contact and recidivism[11–13].

SUDs are characterized by the recurrent use of alcohol and/or drugs within at least a 12-month period that results in substantial impairments in health and a failure to meet major responsibilities at work, school or home. The prevalence of SUDs is higher among individuals involved in the legal system. More than half of the people with multiple arrests have SUDs[30]. Individuals who are incarcerated have alcohol use disorder rates that are up to 6 times higher and drug use disorder rates that are 25 times higher than the general US population[11]. Additionally, 21% of sentenced people in US state prisons and local jails are incarcerated for crimes committed to obtain drugs or money for drugs[31]. SUDs are not only reflective of disinhibition in their own right but also co-occur at a high rate with other disinhibitory disorders[32–34].

BPD is a complex, pervasive psychopathology distinguished by extreme and erratic patterns of thoughts, feelings and behaviours that interfere substantially with general and social functioning[25]. For example, individuals with BPD report having relationships where they love the person one minute and hate them the next, engaging in impulsive behaviours including binge eating, reckless driving, risky sexual behaviour and substance misuse, and experiencing fears of abandonment. Consequently, individuals with BPD often display instability in their relationships, negative self-image, impulsivity and suicidal or self-harm behaviours. The 2-year to 5-year prevalence rates of BPD are estimated to be 1.6% in the global population[35] and up to 21 times higher in populations involved in the legal system in the USA[36–38]. Moreover, approximately half of individuals with BPD meet the criteria for at least one type of SUD[34]. Among individuals involved in the legal system, BPD commonly co-occurs with ASPD[39].

ASPD encompasses a chronic and pervasive pattern of impulsive, irresponsible and antisocial behaviour (for example, theft, lying and aggression) that begins in childhood and persists into adulthood[25]. Characteristics of ASPD overlap with BPD in terms of impulsivity and aggressiveness; however, the ASPD diagnosis does not include symptoms related to fears of abandonment, sense of self, emotional instability and self-harm. Globally, ASPD is represented in approximately 3% of the general population[40] but in approximately 47% of individuals involved in the legal system[41]. ASPD is associated with more substance use diagnoses[8], greater substance abuse severity[42] and premature mortality[43].

Psychopathy is characterized by difficulty establishing genuine relationships, minimal and superficial affective experience, an impulsive behavioural style and a chronic antisocial lifestyle. Psychopathy is not a formal diagnosis in the DSM-5 but is listed in section III as part of emerging models to classify disorders. Early editions of the DSM included sociopathic personality disturbance, which had several features that spanned antisocial behaviours and interpersonal characteristics, such as selfishness and callousness. This classification was removed from the DSM-III when the diagnosis of ASPD was introduced[44] to emphasize observable, behavioural criteria for diagnosis. Consequently, the DSM created a single group based on similarities in behavioural tendencies (for example, impulsive actions and aggression). This shift has been controversial, and many have criticized the DSM for the lack of differentiation between subtypes of antisocial individuals[45,46].

ASPD is often confused with psychopathy. However, most individuals with ASPD do not meet the criteria

Hierarchical Taxonomy of Psychopathology (HiTOP)
A newer classification system focused on grouping signs, symptoms, and maladaptive traits and behaviours into broad spectra of psychopathology rather than discrete categorical diagnoses.

Table 1 | **Classification systems for disinhibitory disorders**

Disorder	Characteristics	Classification system description		
		DSM-5	ICD-11	HiTOP[14,27]
SUDs	Hazardous substance use Interpersonal problems related to use Neglect major roles to use Withdrawal Tolerance Used larger amounts/for longer Repeated attempts to quit/control use Much time spent using Physical/psychological problems related to use Activities given up to use Craving	Mild: 2–3 symptoms within a 12-month period Moderate: 4–5 symptoms within a 12-month period Severe: 6+ symptoms within a 12-month period	Harmful patterns of substance use: repetitive use of substances that has caused harm to physical or mental health, but has not resulted in consistently impaired control over consumption, physiological features or persistence in substance use despite harm Substance dependence: the characteristic feature is a strong internal drive to use substances. The diagnosis requires 2 or more of the 3 central features to be evident over a period of at least 12 months, but the diagnosis may be made if substance use is continuous for at least 1 month: 1. Impaired control over substance use 2. Substance use becomes an increasing priority in life such that its use takes precedence over other interests or enjoyments, daily activities, responsibilities or health or personal care 3. Physiological features (indicative of neuroadaptation to substances)	Disinhibited externalizing (tends to act on impulse, without consideration for potential consequences)
BPD	Fear of abandonment Unstable or changing relationships Unstable self-image Impulsive or self-damaging behaviour Suicidal behaviour or self-injury Varied or random mood swings Constant feelings of worthlessness or sadness Inappropriate, intense anger that can be experienced internally or expressed externally Stress-related paranoia or loss of contact with reality	A pervasive pattern of instability of interpersonal relationships, self-image and affects, and marked impulsivity beginning by early adulthood and present in various contexts, as indicated by 5 (or more) of the characteristics listed	A dimensional approach classifies personality pathology as follows[26]: An enduring (>2 years) disturbance characterized by problems in functioning of aspects of the self, and/or interpersonal dysfunction that manifest across a range of social situations in patterns of cognition, emotional experience, emotional expression and behaviour that are maladaptive Degree (mild, moderate or severe) and pervasiveness of disturbances in functioning of aspects of the self, interpersonal dysfunction across various contexts and relationships, and emotional, cognitive and behavioural manifestations of the personality dysfunction 'Borderline pattern qualifier' may be applied to individuals whose pattern of personality disturbance is characterized by a pervasive pattern of instability of interpersonal relationships, self-image and affects, and marked impulsivity, as indicated by 5 (or more) symptoms from the characteristics listed	Antagonistic externalizing (tends to engage interpersonally with hostility and conflict, and to hurt other people intentionally, with little regard for their rights and feelings) Internalizing distress (reflecting anxiety, melancholy/sadness, neuroticism)
ASPD	Failure to conform to social norms concerning lawful behaviours Deceitfulness/repeated lying Impulsivity or a failure to plan Irritability and aggressiveness Reckless disregard for the safety of self or others Consistent irresponsibility Lack of remorse	A pervasive pattern of disregard for and violation of the rights of others, since age 15 years, as indicated by 3 (or more) of the characteristics listed; evidence of conduct disorder with onset before age 15 years	A dimensional approach classifies personality pathology as follows[26]: An enduring (>2 years) disturbance characterized by problems in functioning of aspects of the self, and/or interpersonal dysfunction that manifest across a range of social situations in patterns of cognition, emotional experience, emotional expression and behaviour that are maladaptive Degree (mild, moderate or severe) and pervasiveness of disturbances in functioning of aspects of the self, interpersonal dysfunction across various contexts and relationships, and emotional, cognitive and behavioural manifestations of the personality dysfunction	Disinhibited externalizing Antagonistic externalizing

Table 1 (cont.) | **Classification systems for disinhibitory disorders**

Disorder	Characteristics	Classification system description		
		DSM-5	ICD-11	HiTOP[14,27]
Psychopathy	Glibness/superficial charm Grandiose sense of self-worth Proneness to boredom/need for stimulation Pathological lying Conning/manipulative Lack of remorse Shallow affect Lack of empathy Parasitic lifestyle Poor behavioural controls Promiscuous sexual behaviour Early behaviour problems Lack of realistic long-term goals Impulsivity Irresponsibility Failure to accept responsibility for actions Many marital relationships Juvenile delinquency Poor risk of conditional release Criminal versatility	Only listed in DSM-5 section III (emerging measures and models)	A dimensional approach classifies personality pathology as follows[26]: An enduring (>2 years) disturbance characterized by problems in functioning of aspects of the self, and/or interpersonal dysfunction that manifest across a range of social situations in patterns of cognition, emotional experience, emotional expression and behaviour that are maladaptive Degree (mild, moderate or severe) and pervasiveness of disturbances in functioning of aspects of the self, interpersonal dysfunction across various contexts and relationships, and emotional, cognitive and behavioural manifestations of the personality dysfunction	Not classified

ASPD, antisocial personality disorder; BPD, borderline personality disorder; DSM-5, *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition; HiTOP, Hierarchical Taxonomy of Psychopathology; ICD-11, International Classification of Diseases 11th Revision; SUDs, substance use disorders.

for psychopathy, whereas nearly all individuals with psychopathy meet the criteria for an ASPD diagnosis[47]. This asymmetry supports the notion that although psychopathy overlaps behaviourally with ASPD, it is a separate disorder[48]. Discussions are ongoing regarding how psychopathy should be represented in future editions of the DSM. Some researchers suggest psychopathy should be added as specifier of ASPD much like limited prosocial emotions were added to distinguish subtypes of conduct disorder in youth. Other researchers promote a dimensional model of pathological personality traits that intersect to represent different presentations of personality disorders. The ICD-11 takes a dimensional trait approach to personality pathology and lists psychopathy as a personality characteristic. Worldwide estimates place the prevalence of psychopathy at about 1% of the general population but approximately 20% of the population involved in the legal system[12,49,50]. Psychopathy is associated with an earlier age of initiation in substance use, more mild (versus severe) substance use diagnoses[8], earlier age of onset for antisocial acts and higher rates of criminal activity than other disinhibitory disorders[12,51]. Individuals with psychopathy also recidivate faster than other individuals involved in the legal system[51].

Overall, across these disinhibitory disorders there are characteristics of aberrant emotionality, aggression, impulsivity, risk-taking and antisocial behaviour. There is also clear evidence that these disorders are over-represented in the legal system. However, despite their phenotypic similarities, the cognitive and affective factors related to each of these disorders are distinct. That is, there are multiple pathways that support the expression of disinhibitory disorders.

Cognitive and affective factors

In this section, we provide an overview of commonly studied cognitive–affective factors underlying disinhibitory disorders (FIG. 2). We start with affective factors, specifically negative emotionality and reward processing, for two reasons. First, affective factors are foundational to aetiological theories of several disinhibitory disorders. For example, according to the self-medication/distress intolerance models of SUDs, individuals with SUDs consume substances to quell the experience of intense negative emotions[52]; according to diathesis–stress models of BPD, experiences of harsh treatment and genetic vulnerability to emotional liability relate to poor functioning in response to stress, difficulty managing negative emotions and behavioural disinhibition[53]; and according to the low fear model of psychopathy, disinhibition is related to a heritable fearlessness[54]. Second, several disinhibitory-related effects in cognitive factors are moderated by affective context. Therefore, establishing affective tendencies is useful for interpreting some

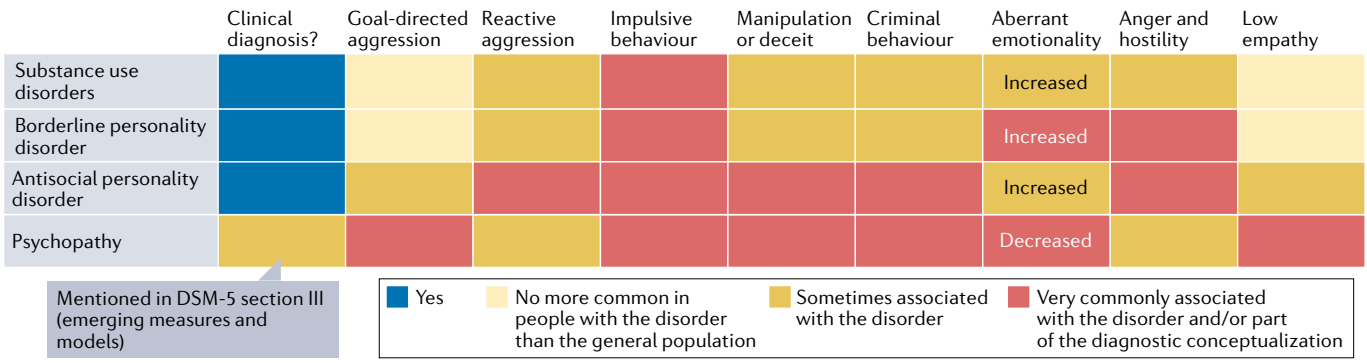

Fig. 1 | **Characteristics of disinhibitory disorders.** Summary of behavioural characteristics of substance use disorders, borderline personality disorder, antisocial personality disorder and psychopathy. Colour represents degree to which each characteristic is associated with the disorder. DSM-5, *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition.

cognitive effects in disinhibitory disorders. Notably, we do not cover all aspects of cognition (for example, perceptual encoding, decision-making or language) or affect (for example, positive emotions or punishment)[55–57]. Instead, we focus on areas where similarities and differences across disorders may be particularly informative for reconciling psychological science with legal intervention.

Negative emotionality. Negative emotionality represents a state or trait associated with emotions such as fear, distress, anger and frustration. Disturbances in negative emotionality appear trans-diagnostically, including in disorders that are not classically characterized by disinhibited behaviour (for example, depression, anxiety and post-traumatic stress disorder), emphasizing the importance of variability in this affective feature for understanding pathological behaviour[55]. In terms of disinhibited behaviours, aberrant negative emotionality is a risk factor for the onset of substance misuse and antisocial acts[58–65]. Moreover, engagement in disinhibited behaviours can be one way that individuals with psychological disorders cope with negative emotions[66,67].

Negative emotionality can be subdivided into several component processes, such as a person's ability to tolerate negative emotions (that is, their distress tolerance), their responses prior to and in reaction to stressful events, and their responsivity to cues that reflect negative emotions such as fear, threat or anger. In experimental settings, negative emotionality across these component processes is indexed through self-report, behaviour (for example, emotion identification or performance on tasks that measure the ability to persist in the face of distress), electrophysiology (for example, heart rate) and neuroimaging (for example, activity in the amygdala, ventromedial prefrontal cortex and fronto-limbic circuitry)[56].

Several studies identify associations between distress intolerance and SUDs[52,61], BPD[68,69] and ASPD[70,71]. Higher distress intolerance in those with SUDs, BPD and ASPD compared with individuals without these disorders may lead these individuals to engage in behaviours such as substance use[72] and aggression[73] to reduce intense negative emotions. There is limited work on distress intolerance in individuals with psychopathy but one study found that these individuals show an ability to tolerate distress, unlike other disinhibited counterparts[70].

Another indicator of negative emotionality is reactivity to stress. Heightened stress reactivity, compared with individuals without psychological diagnoses and compared with individuals with non-disinhibited forms of psychological diagnoses, is well documented in people with SUDs[61], BPD[74–77] and ASPD[78–80], especially when these individuals are confronted with threatening information (for example, electric shock in an experiment). However, measures of electrophysiological arousal, such as heart rate at rest, are lower in individuals with BPD or ASPD[81,82] compared with individuals without these disorders. The discrepancy between lower baseline arousal and heightened arousal when feeling stressed or threatened highlights an imbalance between different physiological states that might contribute to the poorly regulated and impulsive responses of individuals with BPD and ASPD. Furthermore, heightened reactivity to stress might promote substance use or reactive aggression as a way to express or manage an intense experience of negative emotions[60,61,66,67]. Multiple studies and meta-analyses indicate that individuals with SUDs, BPD and ASPD display a reduction in brain volume and over-reactivity in brain regions related to stress responses (such as limbic system regions, including the amygdala and hippocampus)[35,83–89] compared with individuals without psychological diagnoses and compared with individuals with non-disinhibited forms of psychological diagnoses.

Lower resting heart rate compared with the general population is also a predictor of psychopathy[5]. However, evidence on whether psychopathy is associated with aberrant reactivity to stressful experiences is mixed[80]: some work shows no differences in stress reactivity[90–93] and other work shows blunted stress responses[94–97] in those with versus without psychopathy. Thus, whereas SUDs, BPD and ASPD are associated with higher stress reactivity, psychopathy, if anything, may be associated with lower stress reactivity. Although the evidence is equivocal about whether individuals with psychopathy show differential responses to stressful experiences during experimental tasks relative to controls, research demonstrates that these individuals respond less than individuals without psychopathy to stress expressed by

Amygdala
A region of the brain important for emotion processing and detecting salient information.

Ventromedial prefrontal cortex
A brain region in the prefrontal cortex that is involved in processing risk, emotional responding and the cognitive processing of morality.

Fronto-limbic circuitry
Neural circuitry that connects the frontal lobe with subcortical regions, such as the amygdala, and regulates mood, cognition and behaviour.

Hippocampus
A brain structure embedded in the temporal lobe that has a major role in learning and memory.

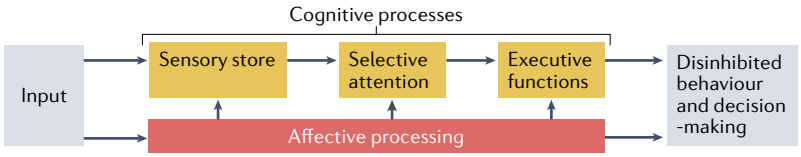

Fig. 2 | **Cognitive–affective factors that give rise to disinhibitory disorders.** How cognitive–affective factors implicated in the described disinhibitory disorders are related to each other within a basic information processing model. Information is registered by sensory systems (for example, vision or hearing) and then used by other parts of cognition. Selective attention serves as a filter that influences the extent to which information is perceived, stored in memory and acted on. Executive functions represent a range of processes that relate to planning, initiation and control of behaviour. Affective factors (such as negative emotions and rewards) can influence what information is perceived, prioritized, selected, remembered and acted on across stages of information processing.

others[12]. For example, in one study, individuals with psychopathy exhibited reductions in fronto-limbic reactivity when spontaneously viewing stress experienced by others compared with non-patient controls[98]. In psychopathy, low stress reactivity to self-related or other-related cues may reflect low arousal. Low arousal could, in turn, result in a high threshold for experiencing negative emotions, giving rise to more extreme disinhibited behaviours and minimizing concerns about possible consequences.

Finally, a large body of research on BPD, ASPD and psychopathy examines responsivity to fear-inducing or anger-inducing cues. Compared with those without BPD, individuals with BPD self-report more intense experiences of negative emotions in experimental and real-world settings[77], display higher and often exaggerated responses to negatively valenced information in real-world interactions (for example, perceived rejection)[99] and perceive neutral cues as negative when viewing facial emotions[100]. Some of the strongest evidence for increased reactivity to negative emotions in BPD is research across multiple studies showing increased amygdala activation in response to negatively valenced stimuli among individuals with BPD compared with controls and with those with other psychological disorders[87,101]. Similarly, individuals with ASPD report intense anger[102] and display amygdala over-reactivity in response to anger and threat-related cues[103,104]. Evidence is mixed about whether psychopathy is associated with aberrant fear or anger responsivity: some studies report blunted self-reported experiences of negative emotions in psychopathy[105] and others show no differences in self-reported negative emotions or in negative emotions in response to experimental stimuli compared with control groups[106,107]. Moreover, there is evidence of lower amygdala reactivity in response to fear among individuals with psychopathy compared with controls[12]. However, there are only small negative differences or no differences (meta-analysis mean effect size $r = 0.097$ (REF.[108])) in the subjective identification of fear among these individuals[108,109]. Thus, consistent with other indicators of negative emotionality, there is a divergence among disinhibitory disorder subtypes whereby both heightened (in BPD and ASPD) or blunted (in psychopathy) responses may relate to disinhibition.

Generally, individuals with SUDs, BPD or ASPD display increased negative emotionality. By contrast, individuals with psychopathy display decreased negative emotionality. However, tendencies towards negative emotionality, regardless of whether they are expressed as heightened or lower responses, are more prominent in certain contexts[6,77,110,111]. For instance, in experimental contexts, blunted fear responding in psychopathy is most reliably demonstrated when fear-related information is presented in a perceptually complex display or is peripheral to goal pursuit[111]. As another example, negative emotional reactivity related to BPD may be more pronounced in response to social stressors compared with non-social stressors[77]. Finally, amygdala responses to faces displaying negative emotions in individuals with ASPD vary depending on experiences of adversity in childhood[6]. Overall, some individuals, such as those with SUDs or BPD, may be so overwhelmed by negative emotions that experiencing them might result in an inappropriately reactive interpersonal style and difficulty managing inner turmoil. However, for those with psychopathy, negative emotions might be suppressed to avoid feeling overwhelmed, resulting in reduced reactions to stress or affiliative emotions. Ultimately, the overexpression or under-expression of negative emotionality can radically undermine the ability of individuals to engage in regulated, sound behaviour.

Reward processing. Reward processing is measured in different ways, including self-reported sensitivity to money or persistence to obtain a desired goal, performance on tasks that have participants pursue points or money and imaging of reward-relevant brain regions (for example, mesocorticolimbic circuitry). The association between disinhibition and reward processing is unsurprising: reward pursuit is inherent in disinhibited behaviours despite serious potential consequences. For example, the goal of theft is often to obtain the reward of others' property or money, despite risk of incarceration; individuals who misuse substances often pursue the reward of a 'high' despite the risk of overdose.

Compared with those without SUDs, individuals with SUDs display an increased desire for rewards and a higher reactivity to rewards when they are obtained, and continue to engage in reward-seeking behaviours even when that behaviour is no longer rewarded[112]. Furthermore, individuals with SUDs show enhanced activation of mesocorticolimbic circuitry when viewing their substance of choice compared with other neutral or rewarding information[113,114], or when receiving monetary rewards compared with no gains or losses, but reduced activation when anticipating rewards compared with no rewards[112,115–118].

Similarly, individuals with ASPD are hypersensitive to monetary rewards. Individuals with ASPD self-report a greater desire for rewards and value rewards more compared with those without ASPD. They also struggle to respond appropriately when tasks do not provide explicit guidance on how to optimize rewards, possibly indicating that a fervid pursuit of reward disrupts controlled behaviour[9,84]. On the neural level, compared with controls, adults with ASPD display enhanced activity in

Mesocorticolimbic circuitry
Neural circuitry that extends from regions deep within the brain to the prefrontal cortex to transport dopamine (a neurotransmitter) and supports reward learning.

Orbitofrontal cortex
A brain region in the prefrontal cortex that has a role in representing the affective values of reinforcers in decision-making, executive function and learning.

the orbitofrontal cortex, a brain region involved in representing the value of rewards, during a rewarded go/no-go task that requires responses in certain situations and response inhibition in others, but not during an unrewarded go/no-go task[119]. In particular, hypersensitivity to rewards among those with ASPD compared with those without ASPD is evident even when reward-driven behaviour is accompanied by negative consequences. This suggests that those with ASPD experience difficulty making advantageous decisions when pursuing rewards[120]. Unlike those with SUDs and ASPD, there is little evidence for disruptions in reward sensitivity among individuals with BPD or psychopathy[9].

One well-researched measure of reward processing is intertemporal choice, in which people must decide between smaller immediate versus larger delayed rewards (for example, US $25 now versus US $36 a month from now). Generally, larger over smaller rewards are preferred; however, there is a shift in preference when rewards are associated with costs, such as delays, uncertainties or effort requirements[121]. For individuals with SUDs[122–134] and those with BPD[135,136], the aversion to larger rewards when they are delayed (delay discounting) is exaggerated compared with participants without these disorders. The evidence for delay discounting differences between those with ASPD and comparison participants is mixed, with some studies showing an exaggeration similar to those with SUDs or BPD[137–139], and one study reporting no differences between a sample of people seeking treatment for substance use with and without ASPD[140]. There is limited research on intertemporal choice in individuals with psychopathy; however, two studies show that those with psychopathy make intertemporal choice decisions similar to individuals without a psychological disorder[141,142].

Evidence of heightened behavioural and neural responses to rewards supports the tendency of individuals with SUDs or ASPD to pursue rewarding outcomes regardless of the risks involved. This disregard for risks in favour of reward pursuit may explain their chronic engagement in illegal (yet rewarding) behaviours, such as drug use or robbery. For individuals with BPD, reward sensitivity might not be a core affective factor, but might be evident in certain contexts when affective regulation (for example, reward responding) interacts with controlled behaviour (for example, not impulsively selecting a response)[143]. Finally, psychopathy does not seem to be inherently associated with sensitivity to rewards. However, reward sensitivity might emerge in particular contexts. For example, individuals with psychopathy might pursue rewards when obtaining rewards is their goal[9].

Executive functioning. Executive functioning encompasses a constellation of processes that facilitate planning, initiation and control of behaviour[55,144]. Common subfactors of executive functioning include inhibition (the ability to deliberately suppress dominant, automatic or prepotent responses to achieve desired goals), set shifting (the ability to flexibly shift between sets of rules or actions amid changing contexts or goals), working memory (the ability to maintain and manipulate information) and planning (the ability to identify and organize steps). Failures of executive control can contribute to the expression of violent or harmful antisocial behaviour, inappropriate drug use and short-sighted reward-seeking.

SUDs are most consistently associated with moderately sized ($d = 0.20–0.58$) deficits in inhibition[145,146] and set shifting[146,147] compared with controls. In addition, working memory[148,149] and planning[146,147,150,151] are impaired in individuals with SUDs compared with controls when cognitive load is high. For example, in tasks where several steps are required, such as the Tower of London[152] test in which individuals are asked to move beads from a starting configuration to a target configuration in a minimum number of moves, once individuals with SUDs make an erroneous first move they tend to perseverate and take more steps than necessary to recover from that initial mistake[146]. Importantly, these deficits are sustained even after abstinence from substance use[151]. At a neural level, SUDs are associated with widespread atrophy in brain volume[153] and dysfunction (hyper-activation or hypo-activation depending on task context) across the prefrontal cortex reflective of difficulties in control, awareness and emotion regulation[154,155].

Similarly, individuals with ASPD show behavioural and neural deficits in many components of executive functioning, including inhibition, set shifting, working memory and planning[156–158]. Meta-analyses indicate small effect sizes ($d = 0.10–0.19$) for deficits associated with ASPD across different executive functioning tasks[156,158]. Individuals with ASPD make first moves impulsively before they have generated a solution to a problem, struggle to integrate rules in working memory and, similar to individuals with SUDs, present more pronounced deficits when cognitive load is high[159]. In addition, individuals with ASPD show reduced brain volume and function in frontal and prefrontal regions that subserve executive functioning compared with those without ASPD[84]. Moreover, the presence of heightened negative emotions or high-value rewards further disrupts inhibitory capabilities (for example, withholding a response during a task) for individuals with ASPD. The disruptive effects of affect (negative emotions or rewards) on executive functions, such as inhibition, is particularly apparent in those with ASPD when there are greater working memory demands, such as during a two-back task in which participants match the information on the screen to what was presented two screens previously[160,161].

There is little evidence of reliable associations between BPD and executive dysfunction[162,163]. However, there is evidence of disrupted task performance and neural responses in the prefrontal cortex during executive function tasks that include affective components. For example, in an emotional Stroop task in which individuals are asked to decide whether the colour print of an adjective word (for example, 'sad' printed in blue) corresponds to a colour word printed in black (for example, the word 'blue' printed in black), those with BPD are less able to inhibit responses to negatively valenced words compared with controls[164]. As another example, as noted above, in delay discounting tasks, those with BPD make more impulsive choices compared with

Startle response
The magnitude of muscle twitch measured by placing sensors on the orbicularis oculi muscle under the eye.

Electroencephalography
A non-invasive electrical monitoring method to record electrical activity on the scalp through a cap and sensors placed on the head and face.

controls[165]. This evidence reinforces the link between affective sensitivity and BPD.

Finally, although some meta-analyses[156] indicate small to medium-sized effects ($d = 0.29–0.42$) for the association between psychopathy and executive function deficits, careful examination of this work suggests that deficits in executive functions are not widespread. Instead, executive dysfunction in psychopathy depends on task demands, such that deficits are evident in tasks that rely on abstraction or the use of working memory to track many pieces of information[156,158,166]. In addition, evidence of executive function deficits in psychopathy is drastically reduced when traits of ASPD or general impulsivity are accounted for in statistical models. Thus, any association between psychopathy and executive dysfunction might be better accounted for by specific traits and behaviours associated with psychopathy but not the whole diagnosis per se[166–168].

Deficiencies in one or more executive function subfactor might contribute to the impulsive, unplanned and inflexible behaviour apparent in individuals with SUDs or ASPD. Given the evidence that individuals with SUDs have problems with response inhibition, they might be more likely to engage in certain behaviours (for example, driving home) even when there are clear signals that they should refrain from doing so (for example, slurred speech or difficulty walking indicative of intoxication). Similarly, individuals with ASPD might commit crimes of opportunity because of limitations in planning and holding the potential consequences of their actions in mind. For individuals with BPD and psychopathy, although executive function deficits might partly contribute to problematic behaviours, the cognitive–affective factors underlying their behaviour might not be as clearly related to deficits in executive functions as in those with SUDs or ASPD.

Selective attention. Selective attention influences the extent to which different sensory inputs are perceived, selected for action and learning, and stored in memory, and how abstract information is represented[169–172]. For example, visual attention can filter information on the basis of specific locations or features. Selective attention can also guide the selection of goals for action on the basis of instructions, previous experiences and memories. Altered selective attention might result in a failure to efficiently incorporate signals that indicate which actions are not (or are no longer) appropriate, such as the fear on a victim's face or the threat of incarceration.

Filtering related to selective attention (an attention bottleneck) might be enhanced in individuals with psychopathy[173]. The basic function of an attention bottleneck is to restrict the flow of information to help individuals to focus on important information without getting overwhelmed by less salient or distracting information[174]. The effects of this bottleneck are amplified in individuals with psychopathy[173,175]. Essentially, individuals with psychopathy are particularly adept at focusing on a single feature or goal but struggle to process multiple streams of information simultaneously (for example, the goal and someone else's emotions). Thus, the fluid processing and integration of important contextual information might be delayed or completely inhibited among individuals with psychopathy.

Research demonstrates enhanced selective attention in psychopathy using indices of behaviour (response accuracy and reaction time)[173], electrophysiology (startle response[176,177] and electroencephalography[173,178]) and neuroimaging (amygdala and lateral prefrontal cortex activation)[179]. The core deficits of psychopathy related to fear[176,177,180], punishment[181,182], regret[107] and empathy[98,183] depend on attention demands. For example, when focused directly on information about fear, punishment, regret or the thoughts and feelings of others, individuals with psychopathy are similar to those without psychopathy in their behavioural and neural responses. However, when this type of information is peripheral to the set goal, individuals with psychopathy struggle to incorporate that information. Evidence of attention-dependent effects across many paradigms (see TABLE 2 for examples) provides strong conceptual replication of the association between psychopathy and exaggerated selective attention. Thus, exaggerated selective attention might be one mechanism central to understanding the behaviour of individuals with psychopathy.

Considerably less research has examined selective attention in other disinhibitory disorders. Some work shows that individuals with SUDs display selective attention biases to substance-related cues[184,185]. Furthermore, there is some evidence that individuals with SUDs are impaired at filtering out redundant information, such as repeated auditory sounds, but these impairments attenuate with abstinence[186]. These findings suggest that selective attention deficits in SUDs might reflect reward-related sensitivities associated with substance use that are not inherent but are, instead, a consequence of the disorder. Similar to SUDs, there is some evidence of selective attention biases towards information that individuals with BPD are particularly sensitive to, namely negative stimuli[35]. Finally, one study found that individuals with ASPD were impaired at filtering out irrelevant information[187]. Thus, an enhanced selective attention capability may be unique to psychopathy compared with other disinhibitory disorders.

For individuals with psychopathy, enhanced selective attention may support a myopic focus on a goal (for example, obtaining money), but at the same time allow these individuals to avoid the 'cost' of emotions or thoughts (for example, anxiety about being punished, or thoughts of others that might hinder their ability to obtain a goal). Although in some ways enhanced selective attention can help a person to pursue their goals unencumbered by distraction, it can leave individuals with psychopathy vulnerable to missing information that provides important clues about context.

Integrative summary. Individuals diagnosed with disinhibitory disorders display similarities in their behaviour — the misuse of substances, risk-taking and criminal activity at higher levels than the general population. However, the combination of cognitive–affective factors that contribute to these behaviours varies across disorders. FIGURE 3 provides a hypothesized schematic of these differences based on the evidence reviewed here.

Table 2 | **Experimental manipulations used to test psychopathy-related dysfunctions in selective attention**

Paradigm	Task description	Results in participants without psychopathy	Results in participants with psychopathy
Threat conditioning[177,225]	Participants are asked to report on the colour (condition 1) or case (condition 2) of a visually presented letter; red information indicates chance of receiving a shock (threat) and green information indicates safety and no chance of shock	Startle response to threat versus safe information in both conditions	Reduced startle response to threat versus safe information in condition 2, where shock is peripheral to another goal; startle response to threat versus safe information similar to participants without psychopathy when asked to report the colour (condition 1)
Picture-viewing[176]	Participants are shown a picture that displays positive (for example, a person skiing), neutral (for example, a pool) or negative (for example, a bloody limb) scenes and a loud noise is briefly played over headphones while the picture is on the screen	Larger startle response to negative versus positive novel and familiar (pictures shown repeatedly) pictures	Reduced difference in startle response between positive and negative novel pictures; startle response with familiar pictures is similar to participants without psychopathy
Dual task[173]	Participants are presented with two types of targets (tones and shapes) and asked to press one button for tones and one button for shapes; the timing of stimulus presentation varies, with tones and shapes sometimes appearing close together (500 ms) and sometimes appearing further apart (1,100 ms)	Slower reaction times to a second target when presented quickly following a first target (500 ms between targets), but not when the time between targets is longer (1,100 ms between targets)	Slower reaction time to a second target for both short (500 ms) and long (1,100 ms) durations between targets
Perspective-taking[183]	Participants are presented with an avatar standing in a room with dots on a wall; participants are sometimes asked to take the avatar's perspective and confirm the number of dots on the wall from the avatar's perspective — other times, participants are asked to take their own perspective, and confirm the number of dots they can see in the room, regardless of what the avatar can see	Slower to respond when they see a different number of dots to the avatar in both conditions	Performance is comparable to individuals without psychopathy when asked to take the perspective of the avatar, but less interference (faster to respond despite inconsistency between what they see and what the avatar sees) when taking their own perspective

Generally, SUDs and ASPD are most similar, with both disorders characterized by heighted affectivity and deficient executive functioning, evident at behavioural and neural levels. Nonetheless, there are particular sensitivities among individuals with these disorders. In SUDs, inappropriate affective abilities related to managing emotions, tracking rewards, and appropriately planning and shifting behaviours across contexts undermine fully controlled behaviour. These combined cognitive–affective tendencies could explain why people with SUDs display compulsive behaviour in a habitual manner rather than adjusting to the demands of the current situation. This compulsivity may be particularly pronounced when seeking a substance or avoiding negative emotions. In ASPD, sensitivity towards negative emotions (such as anger), distress intolerance, desire to obtain high rewards despite the consequences and executive functioning problems that are exacerbated by these affective tendencies might all contribute to actions that are premature and inaccurate. The disinhibited behaviours expressed by individuals with ASPD might reflect an impulsive reaction and difficulty managing that reactivity.

BPD is predominantly associated with negative emotionality, including potential attentional biases towards negative stimuli and misattributing negative valence to neutral information. In addition, individuals with BPD display higher sensitivity to rewards and deficits in executive functioning in affective compared with neutral contexts. These cognitive–affective tendencies suggest that individuals with BPD are prone to disinhibition particularly in real or perceived emotionally charged situations, often leading to reactive behaviours.

Finally, psychopathy diverges from the other disinhibitory disorders in terms of cognitive–affective functioning. Specifically, individuals with psychopathy show blunted emotional reactivity and largely intact reward processing and executive functioning. Instead, psychopathy is characterized by an exaggerated attention bottleneck that influences information processing. For individuals with psychopathy, an exaggerated attention bottleneck creates a fractionated perspective, such that, in many situations, they struggle to fully attend to or incorporate all relevant information. Furthermore, although individuals with psychopathy might be capable of expressing negative emotion related to their choices in the moment, they might fail to incorporate that information in future decisions[107]. Thus, for these individuals there can be a disconnect between their experience, the reality of the present moment and their future behaviour, which can result in poorly controlled and callous acts.

This discussion of the similarities and differences in cognitive–affective functioning across disinhibitory disorders sheds light on why individuals with SUDs, BPD, ASPD or psychopathy find themselves engaging in behaviours that bring suffering to themselves and others. Furthermore, the recognition of disorder-specific cognitive–affective factors identifies targets for intervention that may effectively promote behaviour change for different subtypes of individuals.

Implications for legal intervention

Alterations in cognitive–affective factors among those with disinhibitory disorders provide a nuanced account of why these individuals might struggle to effectively manage their emotions, control their behaviour and

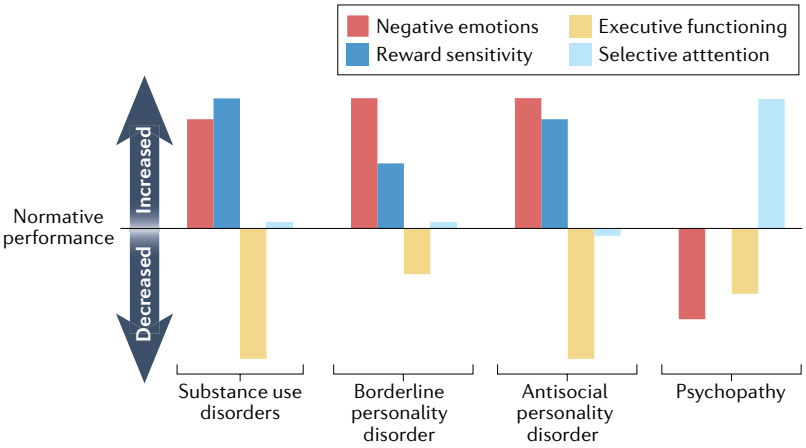

Fig. 3 | **Pattern of performance related to cognitive–affective factors across disinhibitory disorders.** Hypothesized patterns of cognitive and affective processes and functioning across substance use disorders, borderline personality disorder, antisocial personality disorder and psychopathy based on our Review. 'Increased' indicates hypersensitivity, hyper-functioning and/or hyper-reactivity relative to individuals without these disorders. 'Decreased' indicates hypo-sensitivity, hypo-functioning and/or hypo-reactivity relative to individuals without these disorders. Bar height indicates strength of evidence in support of a particular pattern based on the literature reviewed. Height is an estimate reflecting consistency and robustness of evidence covered in this Review and should not be seen as a reflection of statistical effect sizes.

make sound decisions. These underlying factors partly account for the high prevalence of individuals with disinhibitory disorders in legal systems worldwide[11–13]. However, other circumstances perpetuate, and even exacerbate, presenting disorders and, in some cases, trigger the emergence of new mental health problems[188]. In this section, we discuss the ways in which the work of the police, courts and correctional facilities does not acknowledge the role that cognitive–affective factors have in the behaviour of disinhibited individuals and why this failure undermines legal system effectiveness, public safety and, ultimately, social justice.

Police contact. In the USA, the core training for officers is command and control: how to use firearms and handcuffs, engage in close combat, operate vehicles and conduct field duties (such as traffic stops)[189]. In contrast to trainings in other countries, such as Sweden, France and Canada, very little time is spent learning about mental illness and how to interact with individuals with psychological disorders[190]. This lack of preparation is problematic in instances involving individuals with disinhibitory disorders because the risk for violence is exacerbated by their affective reactivity and executive dysfunction[191,192]. For example, as described above, people with BPD can view neutral information as threatening or negative, which can lead to impulsive reactions to this distorted reality; individuals with ASPD are sensitive to anger cues and have difficulty using executive functions in emotionally charged situations. Thus, officers might engage in interactions that can escalate the use of violence by individuals with these disinhibitory disorders.

One way to address how the police handle interactions with individuals with disinhibitory disorders can be based on crisis intervention teams, which have been implemented in more than 2,500 communities across the USA. There is a larger question of whether police should be responding to calls where mental health issues are clear. However, assuming continued police involvement in many calls regarding criminal activity or disturbances, the crisis intervention model provides one avenue for improvement over current practices. In a typical crisis intervention model, officers working on crisis intervention teams complete a 40-h training programme that covers the signs and symptoms of mental illnesses, co-occurring disorders, psychiatric medications, legal criteria for emergency apprehension, de-escalation skills, and awareness of mental health and other community services[193]. The goal is to improve safety in police encounters and divert individuals away from the criminal legal system to psychological services[194,195]. Working on these teams improves officer attitudes towards and knowledge about mental illness compared with officers who do not work on these teams. In addition, the use of crisis intervention teams has been associated with fewer officer injuries, fewer arrests and substantial cost savings (because mental health treatment is less expensive than incarceration)[193,195,196]. However, these positive effects of crisis intervention teams are not evident when teams respond to individuals with SUDs[197] or other disinhibitory disorders.

We suggest that crisis intervention teams could be improved by incorporating specific information into the training model about the behaviours associated with disinhibitory disorders and the underlying cognitive–affective factors. Although police will not be equipped to diagnose individuals with these disorders and are only sometimes aware of an individual's psychological diagnosis, educating police about underlying causes of disinhibited behaviour may provide them with a better frame of reference for why some individuals appear not to listen to commands, struggle to stop their behaviour or repeatedly defy authority. Perceiving defiant or erratic behaviour as not wholly intentional might allow police to engage in more verbal de-escalation and referral to psychological services.

Courts. A fundamental part of the adjudication process is ascertaining criminal responsibility. Principles of criminal responsibility establish when an individual is blameworthy and can therefore be justly punished. Such principles also recognize that punishment cannot be inflicted justly on those who are not blameworthy. The way criminal responsibility is defined and the factors considered in determining responsibility have important implications for disinhibitory disorders.

For instance, in the USA, legal doctrines indicate that individuals may be considered less responsible if they can show that "at the time [their criminal conduct was] a result of mental disease or defect" indicating that the person "lacks substantial capacity either to appreciate the criminality [wrongfulness] of [their] conduct or to conform [their] conduct to the requirements of law"[198,199], and therefore they should be found not guilty by reason of insanity. The insanity defence under the Model Penal Code Test[198], which is used by 20 US states, excludes individuals with disinhibitory disorders because disorders characterized by repeated criminal

or antisocial conduct are disqualified. Yet SUDs, BPD, ASPD and psychopathy are associated with cognitive–affective dysfunctions and neural abnormalities that contribute to difficulty engaging in fully controlled or informed behaviour at any given point in time[200,201].

For example, the evidence presented shows executive dysfunctions that specifically undermine the initiation, planning and regulation of behaviour in SUDs and ASPD. Consequently, it is scientifically reasonable to consider that people with SUDs or ASPD are less likely to have fully functional mental capacities that support choice and reasoning. Similarly, the exaggerated attention bottleneck in individuals with psychopathy limits what and how much information is incorporated into consciousness. Thus, it is possible that, at any given moment in time, individuals with psychopathy have failed to perceive, represent and react to important information that informs behaviour. Similarly, as reviewed above, individuals with BPD are prone to misattributing negative affect to neutral information. Therefore, someone with BPD might have a limited ability to 'know' that what they are doing is wrong because their reality is coloured by inaccurate information. Furthermore, in some emotionally charged situations, individuals with BPD might be influenced by a false sense of threat that could promote reactive behaviours that lack full control. Consequently, much like psychosis, one could argue that individuals with BPD experience states that are divorced from reality. We therefore believe that disinhibitory disorders are associated with factors that explain 'antisocial conduct' in ways that undermine the legal conceptualization of responsibility, and individuals with disinhibitory disorders should be eligible to, unequivocally, put forth an insanity defence on that basis.

The adjudication process also fails to incorporate scientific knowledge about disinhibitory disorders in terms of mitigation. Mitigation refers to factors that warrant leniency in charge or sentence length, including the defendant's age, history of abuse and evidence of psychological disorders. In practice, substance-induced violence, repeated criminal behaviour and psychopathic traits — symptoms of disinhibitory disorders — are often labelled as aggravating factors (that is, factors that increase the culpability of criminal activity), resulting in harsher charges and longer sentences[202,203]. In other words, disinhibitory disorders are psychological disorders that should qualify for some leniency, yet their specific behavioural manifestations are considered as criteria for aggravation.

To be clear, we are not suggesting that individuals with disinhibitory disorders receive no punishment or are treated with extreme leniency. Rather, we are suggesting that current legal practices should be applied equally across different forms of psychological illness and in a scientifically informed way. For example, mood disorders (such as bipolar disorder) and psychotic disorders (such as schizophrenia) are commonly and successfully presented in insanity defences[64,204,205]. It may be that mood and psychotic disorders are more acceptable as legal insanity because their symptoms explicitly note a temporary disconnect from reality. However, it is our opinion that no disorder should be excluded from any defence when there is strong evidence that brain-based differences and psychological factors impact what a person knows or believes.

Courts are beginning to recognize these ideas: there has been an increase in the use of 'drug courts' to divert people with SUDs to treatment rather than incarceration[206]. Although drug courts do not reference doctrines of insanity, they are effectively built on understanding that SUDs might mitigate full responsibility and that the emphasis should be on recovery over punishment. Being more consistent in considering psychological disorders that qualify for insanity or mitigation might promote opportunities for mandating treatment (which does occur following successful insanity defences in some states) or diverting people to rehabilitative care.

Correctional facilities. Many incarcerated individuals present with at least one disinhibitory disorder[11–13]. These individuals engage in higher rates of institutional violence and are placed in solitary confinement at a higher rate than those without such disorders[207,208]. Given the severity of their behaviour, individuals with disinhibitory disorders are regularly referred for treatment within the correctional setting. However, referral does not mean that they actually receive treatment, or that when treatment is offered it is appropriate for their disorder[209,210] or reflective of advances in clinical science (see TABLE 3 for a summary of evidence-based medication and psychotherapy-based treatments).

Research on cognitive–affective functioning in disinhibitory disorders offers suggestions for effective treatments. For example, there is evidence that contingency management (TABLE 3) works for ASPD and SUDs[211–214], which is consistent with the evidence reviewed above that these individuals tend to be sensitive to rewards and have difficulty tracking rules. Thus, rewarding positive behaviours and explicitly outlining the connection between behaviour and outcome leverages affective preferences and circumvents executive functioning deficits. For individuals with BPD, dialectical behaviour therapy, which includes modules on learning to tolerate distress and regulating emotions, is effective[215]. These skills directly address the sensitivities to negative emotions and executive dysfunction in the face of affective information associated with BPD. Treatment research on psychopathy is more limited. Nonetheless, there is some evidence that targeting the attention deficits that characterize this disorder in computerized attention training may result in behavioural change[12].

Unfortunately, correctional facilities are limited in providing personalized, evidence-based treatments because of a dearth of adequate funding, a lack of access to standard treatments and an overall lack of commitment to the rehabilitation of individuals involved with the legal system[216,217]. Nonetheless, a rehabilitative focus benefits all actors in the legal system, from personnel to those in custody. For instance, the forensic psychiatric hospital approach in the Netherlands (TBS hospitals) uses individualized treatment plans that consider person-specific cognitive and affective factors to design a fitting medication and psychotherapy regimen. Research on these hospitals demonstrates that, even for

Table 3 | **Treatments for disinhibitory disorders**

Disorder	Medication	Psychotherapy
SUDs	Medications are used effectively for acute stabilization, to manage withdrawal symptoms and to reduce harm (for example, naloxone to address an opioid overdose)[226,227] The US Food and Drug Administration has approved a handful of medications, specifically for the treatment of alcohol or opioid use disorders[228]	Several psychotherapies have strong, consistent and robust empirical support across a range of substance types[228] Cognitive behavioural therapy emphasizes identifying the antecedents and consequences of substance use, developing skills to recognize and manage situations and states in which substance use is most likely, and implementing coping strategies to manage thoughts and emotions when faced with specific triggers or situations[214] Contingency management involves the use of incentives or rewards (for example, vouchers that can be exchanged for goods or services) for meeting specific behavioural goals (for example, verified abstinence)[213] Motivational interviewing is used to enhance a person's intrinsic motivation for change and is particularly useful for increasing treatment engagement[229]
BPD	Selective serotonin reuptake inhibitors, atypical antidepressants, anxiolytics, antipsychotics and mood stabilizers are commonly prescribed for individuals with BPD[230]; however, there is no empirical base to establish the usefulness of these medications for BPD[231]	The most common, well-studied and effective treatment for BPD is dialectical behaviour therapy[215], which involves the development of skills to reduce observable symptoms of BPD through mindfulness (focusing on the present), emotion regulation, distress tolerance and interpersonal effectiveness strategies Mentalization-based treatment is another empirically supported approach that focuses on improving the individual's understanding of their motives, their emotions and the effects on others[232]
ASPD	Different medications, such as antidepressants, hypnotics, anxiolytics, antipsychotics and antiepileptics, have been prescribed for people with ASPD; however, there is no research evidence to justify the use of these interventions[233]	Research on psychotherapy for ASPD is limited; contingency management seems to have positive effects in populations with ASPD with comorbid SUDs[211,212]
Psychopathy	There has been very little work on medication treatment for psychopathy, with only a handful of anecdotal reports and no reliable systematic investigations	Common psychological interventions, such as cognitive behavioural therapy, are less effective for treating individuals with psychopathy; although in some cases there are improvements following treatment, rarely does treatment result in desired clinical outcomes or 'normative' levels of functioning[223]; however, only a small number of studies have been conducted on psychotherapy for psychopathy, none of these studies included large samples and rarely did these studies report appropriate methodological controls (for example, a control group or random assignment)[234]

ASPD, antisocial personality disorder; BPD, borderline personality disorder; SUDs, substance use disorders.

those with disinhibitory disorders, appropriate treatment reduces recidivism[218]. Thus, it is our opinion that if correctional facilities in the USA continue to be one of the largest mental health providers, they must improve their psychiatric intake evaluations to more accurately diagnose individuals and use evidenced-based treatments (which can include leveraging open-access, online programmes and scalable interventions). A more extreme, but scientifically informed, step would be to follow models such as the TBS hospitals where those individuals with psychological disorders are moved to a forensic mental health setting for rehabilitative services.

Summary and future directions

Psychological science reliably identifies unique combinations of cognitive–affective dysfunctions that characterize different disinhibitory disorders. The disorder-specific patterns of cognitive–affective functioning provide an empirical foundation for revising intervention approaches. Currently, there is an over-focus on the disinhibited behaviours themselves, rather than on the underlying factors, at every stage of the legal system. Consequently, individuals with disinhibitory disorders experience substantial problems with the police, are inconsistently processed through the court system and are incarcerated at high rates with little access to appropriate treatments. Thus, the legal system falls short in delivering justice for all by ignoring important factors that speak directly to why individuals engage in behaviours that are harmful to themselves and to others. In this Review, we briefly touched on several potential avenues for change. However, to achieve a more scientifically informed and effective legal system, psychological science itself must take several important steps.

We focused on research that has been replicated directly and conceptually. However, some of these studies have limited generalizability due to narrow sampling. For example, studies on BPD often exclude individuals with active SUDs and studies on SUDs commonly focus on a single substance at the exclusion of misuse of other substances. Although these sampling approaches help to isolate effects and refine thinking around specific disorders, they do not reflect the complex and overlapping clinical presentation common in disinhibitory disorders. Thus, more research with larger samples, which include comorbid diagnoses, is needed to better capture cognitive–affective functioning in disinhibitory disorders.

In addition, examining cognitive–affective factors is important for elucidating how people may perceive, interpret or act on information. However, these factors are influenced and reinforced in certain situations or environments. That is, some contexts can evoke or amplify cognitive–affective dysfunction that results in disinhibited behaviours, whereas such behaviours may not occur in other contexts[219,220]. A better understanding of when and where individuals with disinhibitory

disorders may be most likely to express problematic behaviour will improve our ability to translate science into law (for example, when determining criminal responsibility) and develop targeted treatments.

Finally, using scientific findings that are estimated for groups to inform legal policy is appropriate: legal policy is developed for classes of individuals (for example, juveniles or people with physical disabilities) and it is our opinion that those with disinhibitory disorders constitute a class. However, it is more difficult to make the same argument about the application of scientific findings to the behaviour of an individual. For instance, expert witnesses might be asked to testify to whether a specific person displays hypersensitivity to rewards or shows deficient amygdala functioning, and how these factors relate to responsibility or opportunities for rehabilitation. However, in most cases, the determination of what is 'normative' or 'atypical' is based on the aggregate data from scientific studies, not the estimates of an individual in those studies. All we can say from aggregate (grouped) data is the probability someone with particular characteristics may show a particular effect. Because statistics are probabilistic and based on averages of data, there will probably be overlap in the distribution of cognitive–affective functioning between those with a given disorder and control groups[221]. For example, as mentioned above, the difference in executive functioning deficits between those with SUDs and controls is moderately sized (around $d = 0.5$). This means that approximately 80% of the distribution of individuals in the disorder and control groups would be overlapping on executive functioning scores and that there is a 64% chance that a person picked at random from the SUD group will have a higher (more deficient) score than a person picked at random from the control group. Given the degree of overlap in cognitive functioning and uncertainty in the probability that a diagnosed individual will exhibit worse functioning than someone without a formal diagnosis, it is difficult to argue that individual cases should be determined by group-level findings. Although advances are being made in modelling techniques that connect group-level effects to individual-level data[222–224], we still need consensus on the degree of uncertainty that we are willing to tolerate when applying scientific findings to individuals, especially in legal contexts.

Psychological science can be a powerful tool to inform legal interventions and produce effective and socially just reforms. However, psychological scientists cannot act alone. Instead, progress will require cooperation and collaboration among scientists, legal scholars, practitioners and those who are affected by disinhibitory disorders.

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