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Rash Impulsiveness and Negative Mood, but not Alexithymia or Reward Sensitivity, Differentiate Young to Middle-Aged Chronic Daily Smokers from Never-Smokers

Michael Lyvers, Ph.D. [a], Monique Bremner, BPsy.Sc. (Hons)[b], Mark S. Edwards, Ph.D.[c], and Fred Arne Thorberg, Ph.D.[d,e]

[a]Associate Professor of Psychology, School of Psychology, Bond University, Gold Coast, Queensland, Australia; [b]Honors Student Researcher, School of Psychology, Bond University, Gold Coast, Queensland, Australia; [c]Professor of Psychology, School of Psychological and Social Sciences, York St. John University, York, UK; [d]Senior Research Fellow, National Centre for Dual Diagnosis, Innlandet Hospital Trust, Brumunddal, Norway; [e]Senior Research Fellow, Department of Behavioural Sciences in Medicine, Institute of Basic Medical Sciences, Faculty of Medicine, University of Oslo, Oslo, Norway

ABSTRACT

Given the well-established associations of the personality traits alexithymia, impulsivity, and reward sensitivity with problematic use of a variety of substances, including alcohol and cannabis, the present study sought to determine whether daily tobacco smoking is similarly linked to these traits. Male and female adults aged 18 to 40 years were recruited from the local Australian community, allowing comparison of demographically similar samples of current daily smokers (n = 47) to never-smokers (n = 59) on the relevant self-report measures. Multivariate analysis of covariance revealed that current smokers scored significantly higher than never-smokers on indices of negative mood, impulsiveness, and risky alcohol use, after controlling for social desirability. No significant group differences were found on indices of alexithymia, reward sensitivity, or punishment sensitivity. Results suggest that chronic daily cigarette smoking may be an exception to the maladaptive behaviors associated with alexithymia, and is driven primarily by mood regulation and poor impulse control.

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Alexithymia; impulsivity; mood; reward; smoking

Cigarette smoking is the world's leading preventable cause of death, yet approximately one billion individuals continue to smoke worldwide (World Health Organisation 2016). In Australia, the 2013 National Drug Strategy Household Survey (Australian Institute of Health and Welfare [AIHW] 2014) estimated that 12.8% of Australians were current daily smokers. Identification of the motives for continuing to smoke despite highly publicized health risks is important in addressing this major public health concern.

One clue to the motivation for smoking can be found in reports of heightened negative affect among chronic smokers, such that smoking may serve as a means of mood regulation (e.g., Lyvers et al. 2014a; McKee et al. 2011). Anxiolytic and mood-enhancing effects of nicotine appear to underlie the reported ability of smoking to alleviate aversive mood states (Dani and De Biasi 2001; Koob 2008; McGranahan et al. 2011). Such effects may be relevant for those with high levels of alexithymia, a trait commonly associated with depression, anxiety, and stress as well as mood regulation difficulties (Lyvers et al. 2014c, 2017; Thorberg et al. 2010). Alexithymia refers to difficulty in identifying and describing feelings and an externally oriented thinking style (Taylor and Bagby 2000).

Both alexithymia and negative moods are highly prevalent among clients undergoing treatment for substance disorders (Lyvers et al. 2014b; Thorberg et al. 2009). In non-clinical Australian samples, alexithymia is associated with heavier use of drugs such as alcohol (Lyvers et al. 2012c), cannabis (Lyvers, Jamieson, and Thorberg 2013), and caffeine (Lyvers, Duric, and Thorberg 2014). Further, social drinkers with higher levels of alexithymia are more likely to report drinking alcohol to cope with negative moods (Bruce, Curren, and Williams 2012; Lyvers et al. 2012b; Thorberg et al. 2009). However, alexithymia has seldom been investigated in relation to cigarette smoking (e.g., Lumley et al. 1994), and their relationship, if any, is unclear (Carton et al. 2008).

Tobacco dependence is often comorbid with other problematic substance use, notably alcohol dependence (Trull, Waudby, and Sher 2004), which in turn is strongly associated with alexithymia (Thorberg et al. 2009). This raises the question of whether alexithymia is associated with smoking as it is with problematic use of other substances. Research conducted to date on the possible association of smoking with alexithymia has yielded mixed findings. Lumley et al. (1994) found no

CONTACT Michael Lyvers mlyvers@bond.edu.au School of Psychology, Bond University, Gold Coast, QLD 4229, Australia.

relationship between alexithymia and tobacco dependence, concluding that alexithymia is unrelated to smoking and that the affect regulation deficits in alexithymia do not predispose to use of nicotine for mood regulation. However, Carton et al. (2008) cited research from France (Corcos, Flament, and Jeammet 2003), Finland (Kauhanen 1993), and Poland (Grabowska et al. 2004) that had indicated higher levels of alexithymia or one or more of its dimensions (difficulty identifying feelings, difficulty describing feelings, externally oriented thinking) in smokers compared to non-smokers. The diverse cultural milieu of the previous studies may complicate interpretation and comparison of their findings. More recently, Sutherland et al. (2013) reported that nicotine-deprived smokers with higher levels of alexithymia reported stronger craving for cigarettes, similar to the association of higher alexithymia with stronger alcohol craving (Thorberg et al. 2011); however, smokers and non-smokers did not appear to differ on this trait in their brain imaging study.

Dawe, Gullo, and Loxton (2004) described two distinct forms of impulsivity—reward sensitivity and rash impulsiveness—and suggested that the former promotes initiation of substance use, whereas the latter promotes maintenance of use in addiction. This paradigm has been recently supported in relation to alcohol and illicit substance use in both clinical (Lyvers et al. 2014b) and non-clinical Australian samples (Lyvers et al. 2012a). Sensitivity to reward (SR) is presumed to reflect the functioning of the dopaminergic Behavioral Activation System in Gray's (1987) theory of motivation. Rash impulsiveness, on the other hand, reflects executive dysfunction, which is likely to interfere with smoking cessation attempts due to the prioritizing of immediate rewards over long-term goals (Bickel and Yi 2008), perhaps eventuating in "hardening" of the current population of smokers in terms of smoking-related psychopathology. The "hardening hypothesis" suggests that, given the strong social pressures against smoking in many Western countries today, psychopathologies that work against quit efforts—such as executive dysfunction, but also clinically significant depression or anxiety—gradually become more common in the remaining smoking population as other smokers are able to quit (Warner and Burns 2003).

In contrast to SR, the other brain motivational system proposed by Gray (1987)—the Behavioral Inhibition System—is proposed to underlie sensitivity to punishment (SP). Unlike SR, SP has not been linked in any consistent way to substance use. High SP has sometimes been reported in problematic drinkers (Loxton and Dawe 2001), but strong negative relationships of SP with cannabis use (Lyvers, Jamieson, and Thorberg 2013) and caffeine use (Lyvers, Duric, and Thorberg 2014) have also been observed. SP has thus been characterized as both a risk factor and a protective factor in relation to substance use. Given the highly publicized health hazards of cigarette smoking, SP might even be expected to protect against initiation of this particular form of substance use.

The present study recruited a group of current daily smokers and a comparison group of never-smokers. Current smokers and never-smokers were then compared on measures of alexithymia, impulsivity, negative mood, and reward sensitivity—traits linked to problematic substance use in previous research—as well as alcohol intake, given the common association of smoking with alcohol consumption. Based on previous research on traits associated with problematic substance use, these variables were expected to be elevated in smokers compared to never-smokers. Although the limited research to date has yielded conflicting findings on alexithymia in relation to smoking or nicotine dependence (Carton et al. 2008; Lumley et al. 1994; Sutherland et al. 2013), in the present study alexithymia was expected to be elevated in smokers compared to never-smokers based on three considerations: (1) the high levels of negative affect and the difficulties with mood regulation associated with alexithymia (Bruce, Curren, and Williams 2012; Lyvers et al. 2014c, 2017; Thorberg et al. 2010); (2) the evidence that mood regulation is an important motive for smoking (Lyvers et al. 2014a; McKee et al. 2011); and (3) reports that alexithymia is associated with use of other substances to regulate mood (Thorberg et al. 2009). SP was measured as well; however, given the mixed findings of previous research on the association of SP with substance use, no prediction was made for this trait variable.

Method

Participants

After excluding cases that did not meet criteria for participation (see the following), the initial sample consisted of 112 Australian community volunteers who were recruited online via Qualtrics.com. This sample was subsequently reduced to 107 participants after deletion of multivariate outliers using Mahalanobis distance ($p < .001$). One light smoker was also excluded to ensure that all smokers scored greater than 2 on the Fagerström Test for Nicotine Dependence (FTND; Fagerström 1978; Heatherton et al. 1991), thus likely reflecting dependence ($N = 106$). Participants in the

final sample had an age range of 18 to 40 years (M = 31.42 years, SD = 6.30), and there were 61 females (58%) and 45 males (42%). To be included, participants were required to be between 18 and 40 years of age to reduce potential cohort effects (AIHW 2014). To participate, current smokers had to have been smoking more than 10 cigarettes per day for a minimum of one year to increase the likelihood that the sample reflected nicotine dependence. Participants were excluded if they were currently taking neurological or psychiatric medications, or had suffered a previous traumatic brain injury, in order to minimize the potential influence of such extraneous sources of variability on responses. Although the proportions of the 35 cases excluded for being on psychiatric medication did not significantly differ between current smokers and never-smokers in the present sample according to chi-square test, p = .14, these cases were nevertheless excluded in this investigation of "normal" smokers. The present study thus differed from investigations targeting the "hardening hypothesis" whereby psychiatric disorders are proposed to be more common among the current smoker population than among non-smokers, as the present study sought to exclude those with such diagnoses.

There were no significant differences between smoker and never-smoker groups on age, gender, ethnicity, education level, or employment (Table 1). Smoking information for the smoker sample is presented in Table 2.

Table 1. Demographic characteristics of the current sample (N = 106).

	Smokers (n = 47)	Never-Smokers (n = 59)
Mean age in years (SD)	31.26 (6.23)	31.53 (6.46)
Gender		
Female	22 (47%)	39 (66%)
Male	25 (53%)	20 (34%)
Employment Status		
Full-time	22 (47%)	24 (41%)
Part-time/Casual	8 (17%)	12 (20%)
Self-employed	1 (2%)	4 (7%)
Unemployed	12 (25%)	13 (22%)
Student	4 (9%)	6 (10%)
Highest level of education		
Grade 12 or below	10 (21%)	11 (19%)
Undergraduate	26 (55%)	41 (69%)
Postgraduate	11 (23%)	7 (12%)
Ethnicity		
Caucasian/White	42 (89%)	39 (66%)
Other or Not Specified	5 (11%)	20 (34%)

Table 2. Smoking data for smokers (n = 47).

Number of daily cigarettes	
11–20	32 (68%)
21–30	12 (26%)
31–40	4 (9%)
Duration of smoking habit	
1–5 years	9 (19%)
Over five years	38 (81%)
Reasons for smoking	
Pleasure	8 (17%)
Calmness	20 (43%)
Promotes concentration	2 (4%)
Relieves craving	14 (30%)
Other	3 (6%)

Materials

Demographics

In an online questionnaire, participants specified their age and ethnicity with open responses. Closed questions were used to identify participants' gender, highest level of education, current occupational status, and smoking status. Smokers reported the average quantity of cigarettes smoked daily, the duration of their smoking habit in years, and their rationale for smoking. To ensure daily smoking, participants also indicated whether they smoked every day or occasionally. Finally, participants indicated if they were currently taking medication for a psychiatric or neurological condition, and if they had ever suffered a serious head injury, to which dichotomous "Yes-No" responses were provided; these reflected exclusion criteria.

Toronto Alexithymia Scale-20 (TAS-20; Bagby et al. 1994)

This 20-item self-report questionnaire assesses the key facets of alexithymia: difficulty identifying feelings (DIF; e.g., "I am often confused about what emotion I am feeling"), difficulty describing feelings (DDF; e.g., "I find it hard to describe how I feel about people"), and externally oriented thinking (EOT; e.g., "I prefer talking to people about their daily activities rather than their feelings"). Participants rate their agreement with each statement on a five-point Likert scale, ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). The sum of responses on items provides subscale scores and a total score, where scores greater than 61 indicate high alexithymia, scores between 51 and 60 indicate borderline alexithymia, and scores less than 51 indicate low or no alexithymia. Scores may range from 20 to 100. The Cronbach's alpha reliability coefficient of the TAS-20 in the current study was .86.

Depression Anxiety Stress Scales-21 (DASS-21; Lovibond and Lovibond 1995)

The DASS-21 is a 21-item measure of negative emotional states experienced over the previous week. It measures three dimensions with seven items each: depression (e.g., "I felt downhearted and blue"), anxiety (e.g., "I felt I was close to panic"), and stress (e.g., "I found it hard to wind down"). Participants indicate

their endorsement of the statements on a four-point Likert scale ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*). Total scores for each dimension are computed by adding appropriate items to determine one's experience of negative emotional states, where higher scores on each domain indicate higher levels of depression, anxiety, or stress. Combining these yields an overall index of negative mood. The present sample yielded an overall Cronbach's alpha coefficient of .95.

Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, and Barratt 1995)

The BIS-11 is a 30-item self-report measure of rash impulsiveness. It assesses three domains: attentional, motor, and non-planning impulsiveness. BIS-11 includes items such as "I plan tasks carefully" (reverse scored item), where participants rate their agreement with statements on a four-point Likert scale ranging from 1 (*Rarely/Never*) to 4 (*Almost Always/Always*). Item responses are added to obtain a total score, where higher scores suggest higher levels of rash impulsiveness. In the current study, the BIS-11 displayed a Cronbach's alpha coefficient of .83.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia et al. 2001)

The SPSRQ is a 48-item self-report measure comprised of two scales, sensitivity to reward (SR) and sensitivity to punishment (SP), which index the proposed influences of the BAS and BIS motivational systems (Gray 1987), respectively. The SR (e.g., "Do you often do things to be praised?") and SP (e.g., "Are you often afraid of new or unexpected situations?") scales consist of 24 items each, where participants provide dichotomous responses of 1 (*Yes*) or 0 (*No*). Affirmative responses are summed to obtain total SR and SP scores, where higher scores indicate higher sensitivity to the respective domain. The Cronbach's alpha coefficients in the current study were .87 and .81 for SP and SR, respectively.

Fagerström Test for Nicotine Dependence (FTND; Fagerström 1978; Heatherton et al. 1991)

The FTND is a six-item self-report test of nicotine dependence in smokers. It includes questions such as "How soon after you wake up do you smoke your first cigarette?" where participants select responses that best describe their smoking behaviors. Item 1 is scored on a four-point scale, ranging from 0 (*After 60 Minutes*) to 3 (*Within 5 minutes*), as is Item 4, which ranges from 0 (*10 or less*) to 3 (*31 or more*). Item 3 requires a dichotomous response of 0 (*All others*) or 1 (*The first one in the morning*). Items 2, 5, and 6 also require a dichotomous response of 0 (*No*) or 1 (*Yes*). Scores on the FTND may range between 0 and 10, where a score less than 4 suggests low dependence, a score between 4 and 6 suggests moderate dependence, and a score greater than 7 suggests high dependence. The Cronbach's alpha coefficient for the current study was .79.

Alcohol Use Disorders Identification Test (AUDIT; Saunders et al. 1993)

The AUDIT is a 10-item measure that assesses alcohol use (items 1 to 3), drinking behaviors and dependence (items 4 to 6), and problems related to drinking (items 7 to 10) on various Likert scales. Item 1 is scored on a five-point scale ranging from 0 (*Never*) to 4 (*4 or more times a week*), as is Item 2, which ranges from 0 (*1 or 2*) to 4 (*10 or more*). Items 3 to 8 are also scored on a five-point scale, ranging from 0 (*Never*) to 4 (*Daily or almost daily*). Items 9 and 10 are scored on a three-point scale, including possible scores of 0 (*No*), 2 (*Yes, but not in the last year*), and 4 (*Yes, during the last year*). Total scores are calculated by summing responses and may range between 0 and 40, where scores of 0 to 7 indicate low-risk drinking, 8 to 15 indicate hazardous drinking, and 16 and higher indicate harmful drinking. The Cronbach's alpha coefficient for the current study was .91.

Marlowe-Crowne Social Desirability Scale Short Form C (MC-SDS; Crowne and Marlowe 1960; Reynolds 1982)

This is a 13-item scale designed to assess the tendency to respond in a manner that will be perceived favorably by others. It contains items such as "I'm always willing to admit it when I make a mistake," where participants respond in a True/False format. The MC-SDS was used to control for such bias in the present study (especially given the socially undesirable nature of smoking in the present Australian context) and yielded a Cronbach's alpha coefficient of .69.

Procedure

Approval was obtained from the Bond University ethics committee prior to data collection. Participants were recruited via the Qualtrics Online Sample, and were screened according to the inclusion and exclusion criteria. The questionnaires were presented electronically on Qualtrics, a survey hosting website. Participants were presented with an explanatory statement describing the research as an investigation of how personality

traits in the community are related to alcohol consumption and smoking. Participants were informed that participation was voluntary, that they could withdraw at any point without penalty, and that their responses would not be identifiable. Participants then had to tick "I agree" to a statement of consent ("I acknowledge that I have read and agree with the explanatory statement, and consent to take part in this research") before they could proceed.

Participants then completed the online questionnaires. All measures following the demographic questions (e.g., TAS-20, BIS-11, SPSRQ, etc.) were separated into blocks and randomized to minimize order and fatigue effects. Following the completion of the battery, Qualtrics provided participants with a monetary incentive of $1.25 AUD.

Results

Data diagnostics

Analyses were conducted with SPSS Version 23.0. There were no missing cases. After a square root transformation was applied to AUDIT scores due to positive skew, skewness and kurtosis were non-significant at $p < .001$ for all variables, fulfilling Kim's (2013) criteria for a medium-sized sample. Disregarding correlations amongst subscale and total scale scores for the same measure, no correlations exceeded .80, satisfying the assumptions of multicollinearity and singularity (Field 2013). Box's M was non-significant ($p = .223$), satisfying the assumption of homogeneity of covariance (Tabachnick and Fidell 2014). Power analyses as per G*Power conventions (Faul et al. 2009) indicated sufficient power and sample size for the present group comparisons. There were no group differences between smokers and never-smokers on any demographic variable; however, smokers were more likely to have ever used illicit drugs than never-smokers were (χ^2 (1) = 7.91, $p = .005$).

Bivariate correlations

In line with previous work, TAS-20 scores displayed significant positive correlations with scores on total BIS-11, SR, SP, and all three DASS-21 negative mood scales (Table 3). The TAS-20 displayed no relationship with FTND nicotine dependence scores in smokers, $r = -.07$, $p = .63$; however, AUDIT scores were positively correlated with FTND scores overall, as were all three DASS-21 scales—Depression, Anxiety, and Stress. Total BIS-11 scores were positively related to the DASS-21 scales, AUDIT and FTND. Scores on the MC-SDS displayed significant correlations with most variables, justifying its inclusion as a covariate. Age did not significantly correlate with any variables, with the exception of a negative correlation with the EOT subscale of the TAS-20 (Table 3).

Group comparisons

A 2 × 2 between-subjects multivariate analysis of covariance (MANCOVA) was conducted to assess the effect of smoking status and gender on TAS-20, BIS-11, SR, SP, DASS-21 subscales (Depression, Anxiety, Stress), and AUDIT scores. Due to its strong relationship with most variables of interest as identified by correlations, scores on the MC-SDS were input as a covariate to control for social desirability bias. Levene's test indicated no violations of homogeneity of variance. As the assumption of normality was met in data diagnostics, Wilk's Lambda is reported for multivariate results (Field 2013).

The covariate MC-SDS had a significant overall multivariate effect ($F(8, 94) = 5.31$, $p < .001$, $\tilde{\eta}^2 = .31$, power = 1.00), as well as significant univariate effects on all variables except AUDIT. There was a significant multivariate effect of smoking status ($F(8, 94) = 4.57$, $p < .001$, $\tilde{\eta}^2 = .28$, power = 1.00) on the dependent variables after controlling for social desirability. There were no significant multivariate effects for gender ($F(8, 94) = 1.94$, $p = .063$) or the smoking status by gender interaction ($F(8, 94) = 1.09$, $p = .377$).

Means and standard deviations for smokers and never-smokers on each dependent variable are presented in Table 4. Current smokers scored higher than never-smokers on each of the DASS-21 subscales, Depression ($F(1, 101) = 10.16$, $p = .002$, $\tilde{\eta}^2 = .09$, power = .88), Anxiety ($F(1, 101) = 15.56$, $p < .001$, $\tilde{\eta}^2 = .13$, power = .97), and Stress ($F(1, 101) = 8.41$, $p = .005$, $\tilde{\eta}^2 = .08$, power = .82), as well as on the BIS-11 ($F(1, 101) = 6.19$, $p = .014$, $\tilde{\eta}^2 = .06$, power = .69), and AUDIT ($F(1, 101) = 26.80$, $p < .001$, $\tilde{\eta}^2 = .21$, power = 1.00). There was no significant difference between groups on TAS-20 ($F(1, 101) = 0.05$, $p = .824$), SR ($F(1, 101) = 0.76$, $p = .384$), or SP scores ($F(1, 101) = 0.36$, $p = .552$).

Discussion

The current study sought to determine whether traits associated with risky or problematic substance use in previous research, including alexithymia, impulsivity, and reward sensitivity, would be associated with chronic daily cigarette smoking. Despite the expectation, based on previous findings in users of other substances, that chronic daily smokers would show higher

Table 3. Pearson's bivariate correlations between study variables.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	–																	
2. Total TAS	−.18	–																
3. DIF	−.16	.88**	–															
4. DDF	−.08	.84**	.61**	–														
5. EOT	−.21*	.77**	.48**	.55**	–													
6. Total BIS	−.08	.33**	.41**	.20*	.17	–												
7. Attention	−.13	.54**	.54**	.44**	.32**	.79**	–											
8. Motor	.02	.06	.17	−.03	−.06	.76**	.42**	–										
9. Non-planning	−.10	.24*	.29**	.10	.17	.80**	.50**	.34**	–									
10. SP	−.14	.50**	.50**	.48**	.22*	.21*	.36**	−.02	.19	–								
11. SR	−.01	.23*	.24*	.16	.16	.21*	.19	.30**	.02	.15	–							
12. Total DASS	−.07	.57**	.63**	.43**	.29**	.39**	.51**	.18	.26**	.42**	.21*	–						
13. Depression	−.10	.54**	.61**	.43**	.23**	.36**	.50**	.13	.26**	.45**	.16	.95**	–					
14. Anxiety	−.06	.43**	.52**	.21*	.27**	.38**	.41**	.26**	.25**	.24*	.25**	.88**	.75**	–				
15. Stress	−.04	.59**	.60**	.52**	.31**	.33**	.51**	.11	.22*	.45**	.18	.94**	.86**	.73**	–			
16. FTND	−.06	.01	.05	−.04	−.02	.24*	.08	.23*	.24*	−.10	.07	.28**	.24*	.33**	.22*	–		
17. AUDIT	−.11	.19*	.13	.18	.19*	.46**	.33**	.43**	.31**	−.04	.28**	.38**	.35**	.41**	.31**	.48**	–	
18. MC-SDS	.08	−.43**	−.40**	−.34**	−.34**	−.24*	−.39**	.01	−.22*	−.28**	−.38**	−.31**	−.31**	−.22*	−.34**	.01	−.04	–

Note. $N = 106$. *$p < .05$, **$p < .01$. See text for scale/subscale abbreviations.

Table 4. Means (*M*) and standard deviations (*SD*) of dependent variables for current smokers and never-smokers.

	Current Smokers (n = 47)	Never-Smokers (n = 59)
Variable	*M* (*SD*)	*M* (*SD*)
Alexithymia (TAS-20)	53.79 (11.81)	53.32 (11.84)
Impulsiveness (BIS-11)	67.64 (11.47)**	62.80 (9.48)
Depression (DASS-21)	15.51 (4.89)***	12.97 (5.10)
Anxiety (DASS-21)	14.19 (4.48)**	11.46 (3.84)
Stress (DASS-21)	15.79 (4.95)***	13.64 (4.78)
Reward Sensitivity (SR)	9.74 (4.36)	8.97 (5.17)
Punishment Sensitivity (SP)	12.98 (5.55)	14.03 (6.17)
Alcohol Use (AUDIT)	11.98 (9.00)***	3.95 (4.66)

Note. N = 106. *p < .05, **p < .01, ***p < .001.

alexithymia scores than never-smokers who were similar in age, gender composition, education levels, and employment status, there was no difference in alexithymia scores between the two groups. The present findings are noteworthy, given that the large difference, by a factor of 3, between the current smoker sample and the never-smoker sample on the AUDIT (see Table 4), was not accompanied by a significant difference on TAS-20, despite the consistently reported positive association of alexithymia with heavier drinking in both clinical and non-clinical Australian samples (Lyvers et al. 2014b; Lyvers et al. 2012c, 2017; Thorberg et al. 2010). The present study replicated previous failures to find an association of smoker status with alexithymia (Lumley et al. 1994; Sutherland et al. 2013), while simultaneously replicating previous reported associations of both alexithymia and smoking with risky or problematic drinking.

Despite previous evidence of higher reward sensitivity (SR) scores in substance-dependent inpatients compared to controls (Lyvers et al. 2014b), and reports of positive relationships between SR and higher levels of substance use in non-clinical samples (Dawe, Gullo, and Loxton 2004; Lyvers et al. 2009), SR scores were unrelated to smoking in the present study. Smokers did, however, score significantly higher on the BIS-11 index of rash impulsiveness than never-smokers in the present study, and also scored significantly higher than never-smokers on all three DASS-21 negative mood scales (Depression, Anxiety, and Stress). Findings thus point to both executive and hedonic dysfunction in chronic daily smokers. High rash impulsiveness as indexed by BIS-11 has been linked to a heightened vulnerability to nicotine dependence (Doran, McChargue, and Cohen 2007; Doran, Spring, and McChargue 2007), as well as stronger craving and negative affect during nicotine withdrawal (VanderVeen et al. 2008). The obtained group difference on rash impulsiveness is noteworthy given that the present study excluded those with a history of traumatic brain injury, or who were on current medication for a neurological or psychiatric disorder, so that indices of alexithymia and impulsivity could be more specifically linked to substance use (smoking). Present results are consistent with Dawe et al.'s (2004) notion that rash impulsiveness as indexed by BIS-11 is the form of impulsivity that maintains drug taking in addiction, as opposed to the other form of impulsivity, SR, which promotes drug experimentation.

Distinct from a trait-based conceptualization of smoking vulnerability, Koob's (2008) conceptualization of drug addictions as "hedonic homeostatic dysregulation" may be particularly relevant to understanding the persistence of daily smoking despite smokers' awareness of the associated health risks. The heightened negative mood states reported by current smokers may, in part, reflect subjective manifestations of multiple daily experiences of nicotine withdrawal, which involves HPA axis dysregulation (Childs and De Wit 2009; McKee et al. 2011) and associated anxiety and irritability (Parrott 1999, 2004). Thus, chronic smoking may be maintained primarily to alleviate aversive withdrawal-induced states (Dawe and Loxton 2004; Koob and Kreek 2007; Parrott and Kaye 1999), irrespective of inherent traits such as alexithymia or SR. Cigarettes replenish nicotine levels and provide short-term alleviation of withdrawal-related negative affect, such that the negative reinforcement offered by cigarettes may drive persistent smoking despite its maladaptive nature (Koob 2001). Consistent with this notion, smokers in the present study most commonly cited calming and relief from craving as their reasons for smoking.

The present study did not predict an association between smoking and punishment sensitivity as indexed by SP scores, given the conflicting findings of research on other forms of substance use in relation to this trait. In the present study, SP was not related to smoker status, nicotine dependence level in smokers as measured by the FTND, or alcohol consumption as measured by the AUDIT, despite positive correlations of SP with all three scales of the DASS-21 negative mood index (Depression, Anxiety, and Stress), which were positively correlated with FTND scores. The lack of a relationship of smoking with the SP trait, despite significant relationships of smoking with negative moods in the present sample, is consistent with the notion that chronic daily smoking itself promotes negative moods, which can then be relieved by smoking. Finally, the commonly reported association of smoking with heavier alcohol consumption (Trull, Waudby, and Sher 2004) was reflected in the present study by the dramatically higher AUDIT scores of smokers compared to never-smokers and the strong positive correlation between AUDIT and FTND scores.

Study limitations include the fact that participants were recruited online; hence, the findings might be generalizable only to those who spend a relatively high proportion of their time on the Internet or who use survey hosting websites as a source of income. The size of the

smoker sample was necessarily limited ($n = 47$), reflecting the low (12.8%) prevalence of daily smoking in Australia today. However, given that the alexithymia scores of smokers and never-smokers were virtually identical, as well as the fact that group differences found in previous research were replicated in the present study, lack of sufficient power would seem an unlikely explanation for the absence of relationship between smoking and alexithymia. The current findings thus provide initial evidence of a disparity between cigarette smoking and use of other substances in terms of a relationship with alexithymia, even though smoking, like other forms of risky or problematic substance use, was associated with higher levels of rash impulsiveness and negative mood. The intriguing results of the present study invite speculation and further research as to why alexithymia is consistently associated with use of various mood-altering substances, but not cigarettes, despite evidence that smokers commonly smoke to obtain relief from negative mood states such as depression, anxiety, and stress—states commonly associated with alexithymia.

ORCID

Michael Lyvers http://orcid.org/0000-0002-8355-3182

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