



Distinct Psychological Profiles Linking Childhood Adversity and Substance Misuse in High-Risk Young Adults

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Abstract

Adverse childhood experiences (ACEs) constitute a key determinant in the development of substance misuse. However, the understanding of how ACEs cultivate this risk lacks the specificity needed to inform effective prevention and intervention practices. This issue may be remedied by exploring the distinction between ACEs and their effects on development. The present study investigated whether distinct patterns of adversity are differentially associated with substance misuse along unique profiles of psychological variables, namely anxiety and punishment sensitivity – an internalizing profile – versus reward sensitivity and executive functioning – an externalizing profile. Using a cross-sectional retrospective design, 124 high-risk young adults completed assessments of childhood adversity and psychological functioning. We employed the ACE-IQ to capture extended ACEs such as community and collective violence, as our sample grew up in the post-conflict society of Northern Ireland. Exploratory Factor Analysis revealed three patterns of adversity co-occurrence – Childhood Maltreatment, Household Dysfunction and Community Adversity, all of which independently predicted different types of substance misuse. Childhood Maltreatment was significantly associated with heavy drug use probability; Household Dysfunction was associated with cannabis dependence probability; and Community Adversity was associated with both cannabis dependence and heavy drug use probability. Logistic regressions (all $p < .05$) showed that heavy drug use probability was predicted by Childhood Maltreatment and anxiety in one model, and by Community Adversity and reduced punishment sensitivity in another, suggesting that different types of ACEs were associated with partially distinct outcomes in this sample. These results support the proposal that different ACE subtypes confer distinct effects, which carries clinical implications for substance misuse prevention and intervention.

Keywords Adverse childhood experiences · Childhood maltreatment · Household dysfunction · Community adversity · Substance misuse · Young adults

Introduction

Extensive research has established adverse childhood experiences (ACEs) as a risk factor for the development of myriad psychopathologies across the life course (Felitti et al., 1998;

Kessler et al., 2010). ACEs are distinguished as adverse experiences occurring before the age of 18, that have the potential to provoke severe or chronic stress as well as disrupt typical development (WHO, 2015). Examples of ACEs include emotional and physical neglect and abuse, sexual abuse, domestic violence in the home, bullying and growing up in violent communities. Specifically, evidence supports a link between early adverse experiences and the later development of substance misuse (Campbell et al., 2016; Fothergill et al., 2016; Herrenkohl et al., 2013; Merrick et al., 2020; Scheidell et al., 2018; Van Dam et al., 2014).

Researchers have advanced different theories as to how ACEs predispose the risk for substance misuse. One line of reasoning suggests that substance misuse may develop as a means of coping with the internalizing symptoms related to ACEs (Douglas et al., 2010; Mezquita et al., 2014; Turner

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et al., 2018; Yoon et al., 2017). Elsewhere, researchers have implicated increased reward sensitivity as the primary mechanism linking ACEs to substance misuse (Kim et al., 2017; Lovallo, 2013; Cicchetti & Handley, 2019). Cicchetti and Handley (2019) have addressed these two apparently incongruent theories as, respectively, the ‘internalizing’ and ‘externalizing’ pathways from ACEs to a given outcome. However, more information is needed to distinguish these profiles and understand the precipitating conditions that promote the development of one profile over another. Such inquiry may enhance the efficacy and relevancy of substance misuse prevention and intervention practices.

Adversity Subtypes

A growing area of research has argued that the heterogeneity in outcomes following ACEs, even the heterogeneity witnessed within a particular outcome such as substance misuse, can be accounted for by the type(s) of ACEs an individual has experienced – their “ACE profile”. One model that has contributed substantially to this area is the Dimensional Model of Adversity and Psychopathology (DMAP; Sheridan & McLaughlin, 2014). The DMAP proposes that ACEs may be differentiated as either threatening or depriving in the environment they create, with each exerting a partially distinct developmental impact as children (mal) adapt to their environment (Humphreys & Zeanah, 2015; Sheridan & McLaughlin, 2014). This way of conceptualising and distinguishing ACEs and their effects goes against the ‘total ACE score’ or ‘cumulative risk’ approach adopted by much of the extant literature, which some researchers suggest may mask the potentially unique impact of different ACEs (Machlin et al., 2019).

Though DMAP is nascent, evidence of distinct effects following threat versus deprivation is growing (Everaerd et al., 2016; Machlin et al., 2019; Miller et al., 2018). Threatening adversities include ACEs such as physical abuse and exposure to domestic violence. Some research has illustrated an association between this type of adversity and heightened punishment sensitivity, an effect which may increase susceptibility to internalizing disorders. In their seminal study, Shackman and colleagues (2007) tasked children with matching emotion labels to facial stimuli, while a second irrelevant emotion cue was simultaneously presented. They found that, compared to non-abused children, physically abused children over-attended to cues of anger, even when the cues were irrelevant to the task. This state of hyperarousal has been shown in some cases to predict the development of anxiety and other internalizing disorders (Briggs-Gowan et al., 2015; Johnson et al., 2003). Compounding these findings, some literature has shown that threatening experiences are a greater risk factor for the development of anxiety than depriving experiences (Coulge et al., 2010;

Miller et al., 2018), and it is possible that changes to punishment sensitivity are how this risk is mechanized (Miu et al., 2017).

Research has also been conducted into the potentially distinct effects of depriving experiences, such as caregiver and material neglect. Research indicates that experiences of deprivation promote a cognitive and behavioral preference for appetitive, rewarding stimuli (reward sensitivity; McNaughton & Gray 2000) through the degradation of executive function (EF) abilities. Emerging research suggests that EF deficits may be pronounced in individuals who have experienced deprivation (Lambert et al., 2017; Sheridan et al., 2017; Su et al., 2019), and in some cases this association has been shown to be stronger than in individuals who have experiences of threat (Su et al., 2019). In turn, EF deficits have been associated with the development of anomalous reward sensitive behaviors (Sandra & Otto, 2018; Ursache & Raver, 2015). Interestingly, the idea that threatening experiences may promote anxiety and punishment sensitivity, while depriving experiences may encourage reward sensitivity, aligns with the theory (Cicchetti & Handley, 2019) that substance misuse may be developed through internalizing symptoms on one hand or externalizing symptoms on the other hand.

Research beyond the DMAP model also supports the idea that distinct ACE subtypes exist, and that they are potentially germane to the development of certain outcomes. Using latent class analysis to organically examine ACE clusters, Shin and colleagues (2018) found four distinct classes of ACE – emotional adversity, household dysfunction/community violence, low adversity and high/multiple adversities. Other researchers have reported approximately similar types of clusters in their samples, dependent on the characteristics of their sample and the measures used to capture adversity (Brown et al., 2019; Lanier et al., 2018; Mersky et al., 2017; McLafferty et al., 2015; Rebbe et al., 2017).

Echoing the conclusions of the DMAP literature, some research in this area supports the view that different co-occurrences of ACEs lead to differential child health outcomes (Beal et al., 2019; Lanier et al., 2018; Lee et al., 2020; McLafferty et al., 2015; Xu et al., 2021). In their sample of adolescents, Lee and colleagues (2020) found evidence to suggest that the adversity cluster “child maltreatment” had greater associations with the outcomes of anxiety and depression than the cluster “household dysfunction”. Conflicting results have also been reported (Merians et al., 2019; Shin et al., 2018), which found that, compared to ACE clusters based on quantitative measurements (e.g. 5 or more), ACE clusters based on ACE type did not differentially predict outcomes. These divergent findings are perhaps not surprising given the variable ages of the samples and the differing social and cultural backgrounds from which they are drawn. Moreover, the current study does not seek to compare

the outcomes resulting from distinct ACE subtypes against those resulting from different levels of ACE frequencies; rather, it aims to explore differences of outcomes between distinct ACE subtypes. Our main interest is to examine the pattern of ACE co-occurrence and associated profiles in a sample of young adults who have grown up in a post conflict society of Northern Ireland (NI). This may in turn highlight different potential profiles that link adversity to substance misuse.

Present Study

Taken collectively, the research explored so far recommends that we should be looking not only at the quantity of ACEs an individual has experienced, but also the composition of these ACEs. The present study aimed to explore whether distinct patterns of ACE co-occurrence are associated with substance misuse through unique sets of variables. The variables examined in this study were selected based on the existing literature, which appears to endorse the predominance of internalizing outcomes for some ACE clusters, and externalizing outcomes for others. We chose to focus on current anxiety symptoms and punishment-sensitive behaviors on one hand, and reward-sensitive behaviors and EF capacity on the other, as these constructs were each analogous to the internalizing and externalizing variables focused on in the contemporary research. While we did not hypothesize the emergence of specific adversity clusters, the use of the ACE-IQ (WHO, 2015) instrument in this study – an extended measure that also captures community and collective violence – coupled with the history of violence in the region of NI, may make collective/community violence more likely to appear as a distinct cluster in this sample.

We investigated these profiles in a sample of young adults, as the research suggests this group may be more susceptible (Degenhardt et al., 2016) yet less equipped in terms of EF capacity (Schwartz & Petrova, 2019) than older adults to inhibit the drive to use substances. We used three variables to represent substance misuse as an outcome: heavy drug use, cannabis use and alcohol use. In Europe, alcohol and cannabis are more widely used than heavy drugs (National Advisory Committee on Drugs and Alcohol, 2016), and though all forms of substance misuse demonstrate potential harm to the user, these effects are seen more strongly and earlier in heavy drug use (Office for National Statistics, 2019). It was therefore important to give these subcategories independent assessment, even though theory anticipates ACEs should be associated with all substance misuse types (Evans et al., 2017). Finally, the present study controlled for gender in the analyses; previous research has denoted gender differences not only in the psychopathologic profile associated with ACEs, but also in the variables through which ACEs are associated with substance misuse (Hudson

et al., 2017; White & Kaffman, 2019). The exploration of such profiles may better elucidate the psychological scaffolding of substance misuse, helping to develop person-centred substance misuse prevention and intervention.

Methods

Study Design and Participants

The study employed a cross-sectional design, with a self-selection sampling method. Eligible participants had to be aged 18 to 25 and deemed at-risk for the development of outcomes typically associated with ACEs. Individuals were recruited via community support services in NI and the participants' engagement with these services was taken as indication of their high-risk status. These services were eclectic and ranged from organisations aimed at supporting young people back into education or work, to those that provided counselling and practical services for those with living with mental health issues, homelessness, and poverty. Potential participants were informed about the research through posters and workshops run by the researchers; they were able to signal their interest by informing their case worker or by contacting the researchers directly. Recruitment was ended when there were no more self-selectors. Participants were not able to proceed with the study if they were unable to sufficiently understand the questions with assistance from the researchers. Ethical approval was granted for the study by the Faculty of Engineering and Physical Sciences Research Ethics Committee, Queen's University Belfast.

One hundred and twenty-four participants completed the measures, with a mean age of 20.7 ($SD=2.37$). The sample comprised more males (56.8%) than females (42.4%) and nonbinary (0.8%) individuals. Out of the nine support services from which recruitment took place, over a third of participants (36.3%) were enrolled from multidisciplinary support services that focus on mental health, substance use reduction, employment, and reducing homelessness. Meanwhile, 16.1% of participants came from NEET (Not in Employment, Education or Training) reduction services, 14.5% came from homelessness services, 11.3% came from mental health services, and 9.7% came from crime rehabilitation services. 12.1% of participants did not provide their affiliated organization.

Measures

A digital questionnaire and assessment battery was administered to participants, containing instruments to capture the independent adversity variables and the dependent substance misuse variables. It also measured psychological variables

relating to internalizing and externalizing behaviors, in line with the existing research that shows different ACE subtypes may affect these factors differentially. This included measures of reward sensitivity, EF, anxiety, and punishment sensitivity. Informed consent was obtained from participants prior to commencing.

Adverse Childhood Experiences (ACEs) ACEs were assessed using items from the Adverse Childhood Experiences International Questionnaire (ACE-IQ; WHO, 2015). The ACE-IQ has 30 items designed to explore 13 domains of childhood adversity. The ACE-IQ improves upon the 10-domain ACE questionnaire employed in the seminal ACE study by Felitti and colleagues (1998) in terms of ACE coverage, by including peer, collective and community violence. As such, it has particular relevance to NI, a post-conflict region in which community violence remains prevalent (McAloney et al., 2009). A further improvement from the original version is that the ACE-IQ allows for scores to reflect frequency of occurrence, wherein the ACE is only counted if it is endorsed within specific frequency parameters (WHO, 2015). For example, a participant would be marked down as having experienced physical abuse if they answered any physical abuse item with “many times”. A total score was therefore a reflection of how many ACEs a participant experienced severely or chronically.

Substance Misuse The Cannabis Abuse Screening Test (CAST; Legleye et al., 2007) is a six-item questionnaire exploring the impact of recreational cannabis use in the past 12 months. A score of seven or more out of 24 indicated a heightened risk for cannabis dependence. Participants who met this criterion therefore formed the high-use cannabis group, labelled ‘Cannabis Dependence’. A tick-box drug screen was used to quantify how many drug types, apart from cannabis, a participant had misused within their lifetime; there were 10 possible drug classes that could be selected, including hallucinogens, opiates, and prescription drugs. Participants with a greater than average score ($M = 3.60$ – in this case rounded up to 4 as 3.6 is not a possible endorsement) on this questionnaire were classed into the high-use drug group, labelled ‘Heavy Drug Use’. The Alcohol Use Disorders Identification Test (AUDIT-10; Babor et al., 2001) is a 10-item tool for the identification of past-year problematic drinking. Scores of eight and more out of 40 were considered indicative of hazardous drinking (Babor et al., 2001). Therefore, participants who met this criterion were classed into the high-use alcohol group, labelled ‘Hazardous Alcohol Use’.

Anxiety Current anxiety symptoms were assessed using the anxiety subscale of the Depression and Anxiety Scale (DASS-21, Lovibond & Lovibond, 1995), which consisted

of seven items. These items sought to capture the physiological, emotional and personality dimensions related to anxiety experienced within the last week. The maximum score was 42, with scores greater than 15 suggesting severe anxiety (Lovibond & Lovibond, 1995). DASS-21 Anxiety is referred to as ‘Anxiety’ in the results section.

Executive Function (EF) The CANTAB (Cambridge Neuropsychological Test Automated Battery) spatial working memory task (Robbins et al., 1994) was used as a marker for EF. Participants completed a computerized search game, in which they were tasked with finding tokens hidden in boxes. Finding tokens with minimal box revisits required participants to retain and manipulate visuospatial information in their working memory. Participants completed two practice trials, followed by three assessed trials, between which the number of boxes increased to test working memory load. Between-search error scores were calculated from the number of revisits made to an empty box despite having found it to be empty in a previous trial. Final between-search error figures were derived from the mean scores across the three assessed trials. Participants with higher scores were deemed as having greater EF difficulties.

Reward and Punishment Sensitivity Reward and punishment sensitivity were assessed using Carver and White’s (1994) behavioral inhibition and activation (BIS/BAS) scale with modified scoring (Gray et al., 2016). The scale comprised 20 items exploring individual differences in reward and punishment sensitivity. There were three reward sensitivity (BAS) subscales: BAS-Fun-Seeking (FS), BAS-Reward Responsivity (RR), and BAS-Drive (D), while BIS-Anxiety (A) and BIS-Fear (F) were subscales of punishment sensitivity (BIS). Higher scores indicated greater endorsement. It should be noted that the BIS Anxiety subscale is related to behavioral motivation and personality and is seen as a risk factor for anxiety (Johnson et al., 2003), distinguishing it from the DASS-21 Anxiety score.

Analysis

The data was analyzed using IBM SPSS Statistics 26. All statistical assumptions were met. To explore which ACEs co-occur in our sample, principal axis factoring with oblique rotation was performed on the 13-domain ACE-IQ. As the ACE data was dichotomous, this was achieved by inputting a tetrachoric correlation matrix into the factor analysis, obtained using SPSS HETCOR. Sample size benchmarks recommend five to ten participants to every variable explored through factor analysis (Cattell, 1978; Everitt, 1975); this was reasonably satisfied with 124 participants to 13 variables. The KMO figure was adequate ($KMO = 0.52$) and Bartlett’s test of sphericity was significant ($p < .001$).

In accordance with the results of the factor analysis, three adversity variables were created: these variables were computed by adding together the items that clustered in each factor. Only those items that had a factor loading coefficient on or above 0.40 were computed into their respective variables.

The analysis of distinct profiles associated with substance misuse was achieved using hierarchical logistic regression. This strategy was chosen as it would illustrate the predictive effect of the variables on the dichotomous substance misuse outcomes. The regression models were built based on bivariate analyses run between the independent, indirect (psychological) and dependent variables. Acknowledging that ACE subtypes often co-occur, we examined their unique effects by adjusting for exposure to all subtypes of adversity simultaneously as recommended by Sheridan and colleagues (2020). The analyses run between the independent and dependent variables were subject to the Bonferroni correction, such that the adjusted p value was 0.0056. The correlations run between the indirect variables were also compared to an adjusted p value of 0.0071. Logistic regression models were only built for those variables that showed significant bivariate associations. By inputting the variables hierarchically, we hoped to illustrate the relative contribution of the variables to the dependent variables. In cases where adding the indirect variable to the model reduced the predictive effect of the independent variable on the dependent variable, potential mediation by the indirect variable was suspected.

Results

Exploratory Factor Analysis

Table 1 shows the existence of three distinct adversity clusters in the sample. Factor 1, labelled ‘Childhood Maltreatment’, included items that implied exposure to interpersonal abuse and neglect. The items within Factor 2, labelled ‘Household Dysfunction’, indicated a household environment characterised by instability and possibly a lack of optimal parental care. The items ‘community violence’ and ‘collective violence’ formed Factor 3, labelled ‘Community Adversity’. The item ‘childhood sexual abuse’ loaded onto ‘Childhood Maltreatment’ with a coefficient of 0.34. It was therefore not included in either of the three adversity variables.

Descriptive Statistics

Adversity On average, participants endorsed around 5 total ACEs ($M = 5.34$, $SD = 2.97$), confirming the sample as one that experienced a high level of adversity during childhood. Looking at the adversity subtypes, 80.6% of participants

Table 1 Results of adverse childhood experiences – International Questionnaire (ACE-IQ) principal axis factoring

ACE-IQ Adversity	Childhood Maltreatment	Household Dysfunction	Community Adversity
Emotional Abuse	0.96		
Physical Abuse	0.71		
Domestic Violence	0.58		
Bullying	0.53		
Physical Neglect	0.52		
Emotional Neglect	0.42		
Household Incarceration		0.84	
Household Substance Use		0.71	
Parental Death/Divorce		0.67	
Household Mental Illness		0.59	
Community Violence			0.97
Collective Violence			0.54
Eigenvalues	4.91	1.53	1.89
% Variance	37.8%	11.8%	14.5%
Cronbach’s α	0.68	0.66	0.47

Note. The item ‘Sexual Abuse’ is not displayed as it failed to load to any factor

experienced 1 or more adversities in the Childhood Maltreatment cluster; this figure was 79.8% for the Household Dysfunction cluster and 64.5% for the Community Adversity cluster.

Substance Misuse Results indicate that in this sample, cannabis was the most prevalent substance of misuse, with 51.6% of the sample falling into the Cannabis Dependence category, followed by 30.6% in the Heavy Drug Use category, and lastly, 21.7% in the Hazardous Alcohol Use category. Cronbach’s alpha scores indicated the substance misuse measures had good to excellent levels of internal consistency (0.92, 0.89 and 0.88 respectively).

Psychological Variables Descriptive statistics for the Anxiety, BIS/BAS and EF measures are presented in Table 2.

Gender

A multivariate ANOVA test was performed to compare adversity patterns between men and women. The non-binary gender group was too small to be included for gender comparisons. Men endorsed significantly higher rates of Community Adversity ($M = 1.15$, $SD = 0.82$) compared to women ($M = 0.63$, $SD = 0.69$; $F(1, 121) = 13.8$, $p < .001$, partial $\eta^2 = 0.13$), but there were no significant gender differences in reports of Childhood Maltreatment and Household Dysfunction. Pearson chi square tests revealed that rates of Cannabis Dependence ($\chi^2(1, N = 123) = 4.23$, $p = .04$) and Heavy

Table 2 Descriptive statistics for the indirect variables: Anxiety, the BIS/BAS subscores and EF

Variables	Mean	SD	Range	Cronbach's α
Anxiety	12.7	10.4	0–38	0.85
BIS-A	10.3	3.86	0–15	0.84
BIS-F	2.98	1.99	0–6	0.60
BAS-FS	8.92	2.52	3–12	0.73
BAS-RR	11.8	2.50	6–15	0.70
BAS-D	7.42	2.92	0–12	0.79
EF	14.8	9.78	0–41	----

Note. Behavioural Inhibition System (BIS) scores are scores that reflect Punishment Sensitivity; the subscores displayed here represent the Anxiety (-A) and Fear (-F) components of BIS. Behavioural Activation System (BAS) scores reflect Reward Sensitivity; the subscores represent the Fun-Seeking (-FS), Reward Responsivity (-RR) and Drive (-D) components of BAS. EF stands for Executive Function

Drug Use ($\chi^2(1, N = 123) = 4.00, p = .045$) were significantly higher among men compared to women with no other gender differences within substance misuse. Punishment Sensitivity (BIS-A) was significantly higher among women ($M = 11.5, SD = 3.55$) in the sample ($F(1, 121) = 8.67, p = .004$, partial $\eta^2 = 0.07$), compared to the men ($M = 9.45, SD = 3.87$). There were no significant gender differences along the remaining indirect variables.

Bivariate Analyses

In order to develop the logistic regression models, associations between the independent and dependent variables (Table 3), the independent and indirect variables (Table 4), and the dependent and indirect variables (Table 5) were investigated. Table 3 shows that growing up with Childhood Maltreatment was significantly associated with Heavy Drug Use whereas Household Dysfunction was significantly associated with Cannabis Dependence. Growing up with Community Adversity was significantly associated with both types of substance misuse. None of the adversity dimensions were associated with Hazardous Alcohol Use.

Childhood Maltreatment demonstrated significant, positive associations with Anxiety and Punishment Sensitivity (BIS-A) scores (Table 4). Household Dysfunction was positively correlated with Anxiety and negatively correlated with Reward Sensitivity (BAS-RR and BAS-FS), and a negative association with Punishment Sensitivity (BIS-A and BIS-F). Contrary to expectation, EF was not associated with any of the variables.

Anxiety was associated with both the Heavy Drug Use and Cannabis Dependence groups. Reduced Punishment

Table 3 T-test results comparing adversity scores between low and high substance misuse groups

		Low-High Heavy Drug Use	Low-High Cannabis Dependence	Low-High Hazardous Alcohol Use
Childhood Maltreatment	<i>t</i> value (<i>df</i>)	3.20 (122)	1.58 (122)	1.85 (122)
	<i>p</i>	0.002*	0.12	0.07
Household Dysfunction	<i>t</i> value (<i>df</i>)	2.42 (122)	3.15 (122)	2.03 (122)
	<i>p</i>	0.017	0.002*	0.05
Community Adversity	<i>t</i> value (<i>df</i>)	3.68 (122)	4.06 (122)	0.34 (122)
	<i>p</i>	< 0.001*	< 0.001*	0.74

Note. * denotes significance to the adjusted *p* value of 0.0056

Table 4 Pearson's product-moment correlations between primary independent variables and the indirect variables

		Anxiety	BIS-A	BIS-F	BAS-FS	BAS-RR	BAS-D	EF
Childhood Maltreatment	<i>r</i>	0.39	0.30	0.15	0.002	-0.15	-0.12	-0.07
	<i>p</i>	< 0.001*	0.001*	0.10	0.98	0.10	0.20	0.44
Household Dysfunction	<i>r</i>	0.17	-0.01	0.06	0.05	0.04	-0.18	0.05
	<i>p</i>	0.054	0.88	0.50	0.58	0.67	0.03*	0.57
Community Adversity	<i>r</i>	0.10	-0.26	-0.17	0.28	0.23	0.14	0.02
	<i>p</i>	0.28	0.004*	0.05*	0.002*	0.009*	0.12	0.84

Note. * denotes significance to the 0.05 level. The indirect variables are Anxiety, Punishment Sensitivity, Reward Sensitivity and Executive Function (EF). Behavioural Inhibition System (BIS) scores are the scores that reflect Punishment Sensitivity; the subscores displayed here represent the Anxiety (-A) and Fear (-F) components of BIS. Behavioural Activation System (BAS) scores reflect Reward Sensitivity; the subscores represent the Fun-Seeking (-FS), Reward Responsivity (-RR) and Drive (-D) components of BAS

Sensitivity was also associated with Heavy Drug Use (see Table 5).

Analyses of the indirect variables indicated that Anxiety was significantly associated with both measures of Punishment Sensitivity (both $r = .39$). The Punishment Sensitivity scores themselves were also highly correlated ($r = .45$). One measure of Punishment Sensitivity, BIS-F, was negatively related to Reward Sensitivity, through BAS-D ($r = .47$) and

BAS-FS ($r = .34$). All three Reward Sensitivity measures were significantly interrelated ($0.58 \leq r \leq .65$). EF was not associated with any of the indirect variables.

Logistic Regression Models

Logistic regressions were performed to test the contribution of (1) Childhood Maltreatment and Anxiety, and (2) Community Adversity and reduced Punishment Sensitivity, to the likelihood of Heavy Drug Use.

Table 5 T-test results comparing indirect variables between high-low substance misuse groups

		Low-High Heavy Drug Use	Low-High Cannabis Dependence
Anxiety	<i>t</i> value (<i>df</i>)	2.70 (122)	2.88 (122)
	<i>p</i>	0.008*	0.005*
BIS-A	<i>t</i> value (<i>df</i>)	2.20 (122)	1.29 (122)
	<i>p</i>	0.03*	0.20
BIS-F	<i>t</i> value (<i>df</i>)	1.09 (122)	0.04 (122)
	<i>p</i>	0.28	0.97
BAS-FS	<i>t</i> value (<i>df</i>)	1.96 (122)	1.59 (122)
	<i>p</i>	0.052	0.11
BAS-RR	<i>t</i> value (<i>df</i>)	0.52 (122)	0.04 (122)
	<i>p</i>	0.61	0.97
BAS-D	<i>t</i> value (<i>df</i>)	1.41 (122)	0.50 (122)
	<i>p</i>	0.16	0.62
EF	<i>t</i> value (<i>df</i>)	0.31 (111)	1.18 (111)
	<i>p</i>	0.76	0.24

Note. * denotes significance to the 0.05 level. The indirect variables are Anxiety, Punishment Sensitivity, Reward Sensitivity and Executive Function (EF). Behavioural Inhibition System (BIS) scores are the scores that reflect Punishment Sensitivity; the subscores displayed here represent the Anxiety (-A) and Fear (-F) components of BIS. Behavioural Activation System (BAS) scores reflect Reward Sensitivity; the subscores represent the Fun-Seeking (-FS), Reward Responsivity (-RR) and Drive (-D) components of BAS

Childhood Maltreatment and Heavy Drug Use The Childhood Maltreatment Model (Table 6) shows the contribution of Childhood Maltreatment and Anxiety to the likelihood of Heavy Drug Use. As expected, Childhood Maltreatment made an independent and significant contribution to the probability of Heavy Drug Use ($Exp(B) = 1.64, p = .003$). Adding Anxiety to the model reduced the significance of Childhood Maltreatment ($Exp(B) = 1.53, p = .01$) in predicting Heavy Drug Use, suggesting that Anxiety may partially mediate the association between Childhood Maltreatment and Heavy Drug Use. Childhood Maltreatment and Anxiety accounted for 10.7% of the variance in the likelihood of Heavy Drug Use, over and above the control variables.

Community Adversity and Heavy Drug Use The Community Adversity Model (Table 7) suggests that Community Adversity and reduced Punishment Sensitivity were significant in predicting the likelihood of Heavy Drug Use. The effect of Community Adversity was significant, associated with an over two-fold increased probability of Heavy Drug Use ($Exp(B) = 2.16, p = .007$). When reduced Punishment Sensitivity scores were added, the significance of Community Adversity was reduced ($Exp(B) = 1.78, p = .053$), indicating a potential for partial mediation. Community Adversity and reduced Punishment Sensitivity accounted for 10.8% of

Table 6 Summary results from logistic regression with Childhood Maltreatment and Anxiety as independent variables and Heavy Drug Use as the dependent variable

Variable	Step 1			Step 2			Step 3		
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>
Gender	-0.41	0.47	0.38	-0.51	0.50	0.30	-0.61	0.52	0.24
Household Dysfunction	0.34	0.16	0.03*	0.10	0.19	0.58	0.11	0.19	0.57
Community Adversity	0.73	0.29	0.01*	0.67	0.29	0.02*	0.57	0.30	0.053
BIS-A	-0.06	0.06	0.27	-0.15	0.07	0.03*	-0.22	0.08	0.004*
Childhood Maltreatment				0.49	0.17	0.003*	0.42	0.17	0.01*
Anxiety							0.06	0.03	0.01*
Cox & Snell R ²	14.8			21.6			25.5		

Note. * denotes significance to the 0.05 level. This was a three-step analysis: control variables were inputted at Step 1, followed by the primary independent variables at Step 2, and the indirect variables at Step 3. The control variables in this analysis were gender, Household Dysfunction, Community Adversity and BIS-A. BIS-A stands for Behavioural Inhibition System (Anxiety) and is a measure of Punishment Sensitivity

Table 7 Summary results from logistic regression with Community Adversity and Punishment Sensitivity as independent variables and Heavy Drug Use as the dependent variable

Variable	Step 1			Step 2			Step 3		
	$\chi^2(4) = 19.7, p = .001$			$\chi^2(5) = 27.5, p < .001$			$\chi^2(6) = 36.6, p < .001$		
	B	SE	p	B	SE	p	B	SE	p
Gender	-1.07	0.46	0.02*	-0.73	0.49	0.13	-0.61	0.52	0.24
Household Dysfunction	0.22	0.18	0.22	0.20	0.19	0.28	0.11	0.19	0.57
Childhood Maltreatment	0.25	0.15	0.09	0.27	0.15	0.08	0.42	0.17	0.01*
Anxiety	0.04	0.02	0.08	0.04	0.02	0.11	0.06	0.03	0.01*
Community Adversity				0.77	0.28	0.007*	0.57	0.30	0.053
BIS-A							-0.22	0.08	0.004*
Cox & Snell R ²	14.7			19.9			25.5		

Note. * denotes significance to the 0.05 level. This was a three-step analysis: control variables were inputted at Step 1, followed by the primary independent variables at Step 2, and the indirect variables at Step 3. The control variables in this analysis were gender, Household Dysfunction, Childhood Maltreatment and Anxiety. BIS-A stands for Behavioural Inhibition System (Anxiety) and is a measure of Punishment Sensitivity

the variance in the likelihood of Heavy Drug Use, over and above the control variables.

Discussion

The present study aimed to investigate whether distinct patterns of ACE co-occurrence exist in a sample of high-risk young adults, and importantly, whether these patterns are associated with differential profiles related to substance misuse. Factor analysis revealed three patterns of adverse experiences in our sample, which we labelled Childhood Maltreatment, Household Dysfunction and Community Adversity. All patterns were significantly and directly associated with an increased likelihood of substance misuse. The hypothesis that these distinct ACE clusters would be associated with distinct profiles was upheld: Child Maltreatment and anxiety were associated with Heavy Drug Use in one model, while Community Adversity and decreased punishment sensitivity were associated with Heavy Drug Use in another – importantly, both models controlled for variables in the other model. There was also evidence of potential partial mediation by anxiety and reduced punishment sensitivity in these respective relationships. Both Household Dysfunction and Community Adversity were related to an increased likelihood of Cannabis Dependence; however, there were no psychological variables that were associated with both Cannabis Dependence and either of the ACE clusters, so they were not examined using logistic regression. We also found no evidence that any pattern of adversity was associated with heightened levels of alcohol consumption. The cultural normalization of dangerous alcohol consumption in the Northern Irish context (Northern Ireland Assembly, 2020) may be one explanation for the non-significant effect

of high adversity, anxiety, punishment, and reward sensitivity on this health-harming behavior in our sample.

The adversity clusters found in the present study both converge and diverge from the existing work on ACE clusters. Childhood Maltreatment, Household Dysfunction and Community Adversity – the subtypes which emerged from our sample – are approximately parallel to the ACE clusters reported in other samples (Beale et al., 2019; Brown et al., 2019; Mersky et al., 2017; Rebbe et al., 2017; Xu et al., 2021). For example, research by Merians and colleagues (Merians et al., 2019) found “high ACEs”, “Non-Violent Household Dysfunction”, “Emotional and Physical Abuse” and “Low ACEs” to be the primary ACE subtypes in their sample. Moreover, the clusters of Childhood Maltreatment and Household Dysfunction are partially depictive of the “threat” and “deprivation” clusters that have been put forward by proponents of the DMAP model (Everaerd et al., 2016; Machlin et al., 2019). However, in the present results, physical and emotional neglect loaded together with exposures to abuse and violence, which does not marry in with the “threat – deprivation” typology as proposed by Sheridan & McLaughlin (2014). On the other hand, “Childhood Maltreatment”, as a variable capturing both abuse and neglect, has emerged as an important ACE cluster in other studies that are data-driven (Brown et al., 2019; Lee et al., 2020; Shin et al., 2018). For example, a data-driven study by some of the same researchers who have worked on the DMAP model showed that neglect- and abuse-type adversities tended to cluster together, while parental education status and other indicators of socio-economic status tended to be more reflective of deprivation (Sheridan et al., 2020). It is possible that the differences between the dimensions proposed by the DMAP model and the patterns found in the present study are reflective of a functional difference

between the theory-driven approach of earlier DMAP work and the data-driven approach used here.

Notably, all of the adversities in the ACE-IQ loaded significantly onto one of the three clusters we found, with the exception of child sexual abuse. The contribution of sexual abuse to the factor Childhood Maltreatment fell just below the employed threshold (>0.40), suggesting it most closely aligns with this factor. This would appear to reflect other data-driven research in which sexual abuse clusters with other interpersonal maltreatment types (Beale et al., 2019; Lee et al., 2020). It may be that the exploration of adversity patterns in a larger sample would reveal child sexual abuse to load substantially onto Childhood Maltreatment. It is also possible that child sexual abuse would emerge as its own unique factor, as it may be that environments in which child sexual abuse occurs may be distinct to other environments of adversity.

Another way in which our ACE patterns differed from some of the existing research was the emergence of Community Adversity as a distinct cluster, reflecting experiences of community and collective violence. The inclusion of Community Adversity as a distinct ACE pattern of co-occurrence in this sample is likely reflective of the use of the ACE-IQ, a measurement of adversity that captures community and collective violence. Much of the existing literature excludes these types of adversity, despite evidence that they exert effects that are at least partially unique to other forms of adversity (Cronholm et al., 2015; Margolin et al., 2010). Where researchers have included measures of community and collective violence in their studies, they have identified similar Community Adversity-type patterns in their samples (Lee et al., 2020; Shin et al., 2018) - though one of these studies did find community adversities to cluster with adversities of household dysfunction (Shin et al., 2018). Further explaining the emergence of community adversity as a distinct cluster, collective violence and community deprivation are endemic to the NI context (Bunting et al., 2013; McLafferty et al., 2016), thus increasing the likelihood that Community Adversity would appear as a significant experience within the sample. Collectively, the results of the factor analysis show that ACEs may be organized into distinct subtypes; further, the emergence of Community Adversity suggests that the composition of these ACE patterns may also be dependent on the measurements used to capture adversity and the demographic attributes of the population from which the data is drawn.

The hypothesis that these distinct ACE patterns would be associated with distinct psychological profiles germane to substance misuse was largely substantiated. This hypothesis was founded on the present research, including research on the DMAP model, which have evidenced at least partially distinct outcomes between individuals who have experienced unique types of adversities (Beale et al., 2019; Lee et al.,

2020; Miller et al., 2018; Su et al., 2019). In the present sample, greater exposure to Childhood Maltreatment and recent anxiety symptoms increased the likelihood of Heavy Drug Use, when controlling for other adversity subtypes and psychological variables. There was also evidence that anxiety may partially mediate the relationship between Childhood Maltreatment and Heavy Drug Use. This is consistent with the literature: children exposed to violent behavior and harm are more likely to develop anxiety (Cogle et al., 2010; Miller et al., 2018), which has been shown in turn to heighten the risk of substance misuse (Turner et al., 2018). Though anxiety was relevant to the association between the Childhood Maltreatment and Heavy Drug Use, the results did not substantiate the relevance of punishment sensitivity to this relationship. Had Childhood Maltreatment aligned more closely with the DMAP conceptualization of “threat”, this association may have manifested in our results. On the other hand, this result may be explicable with further exploration into the concept of punishment sensitivity: punishment sensitivity is thought to represent a stable personality ‘trait’, unlike anxiety which represents a temporary psychological ‘state’ (Lau et al., 2006). It is possible that the more intense ‘states’ of the construct – i.e., anxiety – may be more pertinent than ‘traits’ to the development of substance misuse in the context of Childhood Maltreatment-type adversities. This non-significant association aside, the results support the existence of a distinct psychological profile linking Childhood Maltreatment to substance misuse.

The present study also found that Community Adversity and reduced punishment sensitivity were associated with Heavy Drug Use, independent of other adversity and psychological variables. This result is difficult to compare to the existing literature, as not many previous studies have explored the distinct outcomes of Community Adversity. For example, Shin and colleagues (Shin et al., 2018) found community violence and household dysfunction as a pattern of adversity in their sample; as they did not find community violence/adversity as an isolated cluster, it is not possible to compare our results to theirs. In the context of the DMAP model, Community Adversity can be seen as most synonymous with “deprivation”; previous literature (Oshri et al., 2018; Ursache & Raver, 2015) documents a relationship between experiences of deprivation and reward/punishment sensitivity dysregulation, similar to what is observed here. However, the mechanisms that link Community Adversity to anomalous punishment/reward sensitivity may be different to the mechanisms that link it to experiences of deprivation.

Some previous research has suggested that experiences of Community Adversity are linked to behaviours akin to reduced punishment sensitivity. Impulsivity, the inability to both inhibit potentially risky impulses and heed future consequences (Bakhshani, 2014), has been associated with high levels of exposure to community violence (Lambert et al.,

2010, 2021; Musci et al., 2019). This construct is similar to blunted punishment sensitivity, as both feature a disregard for risk in decision-making. Other studies have suggested that exposure to community violence is linked to increased reward sensitivity (Gudiño et al., 2012) and risk-taking (Estrada et al., 2021) – though this finding was not observed in the present study, the dampened punishment sensitivity we found may imply a similar reduced regard for risk in individuals exposed to Community Adversity. Interestingly, Lambert and colleagues (2010, 2021) note that it is possible punishment-insensitive traits such as impulsivity can precede and predict exposure to Community Adversity. It is not possible to test whether reduced punishment sensitivity in the current study predicts or emerges from exposure to Community Adversity; however, the idea that reduced punishment sensitivity may increase the likelihood of involvement or exposure to Community Adversity fits in with the bioecological framework of childhood adversity (Bronfenbrenner & Morris, 2006), which emphasises the importance of individual-level factors such as personality in determining the incidence and effects of experiences in childhood.

Implications

The findings produced by this study, once replicated and fortified by further research, may be germane to both theory and practice regarding adversity and substance misuse. Firstly, the meaningful discrimination of ACEs may help to explain the variations in risk that are often observed in the sequelae of ACEs. Future research that accounts for ACE differences may be better equipped to explore the mechanisms that link ACEs to unfavourable outcomes. Moreover, primary care providers may use this information to identify different ACE profiles in their clients and tailor the focus of their treatment accordingly. Secondly, these results endorse more than one mechanism to substance misuse, which challenges the dominance of reward-related theories in the substance misuse literature. In terms of clinical practice, substance misuse interventions may be able to increase their effectiveness and sustainability by specifically targeting the psychological variables that are most relevant to the adversity profile of their service user.

Strengths and Limitations

The results of the study should be interpreted with reference to its strengths and limitations. The data reported here formed distinct profiles that were in keeping with the concept that different subtypes of ACEs confer unique risks (Beale et al., 2019; Sheridan & McLaughlin 2014; Sheridan et al., 2020). This finding may contribute to a larger body of research that informs practice in the area of substance misuse prevention and intervention. Moreover, the study was

able to investigate these profiles in a clinically significant population. The prevalence and impact of substance misuse in at-risk young adults is high, so information obtained from this sample may shape interventions to disrupt the development of substance misuse most effectively within a key period. Lastly, we adopted the use of the ACE-IQ, which recognises a greater range of adversities than traditional ACE measures – this is in line with the growing thought that greater cross-cultural validity is needed across the ACE measurement research (Mersky et al., 2017).

On the other hand, the present study was limited by its design. A cross-sectional design meant that causation, and the direction of causation, could not be inferred between the independent and dependent variables. This is important, as it means we do not have a full picture of the distinct profiles that link adversities to substance misuse. Moreover, our substance misuse variables were inconsistent in their period of measurement: alcohol and cannabis use questions were past-year only, while heavy drug use questions looked at lifetime use. This discrepancy means that it is not possible to conclude that Heavy Drug Use did not precede instances of adversity or psychopathology (e.g. anxiety) in some cases. However, as the average age of Heavy Drug Use initiation in our sample was 15 years, it is likely that adversity preceded Heavy Drug Use for some of our participants. Finally, the sample used to test the hypothesized profiles was small, warranting further testing of the current findings with larger sample sizes.

Future Directions

While the findings reported here are modest and subject to limitations, they do encourage further research. The profiles investigated would benefit from mediational analysis or longitudinal inquiry, which may capture the temporal sequence between adversity and substance misuse. Future work may also expound upon the findings presented here by exploring the distinct effects of ACE structures on other areas of functioning. Moreover, the use of the ACE-IQ and the finding that Community Adversity is uniquely related to substance misuse, may encourage future research to use expanded ACE measures in their studies of adversity outcomes. Finally, Childhood Maltreatment, Household Dysfunction and Community Adversity predicted different forms of substance misuse, an outcome that was not forecast by theory. It could be conjectured that the distinct developmental changes produced by different types of adversity have an impact on the motivation to use substances; for example, an individual may become more biologically prone to seek either a stimulatory or a depressive effect. This finding may be developed by further research, which may shed further light on the profiles linking adversity to substance misuse.

Conclusions

The present study sought to analyze how distinct patterns of adversity are related to substance misuse in a sample of high-risk young adults. It was expected that the emergent subtypes would be associated with substance misuse through profiles of unique psychological variables, and these expectations were partly reflected in the results. Heavy Drug Use was predicted by Childhood Maltreatment and anxiety in one profile, and Community Adversity and reduced punishment sensitivity in another. These findings indicate that the unique characteristics of different adversities may shape development in a way that is distinct and clinically significant. Exploring these trajectories may provide valuable information to substance misuse prevention and intervention efforts as to what components should be targeted in which individuals, allowing the development of person-centred practice.

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