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

Abstract

Background. 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. **Method.** 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. **Results.** 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. **Conclusions**. Results suggest that chronic daily cigarette smoking may be an exception to the maladaptive behaviours associated with alexithymia, and is driven primarily by mood regulation and poor impulse control.

Key words: alexithymia; smoking; mood; impulsivity; reward

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 of paramount importance in addressing this major public health concern.

One clue to the motivation for smoking can be found in consistent reports of heightened negative affect among chronic smokers, such that smoking may serve as a means of mood regulation (e.g., Lyvers, Carlopio, Bothma & Edwards, 2014; 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 & De Biasi, 2001; Koob, 2008; McGranahan, Patzlaff, Grady, Heinemann, & Booker, 2011). Such effects might be particularly relevant for those with high levels of alexithymia, a trait commonly associated with depression, anxiety and stress as well as mood regulation difficulties (Lyvers, Makin, Toms, Thorberg, & Samios, 2014; Thorberg et al., 2010, 2017). Alexithymia refers a difficulty in identifying and describing feelings and an externally oriented thinking style (Taylor & Bagby, 2000). Both alexithymia and negative moods are highly prevalent among clients undergoing treatment for substance disorders (Lyvers, Hinton et al., 2014; Thorberg, Young, Sullivan & Lyvers, 2009). In non-clinical Australian samples, alexithymia is associated with heavier use of drugs such as alcohol (Lyvers, Onuoha, Thorberg & Samios, 2012), cannabis (Lyvers, Jamieson, & Thorberg, 2013), and caffeine (Lyvers, Duric & Thorberg, 2014). Further, social drinkers with higher levels of alexithymia are more likely to report drinking alcohol to cope with negative moods (Bruce, Curren, & Williams, 2012; Lyvers, Hasking, Albrecht, &

Thorberg, 2012; Thorberg et al., 2009). However, alexithymia has seldom been investigated in relation to cigarette smoking (e.g., Lumley, Downey, Stettner, Wehmer & Pomerleau, 1994), and their relationship, if any, is unclear (Carton, Bayard, Jouanne & Lagrue, 2008).

Tobacco dependence is often comorbid with other problematic substance use, notably alcohol dependence (Trull, Waudby, & 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 alcohol and other substances. The minimal research conducted to date on the possible association of smoking with alexithymia has yielded mixed findings. Lumley et al. (1994) found no 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, & Jeammet, 2003), Finland (Kauhanen, 1993) and Poland (Grabowska, Targowski, Rozynska, Mierzejewska, & From, 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 above studies may complicate interpretation and comparison of their findings. More recently Sutherland, Carroll, Salmeron, Ross, and Stein (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 reported in other work (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

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has been recently supported in relation to alcohol and illicit substance use in both clinical (Lyvers, Hinton et al., 2014) and non-clinical Australian samples (Lyvers, Duff, Basch & Edwards, 2012). ~~Reward sensitivity~~Sensitivity to reward (SR) is presumed to reflect the functioning of the dopaminergic Behavioral Activation System in Gray's (1987) theory of motivation. ~~, and according to Dawe et al. can be indexed by the Sensitivity to Reward (SR) scale of the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Ávila, Moltó & Caseras, 2001)~~. Rash impulsiveness, on the other hand, reflects executive dysfunction, ~~and can be measured by the Barratt Impulsiveness Scale (BIS-11; Patton, Stanford & Barratt, 1995~~). ~~These two questionnaires were thus administered in the present investigation of traits linked to smoking.~~ which is likely to interfere with smoking cessation attempts due to the prioritizing of immediate rewards over long-term goals (Bickel & 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 (including Australia), 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 & 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). ~~sensitivity, a trait that can be measured by the Sensitivity to Punishment (SP) scale of the SPSRQ.~~ Unlike SR, SP has not been linked in any consistent way to substance use. High SP has sometimes been reported in problematic drinkers (Loxton & Dawe, 2001), but strong negative relationships of SP with cannabis use (Lyvers, Jamieson et al., 2013) and caffeine use (Lyvers, Duric et al., 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.

~~Smoking is often comorbid with other problematic substance use, notably alcohol dependence (Trull, Waudby, & Sher, 2004), which 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 alcohol and other substances. The minimal research conducted to date on the possible association of smoking with alexithymia has yielded mixed findings. Lumley et al. (1994) found no relationship between alexithymia and nicotine 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, & Jeammet, 2003), Finland (Kauhanen, 1993) and Poland (Grabowska, Targowski, Rozynska, Mierzejewska, & From, 2005) 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 above studies may complicate interpretation and comparison of their findings. More recently Sutherland, Carroll, Salmeron, Ross, and Stein (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 reported in other work (Thorberg et al., 2011); however, smokers and non-smokers did not appear to differ on this trait in their brain imaging study.~~

The present study recruited a group of current daily smokers ~~who reported having smoked more than 10 cigarettes every day for at least one year,~~ and a comparison group who reported that they had never tried smoking (i.e., 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 all 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 et al., 2012; Lyvers, Makin et al., 2014; Thorberg et al., 2010, 2017); (2) the evidence that mood regulation is an important motive for smoking (Lyvers, Carlopio et al., 2014; 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 below), t~~T~~he 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, Kozlowski, Frecker, & Fagerström, 1991)~~FTND~~, 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

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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 neurobiological influences on responses~~ 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.

Demographic information for the current sample is displayed in Table 1~~, including relevant information regarding the smoker group.~~ There were no significant differences between smoker and never-smoker groups on age, gender, ethnicity, education level or employment according to the relevant statistical tests (t-test or chi-square). Smoking information for the smoker sample is presented in Table 2.

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Materials

Demographics. In the initial section of the online questionnaire, several demographics questions were presented. 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. In the instance that the participant was a smoker, they were posed additional questions, specifically 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, Parker 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 & 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 down-hearted 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 samplestudy used the total score as an index of negative mood, yieldeding an overall Cronbach's alpha coefficient of .95.

Barratt Impulsiveness Scale (BIS-11; Patton, Stanford & Barratt, 1995Patton et al., 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, Ávila, Moltó & Caseras, 2001Torrubia 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., , Kozlowski, Frecker, & Fagerström, 1991). The FTND is a 6-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, Aasland, Babor, de la Fuente, & Grant, 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 & Marlowe, 1960; Reynolds, 1982). This is a 13-item scale that designed to assess the tendency to respond in a manner that will be perceived favourably 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 number of "False" responses is summed, such that a higher number of "False" responses suggests higher social desirability bias in responding. 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 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. The statement indicated that the questionnaire would take approximately 30 minutes to complete. 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 further.

Participants then proceeded through the online questionnaire, providing demographic information and selecting responses on Likert scales for the measures of personality and substance use. All measures following the demographic questions (e.g., TAS-20, BIS-11, SPSRQ, etc.) were separated into blocks and randomised to minimize order and fatigue effects. The titles of each measure were omitted to minimize response bias. 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 & Fidell, 2014). Power analyses as per G*Power conventions (Faul, Erdfelder, Buchner, & Lang, 2009) indicated sufficient power and sample size for the present group comparisons~~study~~. As mentioned earlier above, there were no group differences between smokers and never-smokers on any demographic variable, and no such differences approached significance. However, smokers were significantly more likely to have ever used illicit drugs than never-smokers were ($\chi^2(1) = 7.91$, $p = .005$).

Bivariate ~~Interc~~Correlations

Pearson's bivariate correlations were conducted to assess relationships between continuous variables (see Table 3~~2~~). 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. 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 (see Table 3~~2~~).

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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 Pearson's 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 ~~index of social desirability~~ 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~~, justifying inclusion of MC-SDS as a covariate~~. 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~~3~~. 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 similarly associated with chronic daily cigarette smoking. ~~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 TAS-20 alexithymia scores were predicted to be higher in smokers than in non-smokers based on three considerations: (1) the high levels of negative affect and the difficulties with mood regulation associated with alexithymia (Bruce et al., 2012; Lyvers, Makin et al., 2014; Thorberg et al., 2010, 2017); (2) the evidence that mood regulation is an important motive for smoking (Lyvers, Carlopio et al., 2014; McKee et al., 2011); and (3) reports that alexithymia is associated with use of other substances to regulate mood (Thorberg et al., 2009).~~ ~~However, d~~Despite the reasonable expectation – based on previous findings in users of other substances - that chronic daily smokers would show higher alexithymia scores than a sample of never-smokers who were~~very~~ similar to the smoker sample in age, gender composition, education levels and employment status, there was no difference in alexithymia scores between the two groups. Indeed, alexithymia scores of smokers and never-smokers were virtually identical in the present sample. The present findings are all the more noteworthy~~striking~~ given that the very large difference - by a factor of 3 - between the current smoker sample and the never-smoker sample on the AUDIT index of alcohol consumption (see Table 4~~3~~) 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, Hinton et al.,, 2014; Lyvers, Onuoha et al., 2012; Thorberg et al., 2010, 2017). The present study thus appears to have 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 more risky or problematic drinking.

Despite previous evidence of higher reward sensitivity (SR) scores in substance dependent inpatients compared to controls (Lyvers, Hinton et al., 2014), and reports of positive relationships between SR and higher levels of substance use in non-clinical samples (Dawe et al., 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. Present 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 & Cohen, 2007; Doran, Spring & McChargue, 2007) as well as stronger craving and negative affect during nicotine withdrawal (VanderVeen, Cohen, Cukrowicz, & Trotter, 2008). The obtained group difference on rash impulsiveness is especially noteworthy given that the present study specifically 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 ~~also~~ 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.

~~Executive dysfunction as manifested by higher levels of rash impulsiveness in smokers is likely to interfere with smoking cessation attempts due to the prioritizing of immediate rewards over long-term goals (Bickel & 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 (including Australia), psychopathologies that work against quit efforts gradually become more common in the remaining smoking population as other smokers are able to quit (Warner & Burns, 2003). Present results are also 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, at least in part, reflect subjective manifestations of multiple daily experiences of nicotine withdrawal, which involves HPA axis dysregulation (Childs & 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 & Loxton, 2004; Koob & Kreek, 2007; Parrott & 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~~irrespective of~~ its maladaptive nature (Koob & Le Moal, 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 further consistent with the notion that chronic daily smoking itself promotes negative moods, which can then be relieved by smoking, as discussed above. Finally, the commonly reported association of smoking with heavier alcohol consumption (Trull et al., 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.

Although the present study replicated some previously reported relationships among the key variables of interest, a notable limitation concerns 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 in the present sample. ~~In any case t~~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

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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.

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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%)

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Table 1

Demographic Characteristics of the Current Sample (N = 106)

	Frequency	Percentage (%)
Gender		
Female	61	58
Male	45	42
Employment Status		
Full-time	47	44
Part-time/Casual	19	18
Self-employed	5	5
Unemployed	25	24
Student	10	9
Highest Level of Education		
Before Grade 12	8	8
Grade 12 (High School)	13	12
Undergraduate/TAFE	67	63
Postgraduate	18	17
Ethnicity		
Caucasian/White	76	72
Asian	19	18
European	5	5
Aboriginal	1	1
Not specified	5	5
Smoking Status		
Current smoker	47	44
Never smoked	59	56

Smokers (*N* = 47)

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Table 2.

Smoking Data for Smokers (n = 47).

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

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Table 32

Pearson's Bivariate Correlations between ~~Key~~ 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~~3~~

Means (M) and Standard Deviations (SD) of Dependent Variables for Current Smokers and Never-Smokers

Variable	Current Smokers (n = 47)		Never-Smokers (n = 59)
	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.