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## Differentiating patterns of substance misuse by subtypes of antisocial traits in male offenders

Grace M. Brennan<sup>a§</sup> , Allison M. Stuppy-Sullivan<sup>a§</sup>, Inti A. Brazil<sup>b</sup> and Arielle R. Baskin-Sommers<sup>a</sup>

<sup>a</sup>Department of Psychology, Yale University, New Haven, CT, USA; <sup>b</sup>Donders Institute for Brain, Cognition, and Behaviour, Radboud University, Nijmegen, The Netherlands

### ABSTRACT

Among criminal offenders, two subtypes of antisocial traits, psychopathy and externalizing-only, are associated with an especially elevated risk for substance use disorders (SUDs). The present study examined the associations of these traits with patterns of substance misuse. In a sample of 1410 male offenders, we used diagnoses for alcohol, cannabis, opioids, and stimulants to examine the association between antisocial traits and SUD severity, as well as, age at substance use initiation. Results indicated that externalizing-only, but not psychopathic, traits predicted greater severity of SUDs (i.e. increased likelihood of dependence) across all substances. By contrast, psychopathic, but not externalizing-only, traits predicted earlier initiation of use across all substances. These differential patterns of substance misuse may be a reflection of distinct psychobiological processes. Ultimately, parsing the patterns of substance use across a continuum of clinically heterogeneous samples, rather than within circumscribed diagnostic categories, might help to refine the phenotype and improve the prediction of substance-related problems.

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**KEYWORDS** Alcohol; drug; antisocial traits; psychopathy; externalizing

Alcohol and drug misuse impose an enormous burden on society, incurring total annual costs of \$417 billion in the United States (U.S. Department of Justice, 2011). In the general population, lifetime prevalence rates are 17.8 and 12.5% for alcohol abuse and dependence, respectively (Hasin, Stinson, Ogburn, & Grant, 2007) and 7.7 and 2.6% for drug abuse and dependence, respectively (Compton, Thomas, Stinson, & Grant, 2007). Among offenders the rates of substance use disorders (SUDs; henceforth, the term ‘substance’ will include both alcohol and drugs) are markedly elevated: 65% of the United States prison population meets a diagnosis of substance abuse or dependence, making prisoners 7 times more likely to have a SUD than members of the general population (National Center

**CONTACT** Grace M. Brennan  [grace.m.brennan@yale.edu](mailto:grace.m.brennan@yale.edu)

<sup>§</sup>Grace M. Brennan and Allison M. Stuppy-Sullivan contributed equally to this work.

on Addiction & Substance Abuse at Columbia University, 2010). These epidemiological data indicate that substance misuse and criminal behavior are closely related pathologies (Compton, Conway, Stinson, Colliver, & Grant, 2005).

Of particular relevance are two subtypes of antisocial traits, psychopathy and externalizing-only, which place individuals at significantly greater risk than other offenders for diverse SUDs (Patrick, Hicks, Krueger, & Lang, 2005; Smith & Newman, 1990). Psychopathic individuals are characterized by a manipulative interpersonal orientation, shallow affect, impulsive behavior, and a chronic antisocial lifestyle. Psychopathy consists of two correlated factors: interpersonal-affective traits (Factor1), such as manipulative interpersonal style and lack of empathy; and impulsive-antisocial traits (Factor2), such as proneness to boredom and juvenile delinquency (Harpur, Hare, & Hakstian, 1989). The interpersonal-affective traits are considered the 'core personality traits' of psychopathy, while the impulsive-antisocial traits reflect criminality and behavioral dysregulation more broadly. By contrast, externalizing-only individuals are characterized by behavioral disinhibition (Iacono, Malone, & McGue, 2008) and high negative emotionality combined with low effortful control (Eisenberg et al., 2009). Externalizing represents a heritable predisposition to diverse forms of disinhibitory psychopathology, including conduct disorder, SUDs, and antisocial personality disorder. In some cases, investigators identify externalizing-only using broad spectrum measures of personality such as the Externalizing Spectrum Inventory (ESI; Krueger, Markon, Patrick, Benning, & Kramer, 2007). Additionally, some researchers use Factor2 of psychopathy (Patrick et al., 2005; Venables & Patrick, 2012) as a measure tapping externalizing-only traits.

A wide body of evidence indicates that psychopathy and externalizing-only are dissociable constructs (e.g. Baskin-Sommers & Newman, 2014; Gao & Raine, 2009; Rodman et al., 2016; Sargeant, Daughters, Curtin, Schuster, & Lejuez, 2011; Verona, Sprague, & Sadeh, 2012). For example, structural equation modeling reveals that a standard self-report measure of externalizing-only dissociates into statistically independent factors that broadly align with psychopathy and externalizing-only (Krueger et al., 2007). The general externalizing-only superfactor accounts for significant variance on all facets of the scale and loads most strongly onto problematic impulsivity and irresponsibility. The independent callous-aggressive subfactor accounts for additional variance on select facets, particularly low empathy and relational aggression, reflecting core aspects of psychopathy. Thus, although there is considerable phenotypic overlap (e.g. crime, impulsivity, substance use) between psychopathy and externalizing-only, they are distinct constructs that relate differentially to individual traits. Thus, psychopathy and externalizing-only are mechanistically and conceptually distinct constructs. To the extent that different processes contribute significantly to the development and maintenance of SUDs in these individuals, these subtypes should be associated with distinct patterns of substance misuse.

Prior research on the relation between antisocial subtypes and substance misuse in offenders indicates that psychopathy is associated with higher rates of SUDs (Smith & Newman, 1990). However, when psychopathy is separated into its factors, only the impulsive-antisocial traits are significantly related to alcohol and drug symptoms. Moreover, inmates high on impulsive-antisocial traits report an earlier age of first intoxication (Hemphill, Hart, & Hare, 1994). Research on externalizing-only indicates that this latent trait indexes risk for early-onset addiction (Iacono et al., 2008). Although there is evidence that both psychopathic and externalizing-only traits are related to elevated risk for substance misuse, no studies have directly compared the patterns of substance use in inmates with these traits. Thus, it remains unclear whether these traits are in fact differentially related to the severity and age at initiation of substance use.

The present study examined the association between two subtypes of antisocial traits – psychopathy and externalizing-only – and alcohol and drug misuse. More specifically, in a sample of male offenders we evaluated the severity of alcohol and drug (cannabis, cocaine/stimulants, and opioids) use disorders, including number of SUD diagnoses, and the age at initiation of substance use. The association between substance use and antisocial behavior is one of the most reliable and important themes in the substance abuse literature. Given the high rates of substance-related problems in psychopathic and externalizing-only individuals, it is important for clinical assessment, treatment, and prevention efforts to more precisely define the nature of the relationship between these traits and behaviors.

## Method

### *Participants*

Participants were recruited from medium-security correctional institutions in Wisconsin. A prescreen of institutional files and assessment materials was used to exclude individuals who had performed below the fourth-grade level on a standardized measure of reading (Wide Range Achievement Test-III; Wilkinson, 1993), who scored below 70 on a brief measure of IQ (Wechsler Adult Intelligence Scale-III; Wechsler, 1997), who had diagnoses of schizophrenia, bipolar disorder, or psychosis, not otherwise specified (Structured Clinical Interview for DSM Disorders; First, Spitzer, Gibbon, & Williams, 1997), or who had a history of medical problems (e.g. uncorrectable auditory or visual deficits, head injury with loss of consciousness greater than 30 min) that may have impacted their comprehension of the materials. All participants were between the ages of 18 and 55 because antisocial behavior has been found to change with advancing age (Steffensmeier, Allan, Harer, & Streifel, 1989). The final sample consisted of 1410 male participants (Table 1). All participants provided written informed consent according to the procedures set forth by the University of Wisconsin-Madison Human Subjects Institutional Review Board.

**Table 1.** Sample characteristics.

	<i>N</i>	Min	Max	<i>M</i>	<i>SD</i>
Age	1410	18	55	31.66	7.61
Race					
White	755				
Black	548				
Hispanic	52				
Asian	6				
Native American	26				
Biracial	20				
Education (years)		1	17	10.68	1.40
SCID alcohol diagnosis					
No diagnosis	399				
Abuse	342				
Dependence	445				
SCID cannabis diagnosis					
No diagnosis	275				
Abuse	411				
Dependence	445				
SCID opioid diagnosis					
No diagnosis	839				
Abuse	41				
Dependence	157				
SCID stimulant diagnosis					
No diagnosis	746				
Abuse	83				
Dependence	240				
Overall abuse diagnoses	1186	0	4	.76	.82
Overall dependence diagnoses	1186	0	5	1.10	1.08
Total drug diagnoses	1186	0	5	1.87	1.19
Age at initiation alcohol	819	5	30	13.42	3.73
Age at initiation cannabis	869	4	37	13.87	3.04
Age at initiation opioid	275	11	40	20.25	5.49
Age at initiation stimulant	722	7	42	17.44	4.29
PCL-R score	1410	3.20	40.00	24.05	6.17
ESI total score	1335	100.00	400.00	229.80	57.11
Psychopathy diagnosis					
30 or above	297				
21–29	740				
Below 21	373				
APD diagnosis					
Present	759				
No diagnosis	646				

## Materials and measures

### *Structured Clinical Interview for DSM-IV Disorders (SCID-IV; First et al., 1997)*

The SCID-IV was used to determine diagnoses of abuse or dependence for alcohol, cannabis, cocaine, opioids, stimulants, sedatives, and hallucinogens. Diagnostic categories – no diagnosis, abuse, and dependence – were employed as indicators of severity of substance misuse, with dependence representing the most severe form of misuse. Given the shared psychopharmacological effects of cocaine and other stimulants (Hyman, 1996), these two diagnostic categories were combined, and are henceforth jointly referred to as stimulants. Moreover,

preliminary analyses indicated that only the alcohol, cannabis, opioid, and stimulant categories had sufficient power to detect differences (moderate effect size) in no diagnosis versus dependence and abuse versus dependence diagnoses. Inter-rater reliability for SUD diagnoses based on 10% of the sample was .92.

### ***Psychopathy Checklist-Revised (PCL-R; Hare, 2003)***

PCL-R ratings were completed using information from prison files and a semi-structured interview that lasted approximately 60 min. Based on information gathered from the interview and file review, the 20 items of the PCL-R were rated 0, 1, or 2, reflecting the degree to which a trait was present: significantly (2), moderately (1), or not at all (0). Total scores for the PCL-R range from 0 to 40. The PCL-R also can be split into a replicable two-factor structure with Factor1 items assessing interpersonal-affective traits (e.g., glib, callous) and Factor2 items relating to impulsive-antisocial behavior (e.g. irresponsible, criminality; see Table 2 for zero-order correlations among independent variables). Inter-rater reliability for PCL-R total scores based on 10% of the sample with dual ratings was .99.

### ***Externalizing Spectrum Inventory-Brief (ESI-Brief; Hall, Bernat, & Patrick, 2007)***

The ESI-Brief is a 100-item self-report questionnaire developed to assess a broad range of behaviors and personality associated with the externalizing spectrum of psychopathology. Although the ESI includes items related to substance use, it does not characterize clinical diagnoses and only assesses what would be best described as potential misuse. Total scores range from 100 to 400. For this sample, high internal consistency (i.e. reliability) was demonstrated (Cronbach's  $\alpha = .96$ ).

### ***Addiction Severity Index (ASI; Leonhard, Mulvey, Gastfriend, & Shwartz, 2000)***

Inmates were asked about their use of specific substances, including alcohol, cannabis, cocaine/crack, methamphetamines, other amphetamines, heroin, and other opioids. Interviewers recorded whether inmates had ever tried a substance, the age at which inmates first used the substance, and whether inmates had regularly used the substance (three or more times per week). For inmates who reported using a substance regularly, interviewers recorded age(s) when regular use started and ended to quantify the total number of years of regular use for each substance. To remain consistent with substance categories represented in the SCID, ages of first use for alcohol, cannabis, stimulants (earliest use out of cocaine/crack, methamphetamines, and other amphetamines), and opioids (earliest use out of heroin and other opioids) were used to establish age at initiation of use for each substance category analyzed.

**Table 2.** Zero-order correlations between independent variables.

	ESI total	ESI score (NS)	PCL-R total	PCL-R F1	PCL-R F2
ESI total	—	—	—	—	—
ESI score (NS)	.982*	—	—	—	—
PCL-R total	.450*	.475*	—	—	—
PCL-R F1	.232*	.264*	.801*	—	—
PCL-R F2	.506*	.516*	.882*	.476*	—

Notes: NS = no substance (ESI score minus substance use items); F1 = Factor1; F2 = Factor2.

\*Significance at  $p < .001$ .

## Results

### Substance use severity

Using multinomial logistic regression, with SUD diagnosis (no diagnosis, abuse, and dependence) and z-transformed PCL-R total and ESI scores simultaneously entered, separate analyses were run for each substance type (Table 3). PCL-R and ESI were simultaneously examined in order to control for the shared variance

**Table 3.** Multinomial logistic regression models for the influence of psychopathic and externalizing traits on the likelihood of SCID substance diagnoses.

	Odds ratio	95% CI for odds ratio
<i>SCID alcohol diagnoses</i>		
No diagnosis vs. dependence		
Psychopathy	1.13	[.95, 1.35]
Externalizing	.31***	[.25, .38]
Abuse vs. dependence		
Psychopathy	1.22*	[1.02, 1.46]
Externalizing	.56***	[.46, .67]
<i>SCID cannabis diagnoses</i>		
No diagnosis vs. dependence		
Psychopathy	.60***	[.49, .73]
Externalizing	.47***	[.38, .58]
Abuse vs. dependence		
Psychopathy	.99	[.83, 1.17]
Externalizing	.73***	[.62, .85]
<i>SCID opioid diagnoses</i>		
No diagnosis vs. dependence		
Psychopathy	1.13	[.90, 1.41]
Externalizing	.47***	[.38, .59]
Abuse vs. dependence		
Psychopathy	1.15	[.74, 1.78]
Externalizing	.85	[.56, 1.28]
<i>SCID cocaine/stimulant diagnoses</i>		
No diagnosis vs. dependence		
Psychopathy	.84	[.69, 1.02]
Externalizing	.40***	[.33, .49]
Abuse vs. dependence		
Psychopathy	1.01	[.72, 1.41]
Externalizing	.78	[.57, 1.07]

Note: Reference group = dependence diagnosis.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

among these overlapping subtypes and isolate the unique contributions of each subtype to substance use. The diagnostic category dependence was chosen as the reference group in order to compare the two categories of diagnosis (abuse vs. dependence) directly and examine which antisocial traits predicted more severe diagnoses. Odds ratios (ORs) significantly different from 1 indicate higher (if  $> 1$ ) or lower (if  $< 1$ ) likelihood of having the non-reference diagnosis. All models provided good fit for the data (alcohol:  $N = 1108$ ,  $R^2 = .16$  (Cox & Snell),  $R^2 = .18$  (Nagelkerke), Model  $\chi^2(4) = 197.02$ ,  $p < .001$ ; Cannabis:  $N = 1053$ ,  $R^2 = .14$  (Cox & Snell),  $R^2 = .16$  (Nagelkerke), Model  $\chi^2(4) = 162.88$ ,  $p < .001$ ; opioids:  $N = 959$ ,  $R^2 = .06$  (Cox & Snell),  $R^2 = .09$  (Nagelkerke), Model  $\chi^2(4) = 63.50$ ,  $p < .001$ ; stimulants:  $N = 991$ ,  $R^2 = .14$  (Cox & Snell),  $R^2 = .18$  (Nagelkerke), Model  $\chi^2(4) = 152.60$ ,  $p < .001$ ).

For alcohol, inmates high on ESI were 1.80 times more likely to meet criteria for dependence than abuse (OR = 0.56,  $p < .001$ , 95% CI [0.46, 0.67]), while inmates with higher PCL-R total scores were 1.22 times more likely to meet criteria for abuse than dependence (OR = 1.22,  $p = .026$ , 95% CI [1.02, 1.46]). For cannabis, inmates high on ESI were 1.38 times more likely to meet criteria for dependence than abuse (OR = 0.73,  $p < .001$ , 95% CI [0.62, 0.85]). Additionally, inmates with higher PCL-R total scores were 1.68 times more likely to meet criteria for dependence vs. no diagnosis (OR = 0.60,  $p < .001$ , 95% CI [0.49, 0.73]), but were not associated with cannabis abuse vs. dependence ( $p = .888$ ). For opioids, inmates high on ESI were 2.12 times more likely to meet a dependence diagnosis over no diagnosis (OR = 0.47,  $p < .001$ , 95% CI [0.38, 0.59]), whereas PCL-R scores were not related to opioid diagnoses (all  $ps \geq .294$ ). Finally, for stimulants, inmates high on ESI were 2.48 times more likely to meet a dependence diagnosis than no diagnosis (OR = 0.40,  $p < .001$ , 95% CI [0.33, 0.49]), but PCL-R scores were unrelated to any stimulant diagnosis (all  $ps \geq .075$ ).<sup>1,2,3</sup>

To further examine the influence of psychopathic and externalizing-only traits on the severity of substance use, the substance categories for which inmates met diagnostic criteria were summed to form count scores for abuse, dependence, and total diagnoses, ranging from 0 to 5. Diagnosis counts were used in negative binomial regression models with z-scored PCL-R and ESI scores simultaneously entered (Table 4). Inmates with higher PCL-R scores were 1.12 times more likely to have more abuse diagnoses (OR = 1.12,  $p = .038$ , 95% CI [1.01, 1.25]) with no significant relationship between ESI and abuse diagnosis counts ( $p = .606$ ), model  $\chi^2(2) = 6.830$ ,  $p = .033$ . For dependence diagnosis counts, inmates higher on ESI were 1.59 times more likely to have more dependence diagnoses (OR = 1.59,  $p < .001$ , 95% CI [1.44, 1.75]) while PCL-R scores were not associated with dependence diagnosis counts ( $p = .551$ ), model  $\chi^2(2) = 121.628$ ,  $p < .001$ . Finally, inmates higher on ESI, (OR = 1.34,  $p < .001$ , 95% CI [1.23, 1.45]), but not PCL-R scores ( $p = .162$ ), were 1.34 times more likely to have a greater number of both abuse and dependence diagnoses across substance categories,



**Table 4.** The influence of psychopathic and externalizing traits on substance use diagnosis counts.

	Odds ratio	95% CI for odds ratio
<i>Total SCID abuse diagnoses</i>		
Psychopathy	1.12*	[1.01, 1.25]
Externalizing	1.03	[.93, 1.14]
<i>Total dependence diagnoses</i>		
Psychopathy	1.03	[.93, 1.14]
Externalizing	1.59***	[1.44, 1.75]
<i>Total SCID drug diagnoses</i>		
Psychopathy	1.07	[.98, 1.16]
Externalizing	1.34***	[1.23, 1.45]

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

model  $\chi^2(2) = 68.535$ ,  $p < .001$ .<sup>4,5</sup> These results are consistent with those of the multinomial logistic regressions relating ESI, but not PCL-R scores, to greater SUD severity.

### *Supplemental analysis using PCL-R factors*

Some researchers advocate parsing PCL-R scores into two factors that represent the 'core' interpersonal-affective (Factor1) and the more 'externalizing-related' impulsive-antisocial (Factor2) traits of psychopathy, respectively. Using the PCL-R Factors, z-transformed and simultaneously entered, in models of SUD diagnosis severity, all models provided good fit for the data (all  $ps \leq .001$ ). Inmates high on Factor2 were 1.28 times more likely to have alcohol dependence over abuse (OR = 0.78,  $p = .008$ , 95% CI [0.65, 0.94]), whereas inmates high on Factor1 were 1.21 times more likely to have alcohol abuse over dependence (OR = 1.21,  $p = .033$ , 95% CI [1.02, 1.43]). For cannabis, inmates higher on Factor2 were 1.27 times more likely to have cannabis dependence over abuse (OR = 0.79,  $p = .008$ , 95% CI [0.66, 0.94]), while Factor1 was not associated with cannabis use diagnoses (all  $ps > .05$ ). For opioids, inmates high on Factor2 were 1.51 times more likely to have dependence over no diagnosis (OR = 0.66,  $p < .001$ , 95% CI [0.53, 0.82]), while Factor1 was not associated with opioid use diagnoses (all  $ps > .05$ ). For stimulants, inmates high on Factor2 were 1.89 times more likely to have dependence over no diagnosis (OR = 0.53,  $p < .001$ , 95% CI [0.44, 0.64]), while Factor1 was not associated with stimulant use diagnoses (all  $ps \geq .451$ ).

Additionally, all models related to diagnostic count showed good fit for the data (all  $ps < .05$ ). Inmates with higher levels of Factor2 traits were 1.14 times more likely to have more abuse diagnoses (OR = 1.14,  $p = 0.016$ , 95% CI [1.03, 1.27]), with no significant relationship between Factor1 and abuse diagnosis counts ( $p = .914$ ). For dependence diagnosis counts, inmates with higher levels of Factor2 traits were 1.43 times more likely to have more dependence diagnoses (OR = 1.43,  $p < .001$ , 95% CI [1.29, 1.58]), while inmates with higher levels of Factor1 traits were 1.11 times more likely to have fewer dependence

diagnoses ( $OR = 0.90, p = .024, 95\% CI [0.81, 0.99]$ ). For total abuse or dependence diagnosis counts, inmates with higher levels of Factor2 traits were 1.30 times more likely to have more diagnoses ( $OR = 1.30, p < .001, 95\% CI [1.19, 1.43]$ ), with no significant relationship between Factor1 and total diagnoses ( $p = .127$ ).

### ***Substance use initiation***

In order to examine potential differences in the age at initiation of substance use as a function of subtypes of antisocial traits, linear regression models were used with ASI age of first use and z-scored PCL-R total and ESI scores simultaneously entered. Age was included as a covariate in these models. All linear regression models provided good fit for the data (all  $ps < .001$ ). PCL-R, but not ESI, scores were significantly associated with earlier alcohol use (PCL-R:  $B = -0.87, SE = 0.15, p < .001$ ; ESI:  $B = -0.14, SE = 0.15, p = .332$ ). PCL-R, but not ESI, scores were also associated with earlier use of cannabis (PCL-R:  $B = -1.14, SE = 0.11, p < .001$ ; ESI:  $B = -0.16, SE = 0.11, p = .152$ ). For opioids, PCL-R scores were associated with earlier use ( $B = -0.61, SE = 0.32, p = 0.049$ ), but there was no indication of a relationship with ESI ( $B = -0.33, SE = 0.30, p = .282$ ). Finally, PCL-R, but not ESI, scores were associated with earlier use for stimulants (PCL-R:  $B = -0.39, SE = 0.19, p = .034$ ; ESI:  $B = 0.05, SE = 0.18, p = .766$ ).

### ***Supplemental analysis using PCL-R factors***

Using PCL-R Factor1 and 2, all linear regression models provided good fit for the data (all  $ps < .001$ ). Factor2, but not Factor1, traits were associated with earlier alcohol use (Factor1:  $B = 0.03, SE = 0.15, p = .871$ ; Factor2:  $B = -1.17, SE = 0.15, p < .001$ ). Factor2, but not Factor1, traits were associated with earlier cannabis use (Factor1:  $B = 0.06, SE = 0.11, p = .616$ ; Factor2:  $B = -1.9343, SE = 0.12, p < .001$ ). Factor2, but not Factor1, traits were also associated with earlier opioid use (Factor1:  $B = -0.09, SE = 0.31, p = .770$ ; Factor2:  $B = -0.93, SE = 0.35, p = .008$ ). Finally, neither Factor2 nor Factor1 traits were associated with earlier stimulant use (Factor1:  $B = -0.10, SE = 0.19, p = .562$ ; Factor2:  $B = -0.35, SE = 0.20, p = .08$ ).<sup>6</sup>

## **Discussion**

The present study examined the relationships between two subtypes of antisocial traits, psychopathy and externalizing-only, and patterns of substance misuse. Results indicated that externalizing-only (and Factor2), but not psychopathic (and Factor1), traits were consistently associated with heightened severity of SUDs. However, both psychopathic and externalizing-only traits were associated with a heightened severity (i.e. dependence) of cannabis diagnosis. Additionally, psychopathic traits predicted younger age at initiation of use

across all substance categories. Overall, the results highlight the unique contributions of psychopathic and externalizing-only traits to SUD severity and age at initiation of substance use.

A substantial body of research demonstrates that the behaviors of individuals with psychopathic and externalizing-only traits stem from distinct psychobiological processes. The distinct patterns of SUD severity and age at substance use initiation found in the present study may similarly reflect these dissociable processes. Recognizing the importance of identifying homogeneous subtypes to inform treatment and prevention efforts (van der Kraan et al., 2014), investigators have traditionally drawn a distinction between an antisocial substance-abusing subtype and other substance-abusing subtypes (e.g. depressed/anxious; Mezzich et al., 1993). While there is strong support for this distinction, it may not be sufficient for specifying psychobiologically homogeneous subtypes, because antisocial behavior, like substance misuse itself, reflects diverse processes. In particular, a distinction based on emotionality may be valuable.

Throughout history, behavioral differences have been reported between emotionally stable and emotionally reactive antisocial subtypes (Karpman, 1941). Broadly, psychopathic and externalizing-only traits can be separated based on this emotionality dimension. Psychopathic traits reflect a callous, irresponsible disposition that stems from a lack of emotional depth. By contrast, externalizing-only traits align with heightened emotional reactivity, excessive reward seeking, intense hostility, and other strong urges that overwhelm inhibitory controls. Whereas the emotionally stable group fails to consider cues that normally initiate cognitive control (Zeier, Baskin-Sommers, Hiatt Racer, & Newman, 2012), the emotionally reactive type lacks the capacity to overcome their intense motivational and emotional reactions (Malterer, Glass, & Newman, 2008). Previous research demonstrates that negative emotionality mediates the relationship between antisocial traits and substance misuse, and this relationship is stronger for non-psychopathic, compared to psychopathic, individuals (Magyar, Edens, Lilienfeld, Douglas, & Poythress, 2011). Even though emotionality may be more strongly related to externalizing, some researchers suggest that two variants of psychopathy can also be identified partly on the basis of differences in emotionality: primary and secondary psychopathy (Blackburn, 1975; Karpman, 1948). The former is characterized by an inherited lack of emotional distress, and the latter is characterized by an acquired emotional hyperreactivity and associated with more severe substance abuse (Hicks, Markon, Patrick, Krueger, & Newman, 2004; Skeem, Johansson, Andershed, Kerr, & Louden, 2007; Vaughn, Edens, Howard, & Smith, 2009). Thus, particularly for externalizing-only, and possibly for secondary psychopathy, negative emotionality may be an important process that determines the severity of substance misuse.

Beyond emotionality, executive functions may also influence the differential associations between substance misuse and subtypes of antisocial traits. Individuals high on psychopathic traits demonstrate relatively intact executive

functions (Baskin-Sommers et al., 2015; Pera-Guardiola et al., 2016). By contrast, externalizing-only traits are associated with deficits in multiple components of executive functions (Endres, Donkin, & Finn, 2014). Poor executive functions have been implicated in more severe substance misuse, suggesting that deficits in executive functions contribute to the more problematic pattern of use in individuals with externalizing-only traits.

Unlike externalizing-only traits, psychopathic traits were less related to diagnosis severity and more related to earlier initiation of use. Though speculative, it may be that for psychopathic individuals, intact executive functions support the planning and implementation of more deliberate behavior to attain desired goals (e.g. trying something new). Moreover, their fearless disposition may make it more likely for psychopathic individuals to try something new but fail to associate that behavior with the consequences (Blair et al., 2004). The possibility that earlier engagement with substances may be more deliberate does not mean that psychopathic individuals do not experience problems associated with substance misuse. In fact, earlier use generally places individuals at higher risk for problems such as substance-related violence, injuries, intoxicated driving, and absenteeism from school or work (Gruber, DiClemente, Anderson, & Lodico, 1996). Moreover, early substance use increases the likelihood of adolescent involvement in the criminal justice system, and this involvement leads to a higher risk of continued deviance, in part due to restricted educational and employment opportunities (Bernburg & Krohn, 2003). Given the replicated association between Factor2, but not Factor1, of psychopathy and earlier initiation, it may be that impulsive action does influence the start of use. But, for psychopathic individuals, who have the added effects of Factor1 traits, earlier initiation may result from a failure to perceive consequences, rather than from the lack of premeditation commonly associated with externalizing. Taken together, it may be that emotional reactivity and impaired executive functions contribute to the severity of substance misuse in individuals high on externalizing-only traits, whereas fearlessness and failure to consider consequences promote the earlier initiation of use in individuals high on psychopathic traits.

Before concluding, it is important to note limitations of the present study. One limitation was the cross-sectional design, which constrained our ability to fully understand the temporal and causal relationships between antisocial traits and substance misuse. In addition, the retrospective nature of participants' reports of substance-related information may have diminished accuracy of reporting. Future studies using prospective design can examine developmental pathways of substance misuse and related antisocial traits. Finally, the present sample consisted of males only. Although the rates of criminal offending and substance misuse are higher in males, future research should examine patterns of substance misuse among subtypes of antisocial traits in female offenders (Schulz, Murphy, & Verona, 2015).

The present study delineated the associations of two subtypes of antisocial traits, psychopathic and externalizing-only, with patterns of substance misuse. While externalizing-only traits predicted greater SUD severity, psychopathic traits predicted earlier age at substance use initiation. The results point to the utility of dimensional characterization of both psychopathic and externalizing-only traits in antisocial groups, so as to better understand, predict, and, crucially, treat their unique substance-related problems. Substance misuse is not only costly, but, as the present study demonstrates, also heterogeneous, even among those exhibiting the most severe antisocial behavior. One way to address this heterogeneity is to consider substance misuse as a common outcome, but one that is achieved through different pathways based on antisocial subtypes (Brennan, Hyde, & Baskin-Sommers, 2017). Future research should continue to dissect antisocial traits and behaviors in various ways (e.g. psychopathy vs. externalizing, factors of psychopathy, four-facet model of psychopathy, aggressive vs. rule-breaking subtypes, primary vs. secondary psychopathy) in order to identify representative but unique patterns of substance misuse and the psychobiological influences on these patterns. The increased focus on specifying unique pathways to SUDs, rather than continuing to view these disorders as monolithic, represents an urgent priority for the development of more specific conceptualizations of substance-related problems in antisocial populations.

## Notes

1. To ensure that the results were not influenced by criterion contamination (given that the ESI items includes assessing substance use), new ESI total scores were calculated by removing items from the four substance subscales of the ESI. After removing the substance use items, all results related to severity, diagnosis count, and age of initiation were conceptually identical to those reported in the text.
2. For all substance types, effects remained significant after controlling for age.
3. When categorical diagnoses for Psychopathy and APD were used in multiple logistic regression models, the models for alcohol, cannabis, and stimulants provided good fit for the data (all  $ps < .001$ ). For alcohol, inmates who met criteria for APD were 2.06 times more likely to meet dependence over no diagnosis ( $OR = 0.49, p < .001, 95\% CI [0.36, 0.66]$ ), and were 1.36 times more likely to meet dependence over abuse ( $OR = 0.74, p = .056, 95\% CI [0.54, 1.01]$ ). Psychopathy was not associated with alcohol use diagnoses (all  $p$  values  $\geq .521$ ). For cannabis, inmates with an APD diagnosis were 1.90 times more likely to have dependence over abuse ( $OR = 0.53, p < .001, 95\% CI [0.39, 0.72]$ ), while psychopathy was not associated with cannabis use diagnoses (all  $p$  values  $\geq .148$ ). For stimulants, inmates with APD diagnoses were 1.72 times more likely to have dependence over no diagnosis ( $OR = 0.58, p = .001, 95\% CI [0.42, 0.81]$ ), and inmates with Psychopathy diagnoses were 1.57 times more likely to have stimulant dependence over no diagnosis ( $OR = 0.64, p = .017, 95\% CI [0.44, 0.92]$ ).
4. Effects remained significant when controlling for age.
5. Using categorical measures of psychopathy and APD, models for dependence and total diagnosis counts showed good fit (all  $ps < .01$ ). Psychopathy diagnoses were

not associated with dependence or total diagnosis counts (all  $p$  values  $\geq .449$ ). Individuals with APD diagnoses were 1.49 times more likely to have more substance dependence diagnoses (OR = 1.49,  $p < .001$ , 95% CI [1.25, 1.76]) and 1.25 times more likely to have more total SUD diagnoses (OR = 1.25,  $p = .006$ , 95% CI [1.07, 1.46]).

6. Using categorical measures of Psychopathy and APD, models for substance use initiation showed good fit (all  $ps < .001$ ). APD, but not psychopathy, diagnoses were significantly associated with earlier alcohol use (psychopathy:  $B = -0.55$ ,  $SE = 0.34$ ,  $p = .108$ ; APD:  $B = -1.71$ ,  $SE = 0.28$ ,  $p < .001$ ). APD, but not psychopathy, diagnoses were also associated with earlier use of cannabis (psychopathy:  $B = -0.46$ ,  $SE = 0.26$ ,  $p = .078$ ; APD:  $B = -2.01$ ,  $SE = 0.21$ ,  $p < .001$ ). Psychopathy, but not APD, diagnoses were associated with earlier opioid use (psychopathy:  $B = -0.76$ ,  $SE = 0.57$ ,  $p = 0.182$ ; APD:  $B = -1.45$ ,  $SE = 0.66$ ,  $p = .028$ ). Finally, neither APD nor psychopathy diagnoses were associated with earlier use for stimulants (psychopathy:  $B = -0.06$ ,  $SE = 0.41$ ,  $p = .885$ ; APD:  $B = -0.47$ ,  $SE = 0.35$ ,  $p = .177$ ).

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## Disclosure statement

No potential conflict of interest was reported by the authors.

## ORCID

Grace M. Brennan  <http://orcid.org/0000-0003-0246-0820>

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