Rumination and problematic substance use among individuals with a long-term history of illicit drug use

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ABSTRACT

Background: Rumination is a cognitive process that is implicated in the development and maintenance of various forms of psychopathology, including problematic substance use. Most studies on the role of rumination in substance use have been conducted among community samples or individuals with alcohol use disorders and have predominately focused on overall rumination rather than differentiating between its subtypes, ruminative brooding and ruminative reflection. The current study therefore aimed to investigate i) whether rumination subtypes are associated with problematic substance use among people with a long-term history of illicit drug use independently of related psychological disorders (depression and post-traumatic stress disorder [PTSD]), and ii) whether gender moderates these relationships.
Methods: This cross-sectional study used data from the Australian Treatment Outcome Study (ATOS); a naturalistic prospective cohort study of people with heroin dependence. At the 11-year follow-up of ATOS, a total of 380 participants completed measures of rumination, depression, PTSD, and indices of problematic substance use.
Results: Hierarchical logistic regression analyses indicated that higher brooding scores were associated with current heroin dependence (OR = 1.11, CI: 1.01–1.22), polydrug use (OR = 1.16, CI: 1.06–1.28) and experience of injection related health problems (OR = 1.08, CI: 1.00–1.17), independently of depression, PTSD, and other covariates. Reflection was not related to any of the substance use measures. These results were not moderated by gender.
Conclusions: Findings indicate that ruminative brooding is related to a poorer substance use profile among people with long-term illicit drug use and highlight the potential benefits of targeting brooding during substance use treatment.

1. Introduction

Substance use and misuse are major contributors to the global burden of disability and premature death (Degenhardt et al., 2013). Among individuals with substance use disorders (SUDs), comorbidity with other mental health conditions such as depressive and anxiety disorders is highly common (Lai et al., 2015) and is associated with added clinical complexity and severity (Teesson et al., 2009). The high rate of comorbidity between these disorders suggests the existence of shared risk factors that underpin their development and maintenance. Efforts to identify such shared or "transdiagnostic" risk factors have considerable appeal, as interventions designed to target these factors have the potential to prevent the onset or relapse of multiple disorders

(Nolen-Hoeksema and Watkins, 2011). Indeed, there is growing emphasis on the development of treatments that simultaneously target underlying processes common to various disorders (e.g. Barlow et al., 2004; Dear et al., 2011; Sofuoglu et al., 2016). One such process, which is gaining increasing attention, is rumination.

Rumination is a cognitive process that involves passive and repetitive self-questioning about the symptoms, causes and consequences of one's emotional distress (Nolen-Hoeksema, 1991). Rumination has traditionally been studied in relation to depression, and its role in the development, severity and persistence of depressive symptoms is well established (Nolen-Hoeksema et al., 2008; Watkins, 2008). It is increasingly acknowledged, however, that rumination is an important transdiagnostic risk factor that is implicated in psychopathology more

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broadly, including in various anxiety, eating, and SUDs (Aldao et al., 2010; Johnson et al., 2016; Nolen-Hoeksema and Watkins, 2011).

Studies on rumination and substance use indicate that higher levels of rumination are related to more problematic substance use both cross-sectionally (Caselli et al., 2008; Willem et al., 2011) and longitudinally (Adrian et al., 2014; Caselli et al., 2010; Nolen-Hoeksema and Harrell, 2002; Nolen-Hoeksema et al., 2007). To date, these studies have predominately relied on the traditional conceptualization of rumination as a unitary construct, as measured by the Ruminative Responses Scale (RRS; Nolen-Hoeksema and Morrow, 1991). This approach to assessing rumination is potentially problematic, however, as certain items of the RRS have been found to overlap with depressive symptoms (Treynor et al., 2003). Furthermore, there is considerable evidence that rumination is not a unitary, uniformly maladaptive construct (Bagby et al., 2004; Cox et al., 2001; Roberts et al., 1998; Watkins, 2008). Most influentially, a factor analysis of the RRS by Treynor et al. (2003) found that rumination consists of two subtypes, "brooding" and "reflection". Brooding involves the tendency to passively focus on one's mood in a judgmental and self-critical manner, while reflection involves a more active examination of one's feelings as an attempt at problem solving.

Research has consistently indicated that brooding is a maladaptive form of rumination. It has been shown to be associated with depression (Burwell and Shirk, 2007; Raes, 2010), suicidal ideation (Chan et al., 2009; O'Connor and Noyce, 2008), generalized anxiety disorder and obsessive compulsive disorder (Watkins, 2009). Findings on reflection have been mixed, with some studies indicating a relationship to depression (Joormann et al., 2006; Siegle et al., 2004) and suicidal ideation (Miranda and Nolen-Hoeksema, 2007), while others have failed to find these relationships (Burwell and Shirk, 2007; O'Connor and Noyce, 2008). There is some evidence to suggest that reflection may actually be adaptive and predict a decline in depression symptoms over time (Treynor et al., 2003) and recovery from a depressive episode (Arditte and Joormann, 2011). Thus, focusing on rumination subtypes rather than overall rumination is arguably a clinically useful approach that may help identify the type of ruminative thinking that is more likely to be maladaptive and should be addressed in treatment.

To date, only three studies have distinguished between the rumination subtypes when investigating the relationship between rumination and substance use, all of which were conducted with samples of community adolescents. In a cross-sectional study, Willem et al. (2011) found that independent of depressive symptoms, higher levels of brooding were related to the negative consequences of substance use, but not to higher drug consumption. Conversely, higher levels of reflection were associated with lower drug consumption. In a subsequent longitudinal study, however, brooding and reflection had no impact on drug consumption over time but higher levels of brooding were unexpectedly related to a subsequent decline in alcohol consumption (Willem et al., 2014). The longitudinal relationship between rumination subtypes and substance use may be indirect, however, as shown by a study which found that among adolescents, depressive symptoms predict an increase in ruminative brooding and reflection, which are in turn differentially related to later SUDs (Adrian et al., 2014). Specifically, increases in brooding predicted subsequent marijuana use disorder, while increases in reflection predicted absence of later alcohol use and marijuana use disorders.

Little is currently known, however, about the impact of different types of rumination on drug use among adults with a complex and chronic history of use, as the majority of existing studies have focused on adolescents (Nolen-Hoeksema et al., 2007; Willem et al., 2011, 2014) and community samples of adults (Nolen-Hoeksema and Harrell, 2002). The few studies that have investigated the relationship between rumination and substance use in clinical samples focused on individuals with alcohol problems and examined overall rumination rather than its subtypes (Caselli et al., 2008, 2010).

Furthermore, to aid the development of more targeted prevention and treatment interventions, it is important to consider factors that may

moderate the relationship between rumination and substance use. Given that women routinely report higher levels of rumination than men (Nolen-Hoeksema, 2012), gender is an important moderating factor to consider. Indeed, a study focused on overall rumination indicated that while rumination was associated with a greater tendency to drink to cope among both men and women in a cross-sectional analysis, at a 12-month follow-up, rumination significantly predicted alcohol-related problems among women but not men (Nolen-Hoeksema and Harrell, 2002). Furthermore, in their study of rumination subtypes, Willem et al. (2011) found that the relationship between reflection and substance use problems was moderated by gender, such that lower levels of reflection were associated with greater substance use problems only among males. Other studies of adolescents have found no gender differences in the relationship between rumination subtypes and substance use (Adrian et al., 2014; Willem et al., 2014). Thus, existing research on the moderating role of gender in the relationship between rumination and substance use has yielded mixed findings.

Finally, while a number of the more recent studies have controlled for the confounding effects of depression when examining the relationship between rumination and substance use (e.g. Caselli et al., 2010), to the authors' knowledge, no studies have accounted for potential effects of other types of psychopathology. This has been noted as an important limitation of current research on rumination among substance using populations (Caselli et al., 2010). One disorder that may be particularly important to account for is post-traumatic stress disorder (PTSD), given its association with rumination (Seligowski et al., 2015) and high prevalence among individuals with SUDs (Mills et al., 2005).

The current study sought to address these limitations of the existing literature by examining the relationship between rumination subtypes and problematic substance use in an adult sample of individuals with a long-term history of illicit drug use. Due to the multidimensional nature of problems related to substance use, we examined a variety of indicators of problematic substance use, including heroin dependence, polydrug use and injection-related health problems. Specifically, the present study aimed to:

i) Investigate whether ruminative brooding and ruminative reflection are associated with indices of problematic substance use independently of related psychological disorders (major depression and PTSD); and,

ii) Determine whether gender moderates the relationships between the rumination subtypes and problematic substance use.

2. Material and methods

2.1. Procedure

The present cross-sectional study relied on data collected as part of the 11-year follow-up of the Australian Treatment Outcome Study (ATOS; Ross et al., 2005; Teesson et al., 2015), a naturalistic prospective cohort study of individuals with heroin dependence. Baseline data were collected between 2001-2002. The cohort comprised entrants into one of the three main treatment modalities for heroin dependence, including 201 entering opioid substitution therapy, 201 entering detoxification, and 133 entering residential rehabilitation. The treatment agencies were selected randomly from within treatment modality and stratified by regional health area. A comparison group of 80 heroin users not in treatment were recruited from needle and syringe programs. Thus, a total of 615 heroin users were enrolled in the study at baseline. While the ATOS cohort has been interviewed on multiple occasions over an 11-year period, the present study is based solely on data from the 11-year follow-up as the rumination measure was not included in the ATOS questionnaire in earlier waves. Participants were recompensed A$40 for completing the 11-year interview. Ethics approval was obtained from the University of New South Wales Human

Research Ethics Committees and participating area health services.

2.2. Participants

Of the 615 participants enrolled in the study at baseline, 431 were re-interviewed at the 11-year follow-up, representing 70.1% of the baseline sample. A further 7 (1.1%) were incarcerated, 63 (10.2%) were deceased and 42 (6.8%) chose not to participate. As the rumination measure was included in the 11-year questionnaire several months after follow-up began, 48 participants had to be excluded as they did not complete the rumination section. A further three participants were excluded because of incomplete responses on the rumination measure. This left 380 participants for inclusion in the present analyses.

2.3. Measures

2.3.1. Sample characteristics

Socio-demographic characteristics obtained included participants' gender, age, main source of income in the past month and years of school education completed. Additionally, participants were asked whether they had ever been incarcerated and about their criminal activity in the past month, which was assessed using the criminality scale of the Opiate Treatment Index (OTI; Darke et al., 1992).

2.3.2. Substance use

Substance use outcomes included current heroin dependence, polydrug use and injection-related health problems. DSM-IV diagnoses of past-month heroin dependence were obtained using the Composite International Diagnostic Interview (CIDI) version 2.1 (World Health Organization, 1997). Substance use in the preceding month was assessed using the OTI (Darke et al., 1992). Polydrug use was defined as reporting the use of two or more of the following drug classes in the past month: heroin, other opioids, amphetamines, cocaine, hallucinogens, benzodiazepines, cannabis, inhalants, alcohol or tobacco. The OTI was also used to assess whether participants had injected drugs in the preceding month and if they had experienced any injection-related health problems, including: overdose, abscesses or infections, a "dirty hit" (i.e. which made them ill), prominent scarring or bruising, and difficulty injecting.

2.3.3. Related psychopathology

DSM-IV diagnoses of current major depression (past-month) and PTSD (past 12-months) were obtained using the CIDI (World Health Organization, 1997). Participants were also asked about their history of suicide attempts across the lifetime and in the preceding 12 months.

2.3.4. Treatment history

Participants were asked about their current and past engagement in opioid dependence treatment (including opioid substitution therapies, detoxification and residential rehabilitation) and whether they had received medication treatment for depression in the preceding month. Furthermore, participants were asked about recent engagement in psychotherapy; specifically, whether they had seen a psychologist, psychiatrist or any other counsellors / therapists in the preceding month.

2.3.5. Rumination

Rumination was assessed with the RRS (Nolen-Hoeksema and Morrow, 1991), a 22-item self-report questionnaire that asks participants to rate the extent to which they engage in rumination when in a depressed mood. Only the 10 items that comprise the brooding (e.g. "Why can't I handle things better?") and reflection (e.g. "I analyze recent events to try and understand why I am depressed") subscales were used in the present analyses as the remainder of the items have been found to overlap with symptoms of depression (Treynor et al., 2003). Brooding and reflection are measured by five items each, which are

rated on a 4-point scale ranging from 1 ("almost never") to 4 ("almost always"). The scores are summed to obtain totals for each subscale (range of 5–20 for each subscale). Higher scores indicate a greater tendency to engage in rumination. The RRS brooding and reflection items have been found to have good internal consistency ($\alpha = .79$ for brooding and $\alpha = .72$ for reflection) and test-retest reliability ($\alpha = .60$ for brooding and $\alpha = .60$ for reflection; Treynor et al., 2003).

2.4. Statistical analyses

The representativeness of the sample was assessed through a comparison with other living cohort members at the 11-year follow-up on key baseline characteristics. Sample characteristics and rumination means were reported by gender and for the total sample. For these descriptive analyses, differences between groups in continuous variables were assessed using independent samples t-tests, or Mann-Whitney U tests for variables with skewed distributions. Differences in categorical variables were examined using the Chi Squared test or, in the case of variables with low cell sizes, using Fisher's exact test. The internal consistency of the two rumination subscales was measured using Chronbach's alpha coefficient.

The effects of ruminative brooding and reflection on substance use were investigated in a series of hierarchical logistic regressions with past-month heroin dependence, polydrug use, and injection-related health problems as the outcome variables. The predictor variables were entered into the models in four steps, with gender and age entered in step 1, recent psychotherapy, depression and PTSD in step 2, brooding and reflection in step 3, and the interaction between gender and brooding/reflection in step 4. Multi-collinearity was examined using the tolerance index (T_i) and the variance inflation factor (VIF). A T_i of more than 0.2 and a value less than 5.0 for VIF are considered reliable cut-off points for the absence of multi-collinearity (Cohen, 1988). No evidence of multi-collinearity was found. The analyses were performed using IBM SPSS Statistics for Windows, Version 20.0.

3. Results

3.1. Sample description

The complete ATOS sample re-interviewed at the 11-year follow-up (n = 431) has been shown to be broadly representative of other living cohort members not followed-up (Darke et al., 2014). However, in order to determine whether the participants included in the present study (n = 380) were representative of other surviving cohort members, we compared those who completed the rumination section and those who did not on key baseline characteristics. Those who did not complete the rumination section included participants followed up at 11 years but who were interviewed before the rumination section was included in the questionnaire, as well as those who were known to be alive at 11 years but not followed up. There were no differences in terms of percent male (66.6% vs 65.1%, $\chi^2_{1df} = 3.4$, p = .811), mean age (40.1 years vs 39.2 years, U = 9240.5, p = .590), major depression (22.4% vs 26.7%, $\chi^2_{1df} = 1.02$, p = .312), and PTSD (42.1% vs 36.0%, $\chi^2_{1df} = 1.57$, p = .211). Participants who had used a greater number of drug classes at baseline were more likely to have been included in the present analyses (4.9 classes vs 4.6 classes, U = 29124, p = .038).

Sample characteristics are presented in Table 1. Of the 380 participants, 66.6% were male, with a mean age of 40.1 years (SD = 7.7, range: 28–66 years) years. Participants had completed a mean of 10.1 years of school education (SD = 1.6, range: 3–12 years). Nearly two thirds of the participants were receiving government allowances as their main source of income. More than half had been imprisoned in their lifetime, and one in five reported engaging in crime in the preceding month. The prevalence of past-month major depression was 21.1%, and the prevalence of PTSD in the last 12 months was 20.8%. A lifetime suicide attempt was reported by a third of the sample, with

Table 1
Sample characteristics.

	Males (*n* = 253)	Females (*n* = 127)	Total (*n* = 380)	Comparisons by gender
Sociodemographic characteristics				
Age, *mean (SD)*	40.8 (7.8)	38.7 (7.3)	40.1 (7.7)	$U = 13558, p = .013$
Years of school completed, *mean (SD)*	10.1 (1.5)	9.9 (1.7)	10.1 (1.6)	$U = 14683, p = .158$
Government benefits as main income (past month), *n* (%)	145 (57.3)	97 (76.4)	242 (63.7)	$\chi^2_{1df} = 13.3, p < .001$
Criminal history				
Criminal activity (past month), *n* (%)	52 (20.6)	27 (21.3)	79 (20.8)	$\chi^2_{1df} = 0.0, p = .873$
Incarceration history (lifetime), *n* (%)	160 (63.5)	47 (37.0)	207 (54.6)	$\chi^2_{1df} = 23.9, p < .001$
Substance use				
Heroin dependence (past month), *n* (%)	35 (13.8)	20 (15.7)	55 (14.5)	$\chi^2_{1df} = 0.3, p = .617$
Polydrug use (past month), *n* (%)	211 (83.4)	100 (78.7)	311 (81.8)	$\chi^2_{1df} = 1.2, p = .266$
Injecting drug use (past month), *n* (%)	85 (33.6)	37 (29.1)	122 (32.1)	$\chi^2_{1df} = .7, p = .379$
Injection related health problems (past month), *n* (%)	64 (25.2)	26 (20.8)	90 (23.6)	$\chi^2_{1df} = 1.1, p = .297$
Psychopathology				
Major depression (past month), *n* (%)	42 (16.6)	38 (29.9)	80 (21.1)	$\chi^2_{1df} = 9.0, p = .003$
PTSD (past 12 months), *n* (%)	45 (17.8)	34 (26.8)	79 (20.8)	$\chi^2_{1df} = 4.1, p = .042$
Attempted suicide (past 12 months), *n* (%)	5 (8.1)	2 (4.5)	7 (6.6)	$p = .697^a$
Attempted suicide (lifetime), *n* (%)	69 (27.5)	52 (40.9)	121 (32.0)	$\chi^2_{1df} = 7.0, p = .008$
Treatment history				
Heroin dependence treatment (current), *n* (%)	111 (43.9)	60 (47.2)	171 (45.0)	$\chi^2_{1df} = 0.4, p = .533$
Heroin dependence treatment (lifetime), *n* (%)	253 (100.0)	127 (100.0)	380 (100.0)	–
Antidepressant use (past month), *n* (%)	51 (20.2)	46 (36.2)	97 (25.5)	$\chi^2_{1df} = 11.5, p = .001$
Psychotherapy (past month), *n* (%)	49 (19.4)	43 (33.9)	92 (24.2)	$\chi^2_{1df} = 9.7, p = .002$

Note: PTSD = post-traumatic stress disorder.
[a] Based on Fisher's Exact Test due to cell sizes of < 5 on this variable.

6.6% having made an attempt in the preceding 12 months. The prevalence of depression, PTSD, and lifetime attempted suicide was higher among females. All participants had received treatment for opioid dependence in their lifetime and nearly half were currently receiving treatment. A quarter of the participants were currently receiving antidepressant medication and a similar proportion reported recent engagement in psychotherapy.

3.2. Substance use

The most commonly used substances in the month preceding interview were tobacco, alcohol and cannabis (Fig. 1). Heroin and other opioids were used by 24.7% and 26.1% of the participants, respectively. Data on other substance use outcomes are shown in Table 1. The prevalence of current heroin dependence was 14.5%, while polydrug use was reported by 81.8% of the sample. Nearly a third reported injecting drugs in the preceding month, and 23.6% experienced injection-related health problems. Males and females did not differ in terms of heroin dependence, polydrug use, or injection-related health problems.
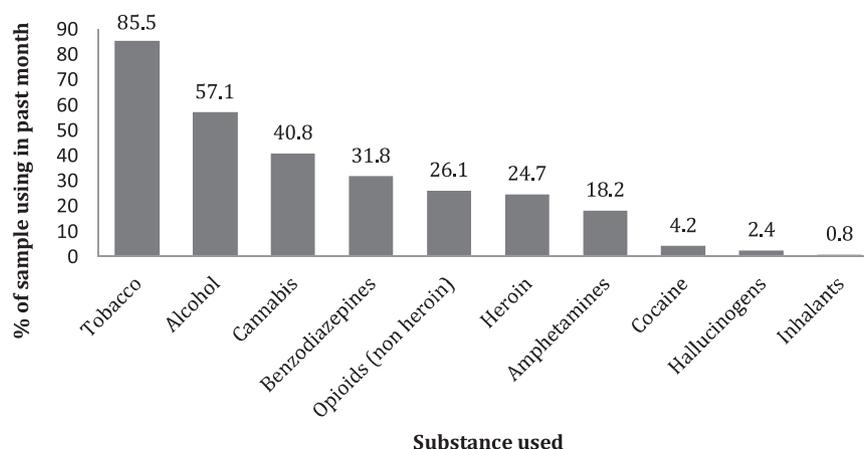
3.3. Rumination

The brooding subscale showed good internal consistency (Cronbach's α = .83), and the internal consistency of the reflection subscale was adequate (Cronbach's α = .72). The mean score for the brooding subscale was 11.0 (SD = 4.0) and the mean for the reflection subscale was 9.9 (SD = 3.4). The two scales were moderately correlated (r = .52, p = .000). Scores on the brooding subscale were significantly higher among females (12.1 vs 10.5, $t_{225.8}$ = 3.8, p = .000), as were scores on the reflection subscale (10.5 v 9.7, t_{378} = 2.2, p = .022).

3.4. Hierarchical logistic regression analyses

Hierarchical logistic regression analyses (Table 2) indicated that brooding is a significant predictor of heroin dependence over and above the effects of gender, age, psychotherapy, depression and PTSD (OR = 1.11, CI: 1.01–1.22). For every one unit increase in brooding scores, the odds of a participant having heroin dependence increased by 11%. Brooding was also a unique predictor of polydrug use (OR = 1.16, CI: 1.06–1.28) and injection related health problems (OR = 1.08, CI: 1.00–1.17), even when accounting for the other variables in the model. The odds of engaging in polydrug use or having injection related

Fig. 1. Substances used in the past month.

Table 2

Hierarchical logistic regressions with heroin dependence, polydrug use and injection-related health problems as the outcome variables, and ruminative brooding and reflection as the predictor variables.

		Heroin dependence			Polydrug use			Injection-related health problems		
		OR	95% C.I.	*p*	OR	95% C.I.	*p*	OR	95% C.I.	*p*
Step 1	Gender	0.84	0.46 - 1.54	.581	1.38	0.80 - 2.37	.250	1.28	0.76 - 2.15	.358
	Age	1.01	0.97 - 1.05	.664	0.99	0.96 - 1.03	.693	1.02	0.98 - 1.05	.348
Step 2	Gender	1.13	0.59 - 2.17	.709	1.56	0.89 - 2.78	.118	1.70	0.97 - 3.00	.065
	Age	1.02	0.98 - 1.06	.408	1.00	0.96 - 1.03	.840	1.02	0.99 - 1.06	.187
	Psychotherapy (past month)	1.24	0.64 - 2.43	.525	0.67	0.36 - 1.23	.196	1.28	0.73 - 2.26	.391
	Major depression (past month)	2.37	1.22 - 4.61	.011	3.81	1.43 - 10.162	.007	2.31	1.29 - 4.13	.005
	PTSD (past 12 months)	3.25	1.69 - 6.26	.000	2.14	0.90 - 5.05	.084	2.59	1.45 - 4.62	.001
Step 3	Gender	1.21	0.62 - 2.34	.578	1.73	0.96 - 3.09	.066	1.82	1.03 - 3.23	.041
	Age	1.02	0.98 - 1.07	.270	1.00	0.97 - 1.04	.816	1.03	0.99 - 1.06	.126
	Major depression (past month)	1.95	0.96 - 3.96	.066	2.96	1.08 - 8.10	.034	1.87	1.01 - 3.47	.046
	Psychotherapy (past month)	1.20	0.61- 2.38	.597	0.62	0.33 - 1.16	.133	1.21	0.68 - 2.15	.522
	PTSD (past 12 months)	2.82	1.40 - 5.70	.004	1.62	0.66 - 3.97	.296	2.13	1.16 - 3.93	.015
	RRS-Brooding	**1.11**	**1.01 - 1.22**	**.039**	**1.16**	**1.06 -1.28**	**.002**	**1.08**	**1.00 - 1.17**	**.047**
	RRS-Reflection	0.94	0.84 - 1.04	.241	0.93	0.85 - 1.02	.142	0.99	0.91 - 1.08	.836

Note: PTSD = Post-traumatic stress disorder; RRS = Ruminative Responses Scale score.

problems increased by 16% and 8% respectively for every one unit increase in brooding scores. The brooding by gender interactions, were not significant (OR = 0.98, CI: 0.84–1.14 for heroin dependence; OR = 1.06, CI: 0.90–1.25 for polydrug use; OR = 1.01, CI: 0.89–1.16 for injection health problems). Furthermore, reflection showed no relationship to heroin dependence, polydrug use or injection health problems.

4. Discussion

The present study examined the cross-sectional relationship between rumination subtypes and substance use among people with long-term illicit drug use. Ruminative brooding was consistently associated with a more severe substance use profile, whereas ruminative reflection showed no relationship with measures of substance use. The relationships between the rumination subtypes and substance use outcomes were not moderated by gender.

The findings of this study add to the growing body of evidence on the role of rumination in substance use (e.g. Caselli et al., 2010; Nolen-Hoeksema et al., 2007; Willem et al., 2011) and extend existing research by demonstrating that ruminative brooding is related to substance use problems of a more severe nature, among a more complex and chronic population of people who use illicit substances than previously studied. Specifically, brooding was independently associated with current heroin dependence, polydrug use and injection-related health problems. Importantly, the present study was the first to investigate the relationship between rumination subtypes and substance use while controlling not only for depression but for other related psychopathology, namely PTSD. The current findings therefore show that brooding is associated with substance use outcomes independently of multiple comorbid disorders. In conjunction with evidence from the literature on depression, suicidal ideation and anxiety disorders (e.g. O'Connor and Noyce, 2008; Raes, 2010; Watkins, 2009) the present findings highlight the maladaptive nature of ruminative brooding and its potential utility as a substance use treatment target.

There are several reasons why brooding may be related to problematic substance use patterns. One possibility is that substance users who are more judgmental and self-critical may be less likely to engage in self-care practices, and therefore more likely to engage in risky substance use behaviors. Indeed, lower levels of self-compassion are associated with risk for drug use (Phelps et al., 2018) and higher levels of rumination are associated with less self-compassion (Neff and Vonk, 2009). It is also possible that individuals who are prone to ruminative brooding may turn to substance use in order to escape from their ruminative thoughts and self-medicate the distress caused by rumination (Caselli et al., 2008). Indeed, in a study focusing on overall rumination, Caselli et al. (2013) found that instructing alcohol dependent individuals to ruminate leads to an increase in alcohol cravings, suggesting that alcohol is used as a means of controlling rumination.

Unlike brooding, reflection was not related to any of the substance use measures. These findings contrast with two studies of adolescents which indicated that higher levels of reflection are associated with more favorable substance use outcomes (Adrian et al., 2014; Willem et al., 2011). A potential explanation for this discrepancy in findings is that reflection may be more likely to be protective against adolescent substance use, which is presumably of a less severe and entrenched nature than substance use problems experienced by people with a long history of illicit drug use. There is also evidence to suggest that reflection may not be a stable subscale of rumination. Whitmer and Gotlib (2011) conducted a factor analysis of the RRS scale in currently depressed, formerly depressed, and never depressed individuals and found that the reflection items did not load reliably on one factor across the different groups. This might explain the conflicting findings about the effects of reflection that have been evidenced in both the substance use and depression literature (e.g. Arditte and Joormann, 2011; Burwell and Shirk, 2007; Joormann et al., 2006; Treynor et al., 2003; Willem et al., 2011, 2014).

The absence of a moderating effect of gender is in line with two previous studies of rumination subtypes and substance use (Adrian et al., 2014; Willem et al., 2014). Both these studies examined these relationships longitudinally, however. It is therefore important to note that the current findings are in contrast to the only other cross-sectional study of rumination subtypes and substance use, which found that higher levels of reflection were associated with fewer substance use problems among boys only (Willem et al., 2011). A potential reason for this discrepancy may lie in the differences between our samples. In the Willem et al. study of adolescents, boys reported higher levels of substance use consumption and related problems compared to girls, whereas in our study of people with a long-term history of drug use, there were no differences between males and females on any of the indices of problematic substance use. It therefore appears that among individuals heavily entrenched in drug use, gender differences in the effects of rumination are less salient.

The findings of the present study are of clinical relevance insofar as they point to a potential mechanism – ruminative brooding - that may be a promising treatment target in SUD interventions. Intake procedures for substance use treatments may benefit from screening for brooding so that individuals prone to this thinking style may be

identified and assigned to appropriate treatment. Given that rumination more broadly, and brooding specifically, appear to be transdiagnostic risk factors for psychopathology (e.g. Nolen-Hoeksema and Watkins, 2011; Watkins, 2009), treatments that focus on targeting brooding also have the potential to lead to improvements in disorders commonly comorbid with SUDs, such as depression and anxiety disorders (Vujanovic et al., 2017).

A recent systematic review indicates that cognitive behavioral therapy (CBT) and mindfulness-based treatments (MBTs) are particularly effective at reducing rumination (Querstret and Cropley, 2013). While there is a form of CBT designed specifically to target rumination, called Rumination-Focused CBT (Watkins et al., 2007), it has not been evaluated among individuals with SUDs. MBTs on the other hand have been shown to lead to improvements in the treatment of both depression and substance use individually (Khoury et al., 2013; Li et al., 2017; Strauss et al., 2014), and have recently begun attracting attention as a promising transdiagnostic treatment for comorbid disorders (Brewer et al., 2010; Vujanovic et al., 2017). Importantly, it has been noted that one pathway through which MBTs may lead to improvements for comorbid depression and SUDs for instance, is by decreasing the tendency to ruminate (Brewer et al., 2010). Although this is purely speculative at present, evidence from research on depression and anxiety indicates that a reduction in rumination is one of the core mechanisms through which MBTs lead to improvement in symptoms (Gu et al., 2015; van der Velden et al., 2015).

The present findings need to be considered in the context of study limitations. Self-report measures were used to assess substance use outcomes and psychopathology. Previous research, however, has shown that substance users provide reliable and valid information through self-report measures (Darke, 1998; Napper et al., 2010; Ross et al., 2006). Given the cross-sectional design of the current analyses, it is not possible to infer causality. Prospective longitudinal studies are needed to investigate the relationship between rumination subtypes and problematic substance use in more detail. In particular, it would be valuable to explore the potential role of rumination as a mediating mechanism in the relationship between substance use and commonly comorbid disorders such as depression and PTSD. Future research could also investigate whether rumination is not only a risk factor for current substance use, but also whether it is a predictor of relapse to use after periods of abstinence. As PTSD was the only anxiety disorder assessed in the ATOS, we were unable to control for other anxiety disorders in our analyses. Given the association between rumination and anxiety disorders (Aldao et al., 2010) and the high prevalence of anxiety disorders among individuals with SUDs (Conway et al., 2006), it will be important to account for a broader range of anxiety disorders in future research on rumination and substance use. It also needs to be noted that the two-factor structure of the RRS has not yet been validated in a sample of individuals with SUDs. This is an important issue for future research to address, given evidence from other types of samples that the reflection subscale may be unstable (e.g. Whitmer and Gotlib, 2011).

In summary, this is the first study to demonstrate that ruminative brooding is associated with a more severe substance use profile among people with a long-term history of illicit drug use, over and above the influence of related psychological disorders such as depression and PTSD. These findings highlight the potential benefits of targeting ruminative brooding during treatment of substance use and add further support to the growing recognition of rumination as a transdiagnostic risk factor for psychopathology.

Author disclosures

Contributors

Sonja Memedovic was a Doctoral Candidate on the project, responsible for the addition of the rumination measure to the 11-year follow-up ATOS questionnaire, and the design, statistical analyses and write-up of the manuscript. Tim Slade, Joanne Ross, Shane Darke, Katherine L. Mills, Lucy Burns, Michael Lynskey, and Maree Teesson were Chief Investigators on the project. Christina Marel was the project coordinator, involved in data collection and data management. All authors contributed to, reviewed and approved the final manuscript.

Declaration of Competing Interest

All authors declare that they have no conflicts of interest.

Acknowledgments

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